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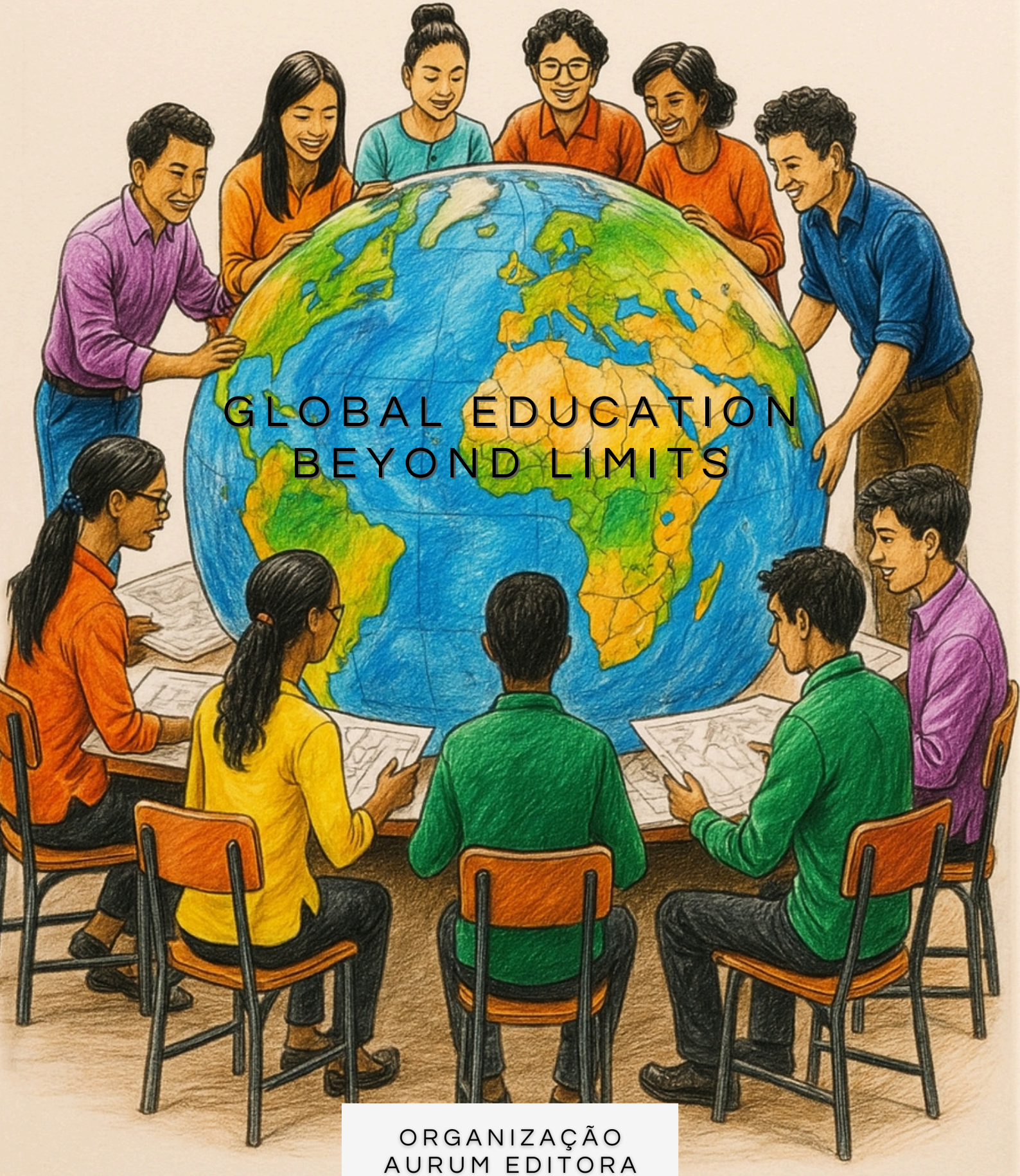

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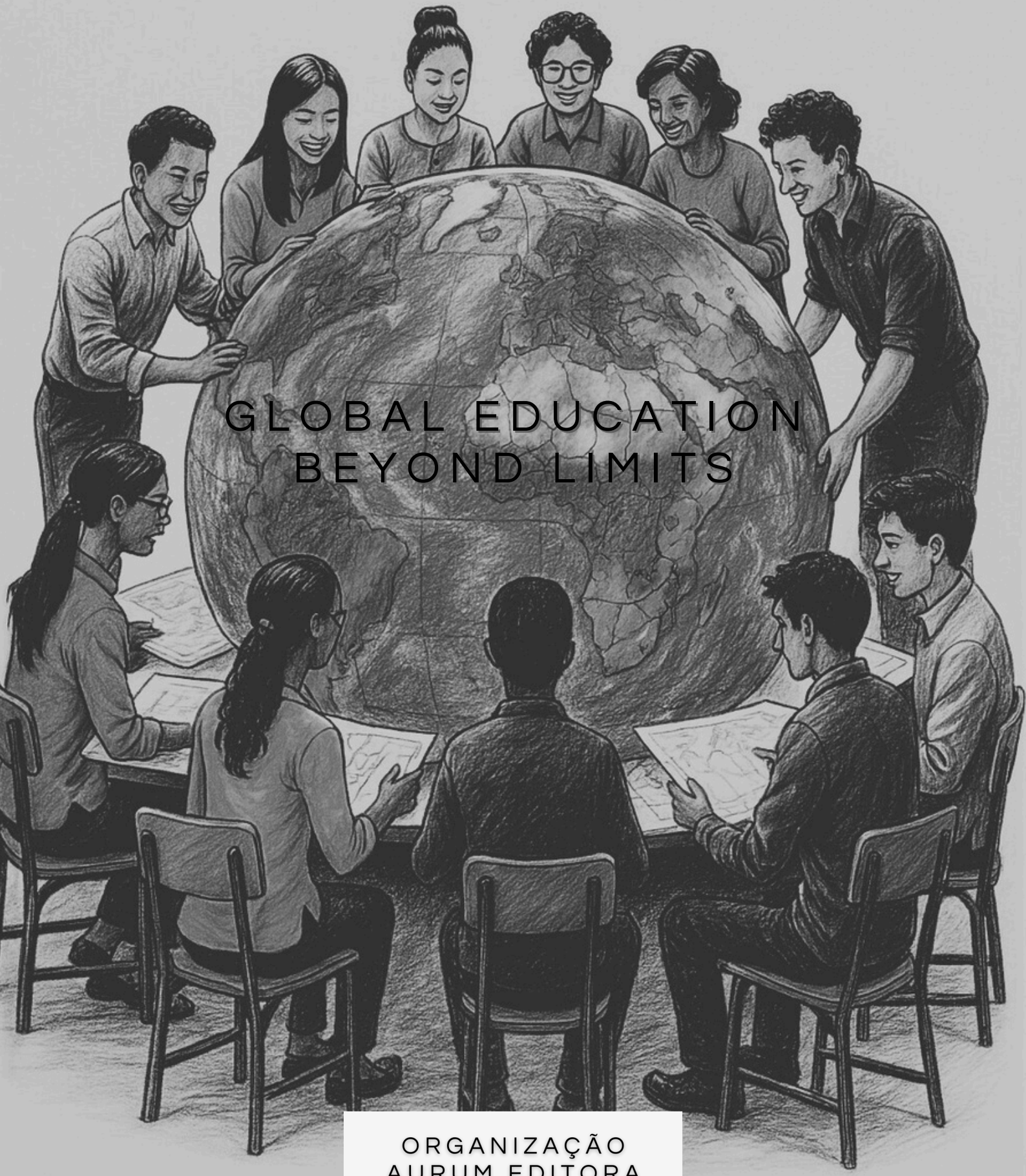

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AUTHORS

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Aurora de Castro Pantoja
Cindy Izabelle Hage Pantoja
Eduardo José Pereira Maia
Eliene de Carvalho Vieira
Elizete Ferreira Morais Barbosa
Evânia Bezerra de Souza
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Waléria de Jesus Barbosa Soares
Wemerson Simões
Zuziane Ferreira da Rocha

SUMMARY

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CHAPTER 1

REFLEXIVE GOVERNANCE: SCIENCE, TECHNOLOGY, SOCIETY, RISK SOCIETY, AND THE 2030 AGENDA FOR GLOBAL SUSTAINABILITY

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Plínio Gabriel João[1] and Evânia Bezerra de Souza[2]

ABSTRACT

The complexity of contemporary global challenges—marked by unprecedented scientific-technological advances alongside socio-environmental crises—demands a profound understanding of the interactions among science, technology, and society. Although existing literature addresses Risk Society theory and the 2030 Agenda separately, it lacks an integrated, critical analysis exploring how reflexive modernity and manufactured risks impact sustainability governance. This study critically examines the intersections among Science, Technology, and Society (STS) studies, Anthony Giddens's and Ulrich Beck's Risk Society theory, and the 2030 Agenda—proposing an analytical framework for a more reflexive, equitable governance of global challenges. We hypothesize that reflexive modernity, by engendering intrinsic development risks, imposes fundamental obstacles to achieving the Sustainable Development Goals (SDGs). Consequently, a critical approach to science and technology is required to address governance gaps. Employing a qualitative, application-oriented methodology with an explanatory objective, the research centers on a critical, systematic literature review. Its corpus comprises seminal books and high-impact journal articles in STS, Risk Sociology, and Sustainable Development, subjected to qualitative content analysis. Findings indicate that—despite their centrality to the SDGs—science and technology remain ambivalent, simultaneously serving as sources of manufactured risks that the 2030 Agenda, in its current formulation, fails to address structurally. The vagueness of the "Leave No One Behind" principle and the technocratic nature of indicator design limit the Agenda's efficacy and perpetuate inequalities. We conclude that effective global sustainability governance requires a reflexive modernization of the 2030 Agenda itself—incorporating self-critical evaluation, multi-sector participation, and accountability mechanisms to manage inherent development risks. This entails moving beyond purely technocentric solutions toward a more politically and socially engaged approach to science and technology.

Keywords: Science, Technology, and Society; Risk Society; 2030 Agenda; Sustainable Development; Governance.

[1] PhD in Science, Technology, and Society - UFSCar
Affiliation: CPS – Etec de Ibaté
LATTES: http://lattes.cnpq.br/2410215634171249
[2] Master's student in Science, Technology, and Society - UFSCar
LATTES: http://lattes.cnpq.br/1856602113808184

INTRODUCTION

The contemporary scenario is characterized by increasing complexity, in which unprecedented scientific and technological advances coexist with multifaceted socio-environmental crises and global challenges. Humanity's pursuit of progress and well-being has profoundly transformed the planet, simultaneously generating uncertainties and threats previously unimaginable. Understanding this dynamic requires an analytical lens that transcends traditional disciplinary approaches and embraces the intrinsic interconnection among knowledge, innovation, and social organization.

In this context, Science, Technology, and Society (STS) studies emerge as a crucial investigative field. This interdisciplinary approach unveils the co-production of scientific-technological knowledge and social organization, rejecting the linear, deterministic view that science and technology are neutral forces simply driving progress. Rather, STS studies demonstrate that science and technology are social products—shaped by values, interests, and cultural contexts—and that, in turn, they shape society. This perspective is essential for understanding how technological innovations, despite promising solutions, can also engender new problems or exacerbate existing ones.

Concurrently, the emergence of "Risk Society," a central concept developed by sociologists Anthony Giddens and Ulrich Beck, offers a framework for comprehending how modernity itself—through its development processes—generates intrinsic uncertainties and threats. Beck argues that industrial society, primarily focused on wealth production, has given rise to a society where risk production—often invisible and global—surpasses the logic of goods production. Giddens, in turn, highlights "manufactured risks," those directly stemming from human knowledge and technology's impact on the natural world, in contrast to exogenous, natural hazards. This conception of modernity as an inherent risk producer is vital for any future-oriented planning effort.

Amidst this panorama of complexity and uncertainty, the United Nations' 2030 Agenda for Sustainable Development—with its 17 Sustainable Development Goals (SDGs)—was established in 2015 as the principal global framework to confront these challenges. The Agenda proposes a universal, integrated, and transformative vision for a more equitable, prosperous, and sustainable future, encompassing social, economic, and environmental dimensions. Its SDGs aim to eradicate poverty, combat hunger, promote quality health and education, ensure gender equality, secure water and sanitation, provide affordable and clean energy, foster decent work and economic growth, build resilient infrastructure and drive innovation, reduce inequalities, create sustainable cities, encourage responsible consumption and production, address climate change, preserve aquatic and terrestrial ecosystems, promote peace, justice, and effective institutions, and strengthen global partnerships.

The intersection of these three pillars—STS studies, Risk Society theory, and the 2030 Agenda—is not merely additive but dialectical, revealing deeper layers of understanding. STS analyses show that

science and technology are not neutral, being imbued with social values and interests. This perspective is crucial for grasping how Risk Society is constructed and how the 2030 Agenda—frequently relying on technological solutions—may inadvertently perpetuate or generate new risks. If science is socially constructed, then proposed technological solutions for the SDGs are not free of values. Risk Society theory reveals that modernity itself produces manufactured risks. Consequently, pursuing sustainability through technology—without critically analyzing risk co-production—can lead to "greenwashing" or solutions that benefit some while marginalizing others, thereby exacerbating the inequalities the 2030 Agenda seeks to eliminate. A profound understanding of these dynamics is essential for formulating governance strategies that are genuinely reflexive and capable of navigating the complexity of contemporary challenges.

In light of the complex intersection among scientific and technological advances, systemic risks, and the global ambition for sustainable development, this article's central question is:

How can insights from Risk Society theory, illuminated by STS studies, inform and critique the implementation of the 2030 Agenda—particularly regarding manufactured risk management and the promotion of more equitable, reflexive governance?

Methodologically, this investigation relies on a qualitative approach, indispensable for deepening comprehension of STS, Risk Society theory, and the 2030 Agenda's complex interrelations. This choice enables exploration of the nuances and intrinsic meanings of these theoretical pillars, aiming not to quantify phenomena but rather to interpret the "why" and "how" of their social and theoretical dynamics.

As applied research with an explanatory objective, the study seeks to employ existing knowledge to develop an analytical framework capable of guiding practical solutions—especially those related to 2030 Agenda implementation and global risk management. Its explanatory aim is to identify the factors driving manufactured risk production and the ambivalent role of science and technology in sustainability—delving into reality beyond mere description.

Procedurally, the research comprises a critical, systematic bibliographic review followed by qualitative, reflexive content analysis. This process facilitates identifying key concepts, formulating hypotheses, and exploring implications for theory and practice, ensuring construction of a critical, propositional argument on these fields' intersections.

THEORETICAL FRAMEWORK

SCIENCE, TECHNOLOGY, AND SOCIETY (STS): FOUNDATIONS

Science, Technology, and Society (STS) studies constitute an interdisciplinary field dedicated to analyzing the intricate interactions among science, technology, and society. This approach transcends the traditional, linear view of scientific-technological progress, which often portrays it as inevitable and

inherently beneficial. Instead, STS studies reveal that science and technology are social constructions—deeply rooted in and shaped by cultural contexts, values, interests, and power structures.

Historically, the inherited conception of science—known as the "traditional view"—postulated science as an autonomous, objective, and neutral endeavor, operating under a purely rational code free from external interference. The scientific method was deemed the intellectual tool guaranteeing the objectivity of scientific products by empirically testing general claims and ensuring theoretical consistency. Scientific development was seen as a cumulative, linear process—a paradigm of human progress.

However, the twentieth century witnessed a robust anti-positivist reaction within academia, propelled by critiques from prominent authors. In his seminal 1962 work, Thomas S. Kuhn introduced irreducibly social concepts to explain how science changes and develops. He argued that understanding science necessitates a detailed study of its actual history, proposing that science advances through periods of "normal science," during which scientists solve "puzzles" guided by a shared theoretical paradigm. Yet, the accumulation of unresolved problems engenders anomalies that may lead to a paradigm crisis—ushering in "extraordinary science" and culminating in a "scientific revolution." During such revolutions, alternative paradigms emerge, sparking disputes and potentially displacing the preceding paradigm. Kuhn underscored that the scientific community—rather than empirical reality alone—determines the criteria for theory acceptance, thereby challenging traditional rationalist analyses of science and emphasizing the social and historical dimensions of scientific knowledge production.

This critique deepened with concepts such as the "theoretical load of observation" and "underdetermination." The former posits that observations rely not only on sensory impressions but also on prior knowledge, expectations, biases, and the observer's internal state—rendering every observation theoretically loaded. The latter suggests that for any given theory or hypothesis explaining a phenomenon, an indefinite set of empirically equivalent yet incompatible alternative theories can be generated. These notions demonstrate that scientific observation and theory are not intrinsically neutral; rather, science actively constructs its representation of reality.

In the 1970s, David Bloor—alongside Barry Barnes and Steve Shapin—formed the Edinburgh School, a research group dedicated to developing a sociology of scientific knowledge. They aimed to analyze science as a social process, emphasizing that non-epistemic values (political, economic, ideological—i.e., "social context") influence the origin, change, and legitimation of scientific theories.

Bloor formulated the "Strong Programme" (1976/1992), which sought to establish principles for a satisfactory (sociological) explanation of scientific knowledge's nature and evolution. This programme stands as an explanatory framework rivaling traditional philosophical approaches such as logical positivism or Popperian views. Its core principles are:

1. **Causality:** Scientific episodes must be explained by focusing on the effective conditions producing beliefs or knowledge states.
2. **Impartiality:** The analysis must remain impartial to truth and falsity, rationality and irrationality, success and failure—providing explanations for both sides of these dichotomies.
3. **Symmetry:** The same types of causal factors must explain both true and false beliefs.
4. **Reflexivity:** Explanatory patterns should apply to the sociology of science itself.

Bloor presented his programme as an empirical study of science, asserting that only through sociology could the peculiarities of the scientific world be adequately explained.

In the early 1980s, Harry Collins at the University of Bath developed a more concrete programme—the Empirical Programme of Relativism (EPOR)—grounded in Bloor's theoretical framework. The EPOR focuses on empirically studying scientific controversies, arguing that these controversies reveal science's interpretative flexibility regarding reality and scientific problems. It highlights the importance of social interaction processes in shaping how reality is perceived and how scientific problems are resolved. The EPOR proceeds in three stages: 1) Demonstrating the interpretative flexibility of experimental results; 2) Uncovering social, rhetorical, and institutional mechanisms that constrain interpretative flexibility and promote controversy closure. 3) Relating these "closure mechanisms" to broader sociocultural and political contexts.

Beyond the Edinburgh School, other critical perspectives significantly enriched STS studies. In Laboratory Life (1979/1986), Bruno Latour and Steve Woolgar argued that science scholars should become anthropologists—entering laboratories to describe scientists' and technologists' daily practices as purely as possible. Their imperative was to "open the black box" of scientific knowledge and detail its contents, emphasizing science's practical, social dimensions.

Philosophical analyses of technology also contributed to the field. Lewis Mumford—aligned with the North American Romantic-naturalist tradition—focused on environmental ecology, urban life harmony, and nature preservation. He argued that machines must be analyzed concerning their psychological and practical origins and evaluated ethically, aesthetically, and technologically. In Technics and Civilization (1934), Mumford explored how machines transformed Western civilization, categorizing technologies as either polytechnic (life- and culture-oriented) or monotectonic (scientific knowledge–based, economically and militarily focused). He contended that modern technology—an exemplar of monotectonic systems—predated the Industrial Revolution, emerging with rigid, hierarchical social organizations he called "megamachines."

José Ortega y Gasset integrated technical studies into his "racio-vitalism" current, proposing an ontological perspective of technology as human acts aimed at satisfying needs by altering nature. He divided technological history into three stages: chance-based techniques, artisanal techniques, and

engineering techniques—distinguished by how humans discovered means to achieve their ends. In The Question Concerning Technology (1954), Martin Heidegger approached technology from an ontological standpoint, linking it to the question of Being. He argued that technology represents a form of "unveiling" that transforms and challenges nature to generate storable, transmissible energy—contrasting modern technology's "enframing" of nature with older techniques that maintained more respectful relationships with the environment. Jacques Ellul deemed technology the most important phenomenon of modernity—arguing that, rather than capital, it is the world's driving force. He defined technology as the totality of methods achieved through rationality, yielding absolute efficiency in all human activities.

Sheila Jasanoff, in her article "Procedural Choices in Regulatory Science" (1995), argued that the traditional model of the science-society relationship is simplistic. Introducing "regulatory science," she highlighted science's new role in providing political action's epistemic basis—distinguishing it from traditional academic science. Regulatory science operates under deep uncertainties, limited knowledge, and time constraints—moving amid uncertain facts, underdeveloped theoretical paradigms, and inconsistent methods—thus giving rise to frequent controversies.

The evolution of STS—ranging from Kuhn's internalism to the Edinburgh School's social constructivism and philosophical critiques of technology—reveals growing skepticism regarding science and technology's inherent neutrality and benevolence. This demystification is fundamental for critically analyzing Risk Society theory and the 2030 Agenda, which often assume an optimistic, instrumental vision of science as a panacea. If science is a socially constructed, nonneutral endeavor, then its proposed "solutions" for Risk Society problems and SDGs carry producers' values and interests. This raises questions about the legitimacy and equity of technology-based interventions—especially when risks are "manufactured" by modernity itself.

RISK SOCIETY: PERSPECTIVES OF ANTHONY GIDDENS AND ULRICH BECK

Anthony Giddens and Ulrich Beck are prominent sociologists who—independently yet convergently—developed Risk Society theory. Both contend that living with risk is an inevitable condition of postmodern society, perpetually facing potential threats to its integrity.

For Ulrich Beck, postmodernity signifies a historical rupture: the transition from an industrial society—focused on wealth production—to a risk society. In this new model, conventional techniques prove inadequate for predicting and controlling risks to human health or the environment. Risks themselves become central to new market productions. Risk society is simultaneously a "science, media, and information" society.

Beck argues that contemporary risks are so severe they transcend socioeconomic class boundaries—affecting both rich and poor indiscriminately. This "democratization and globalization of

risk" redefines social risk individualization, diminishing class distinctions' salience. In advanced modernity, social wealth production goes hand in hand with risk production. Beck asserts that, in risk society, the logic of risk production surpasses wealth production—since risks and wealth are inseparable, more risks are generated than wealth.

Examples include environmental disasters, daily nuclear threats, epidemics, rising armed conflicts, international financial crises, and diffuse crime. Beck characterizes the present era as a "modern medieval age of danger." Risks are ambiguous—dual-natured—demanding weighing opportunities against losses. This ambiguity calls for a new division of labor among science, politics, and economics to curb risk production. For Beck, modernization is not merely a backdrop but the problem itself—exposing individuals to risk regardless of social class. He distinguishes between risk and calamity: while tragedies are bounded in space and time, risk signifies anticipating catastrophe—always a future event that becomes present only through "presentification" or dramatization of global threats.

Despite its contributions, Beck's theory faces criticism. Observers note evolutionism, linearity, and Eurocentrism in his globalization account. He neglects coexistence between class-based and risk-based societies in a globalized world—offering another dimension to risk society. Initially, Beck failed to analyze how poverty and severe risks intertwine, how precarious state control systems amplify risks, or how fragmented democratic cultures appear. Furthermore, he imprecisely discusses implementing his proposals for "subpolitics" or new political forms to address grave risks and for "de-monopolizing scientific knowledge." His political optimism seems inconsistent with his modernity critique.

Anthony Giddens, by contrast, regards globalization as a crucial social phenomenon—defining it as the "intensification of global interdependence and social relations." Globalization transforms the world into a "single world," where actions in one group affect others, and global problems affect individuals—altering everyday life.

Giddens argues that although humans have always confronted risks, contemporary risks are "manufactured"—stemming from human knowledge and technology's impact on the natural world. This contrasts with "external risks" (e.g., droughts, earthquakes) originating in nature. He traces modern risks' emergence to the unforeseen consequences of industrial labor—consequences that classical sociologists did not fully anticipate—particularly the large-scale destructive potential of "productive forces" on the material environment.

The production of new risks contributes to constructing societal fear. Giddens identifies seven ways in which risk is characterized in modernity: 1) Globalization of risk in intensity (e.g., nuclear war); 2) Globalization of risk in contingent events' expansion (e.g., shifts in global labor division); 3) Risk derived from the created environment, or "socialized nature" (e.g., genetically modified foods); 4) Institutionalized environmental risks (e.g., financial markets); 5) Awareness of risk as risk (knowledge

gaps unconverted into certainties by religious or magical knowledges); 6) Well-distributed risk awareness (collective knowledge of dangers by the public); e 7) Awareness of expertise limitations (no expert system can fully predict the consequences of applying experts' principles).

Giddens agrees with Beck that wealth production cannot occur without individual, social, and environmental risks intrinsic to productive activities. Social well-being—as a modern presumption—diminishes, replaced by pervasive risks.

Convergences and Divergences

While Beck's and Giddens's theories present distinct nuances, they share fundamental premises and feature significant divergences.

Convergences:

Reflexive Modernity: Both sociologists agree that modernity is reflexive—meaning contemporary problems are consequences of societal advancement.

Universalization of Risks: Both acknowledge that risks are global, transcending ethnic, social, and geographic boundaries.

Inseparability of Development and Risk: Both contend that contemporary scientific and industrial development accompanies risks neither specifiable nor containable by space and time.

Erosion of Social Well-Being: Both assert that modernity's guarantee of social well-being has eroded—supplanted by pervasive risks.

Divergences:

Source of Risks: Beck sees risk society as emerging from a rupture with primitive industrial society, where scientific and industrial progress chiefly generates social risks—arguing for societal paralysis and the need to measure responsibilities. Giddens posits that manufacturing social risks is inseparable from modern society's constitution—natural, involuntary, reflexive consequences of advanced social knowledge. For Giddens, risks are intrinsic to contemporary societies due to significant technical and scientific complexity.

Nature of Modernity: Beck adopts a more sober view—labeling the era a "civilizational volcano," where risks are simultaneously real and unreal—merging past dangers with calculated threats. Giddens claims the present is purely reflexive due to massive information production and technology use—yielding unpredictable social consequences.

Class Distinction: Beck argues contemporary threats no longer target a specific class—unlike primitive industrial society, where the less fortunate bore disproportionate harm. Giddens's

modernity perspective does not delve into socioeconomic class distinctions or their differential risk impacts.

Accountability: Beck emphasizes the imperative to identify and measure responsibilities to curb social risks. Giddens suggests that, a priori, there is no legal recourse to hold anyone accountable for damage from social risks—nor possibilities for compensating victims.

The distinction between "external" and "manufactured" risks (Giddens) is crucial for the 2030 Agenda. While SDGs address both (e.g., SDG 13 on climate and SDG 9 on infrastructure), persistent manufactured risks—intrinsic to development—imply the Agenda may treat symptoms without tackling modernity's deep-rooted risk production. If environmental and social risks are "manufactured" by human and technological activity (Giddens), Agenda 2030 solutions must go beyond mitigating impacts or promoting new technologies. A fundamental critique of production and consumption models (SDG 12) that generate these risks is required—an omission critics have identified. Thus, sustainability governance must be more than technical; it must be deeply political and reflexive.

THE 2030 AGENDA AND THE SUSTAINABLE DEVELOPMENT GOALS (SDGS): STRUCTURE AND IMPLICATIONS

Adopted by the UN General Assembly in September 2015, the 2030 Agenda for Sustainable Development represents a universal, integrated, and transformative action plan—aiming at global peace and security. Comprised of a Declaration, 17 Sustainable Development Goals (SDGs), and 169 targets, the Agenda seeks to ensure that all nations and peoples everywhere are included and benefit from its realization.

The 17 SDGs span a wide array of global challenges—integrating sustainable development's social, economic, and environmental dimensions. They are interlinked: progress in one SDG may influence advancement or regression in others. For instance, SDG 2 (Zero Hunger and Sustainable Agriculture) is inherently connected to health (malnutrition) and water quality, while SDG 7 (Affordable and Clean Energy) directly impacts health (respiratory issues from air pollution). This interdependence underscores the need for an integrated approach to address health challenges—acknowledging complex interactions among health, poverty, education, environment, economy, and governance.

The SDGs are:

No Poverty: End poverty in all its forms everywhere.

Zero Hunger and Sustainable Agriculture: End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.

Good Health and Well-Being: Ensure healthy lives and promote well-being for all at all ages.

Quality Education: Ensure inclusive, equitable, and quality education, and promote lifelong learning opportunities for all.

Gender Equality: Achieve gender equality and empower all women and girls.

Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all.

Affordable and Clean Energy: Ensure access to reliable, sustainable, modern, and affordable energy for all.

Decent Work and Economic Growth: Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.

Industry, Innovation, and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

Reduced Inequalities: Reduce inequality within and among countries.

Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient, and sustainable.

Responsible Consumption and Production: Ensure sustainable consumption and production patterns.

Climate Action: Take urgent action to combat climate change and its impacts.

Life Below Water: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.

Life on Land: Protect, restore, and promote sustainable use of terrestrial ecosystems; combat desertification; halt and reverse land degradation; halt biodiversity loss.

Peace, Justice, and Strong Institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.

Partnerships for the Goals: Strengthen means of implementation and revitalize the global partnership for sustainable development.

A central principle of the 2030 Agenda is "Leave No One Behind" (LNOB), aiming to ensure all nations, peoples, and segments of society are included—especially vulnerable groups such as children, youth, persons with disabilities, older persons, indigenous peoples, refugees, internally displaced persons, and migrants. The Agenda's Declaration explicitly calls for including refugees. The UNHCR (United Nations High Commissioner for Refugees) works to integrate these populations into national development guidelines and conventional national systems (e.g., health and education).

Despite its ambition and scope, the 2030 Agenda's implementation faces significant challenges and criticisms:

Conceptual Vagueness: Critics highlight conceptual and empirical issues with the LNOB principle due to its vague vocabulary. The lack of an official definition of who counts as "left behind" leads to disputes and imprecision—delegating delimitation responsibility to Member States.

Failure to Question Inequality Sources: The Agenda prioritizes groups at the "end of the line" for distribution of income, goods, and opportunities but does not address structural inequality causes. Thus, although dubbed transformative, it does not commit to tackling institutionalized discrimination perpetuating such inequalities.

Political Disputes in Indicator Definition: Indicator definition—traditionally seen as a technical matter—was permeated by political conflicts among stakeholders (international organizations, private sector, civil society). The Inter-Agency Expert Group on SDG Indicators (IAEG-SDGs) dynamics were guided by technocratic and financial considerations—resulting in indicators that only partially reflect the Agenda's qualitative ambitions.

Absence of Primary Health Care (PHC) Reference: A significant omission in the Agenda's health perspective is the lack of explicit reference to Primary Health Care (PHC)—despite WHO later emphasizing PHC as a driving force for achieving the SDGs.

Unsatisfactory Progress: Doubts exist about countries like Brazil meeting targets by 2030. Reports indicate insufficient progress—highlighting urgency for improved national planning, public sector capacity, digital infrastructure, local governance, and private sector alignment.

Risk of "Greenwashing": The Agenda may serve as a "greenwashing umbrella," yielding little real progress beyond political rhetoric. There is recognition that sustainable development is politically contentious—requiring difficult decisions that inevitably create winners and losers.

Lack of Political Will: Achieving the Agenda depends on genuine political will—demanding bold political decisions to advance sustainability.

Despite its universal, transformative character, the 2030 Agenda faces an inherent contradiction: it proposes global solutions (SDGs) for systemic problems, yet its own critiques reveal reluctance to address structural inequality and risk sources—potentially limiting its efficacy and perpetuating Risk Society dynamics. If the Agenda pledges to "leave no one behind" but does not challenge inequality sources, it may focus more on mitigating Risk Society effects than transforming its root structures. If risks are "manufactured" by modernity (Giddens) and the Agenda does not question development models generating them, it may become a tool for "greenwashing," masking a lack of real progress.

DIALOGUES AND TENSIONS: INTERSECTIONS AMONG STS, RISK SOCIETY, AND THE 2030 AGENDA

Analyzing the intersections of STS studies, Risk Society theory, and the 2030 Agenda uncovers a complex web of dialogues and tensions—vital for a comprehensive understanding of global sustainability challenges.

Reflexive modernization theory—articulated by Beck and Giddens—posits that contemporary problems are consequences of social advancement. This suggests that pursuing SDGs as a form of "more (albeit sustainable) modernity" risks generating new threats or exacerbating existing ones if unaccompanied by deep reflection on foundational premises and methods. Modernity inherently produces risks. Therefore, implementing SDGs—often relying on scientific and technological solutions—must proceed cautiously, avoiding replication of risk-producing mechanisms.

Science and technology are frequently presented as "progress drivers" and deemed essential for attaining SDGs—particularly SDG 9 (Industry, Innovation, and Infrastructure), which underscores innovation and technological transformation for human well-being and environmental harm reduction. They are indispensable for devising new sustainable industrial models, monitoring industrialization's impacts, and developing solutions for issues like climate change and health (e.g., vaccines).

However, Risk Society perspectives and STS critiques reveal science and technology's ambivalence. They serve as primary sources of manufactured risks—industrial pollution, nuclear, chemical, and genetic hazards. Scientific and technological development is not neutral; unregulated application or an exclusive focus on economic growth can inadvertently generate risks or deepen inequalities. By promoting innovation and technological development to achieve sustainability (SDG 9), the 2030 Agenda risks falling into the "reflexive modernization trap," where uncritical technological solutions—absent critical, participatory governance—may spawn new risks or worsen inequities. If modernity intrinsically produces risks (Beck) and technology is a principal manufacturing mechanism (Giddens), then unreflective technological promotion for SDGs can be counterproductive. A technology assessment must transcend technical efficacy—considering long-term social and environmental impacts and equitable benefit-burden distribution. The critical question is not whether to use technology, but how and for whom it is developed and applied.

Jasanoff's "regulatory science" exemplifies this ambivalence—functioning under uncertainty and political pressure—rendering it a field of controversy rather than absolute truth. This demonstrates that exclusive reliance on scientific expertise for SDGs is insufficient: science is "theoretically loaded" and underdetermined. Complex manufactured risks demand science and technology governance for sustainability to be transparent, participatory, and controversy-responsive—integrating diverse

perspectives. This underscores Beck's "subpolitics" and the democratization of decision-making, advocating actor inclusion beyond formal politics.

A robust governance structure is indispensable for SDG implementation. Such governance must involve multiple actors—government, academia, industry, civil society, development partners—in designing and executing Science, Technology, and Innovation (STI) roadmaps for SDGs. This includes institutional structure considerations, cross-sector coordination, clear role and responsibility allocation, and transparency promotion.

The 2030 Agenda's governance operates amid Risk Society's uncertainties—where action consequences are unpredictable and accountability attribution is complex. Yet, this scenario also offers opportunities for more reflexive governance. It is crucial to move beyond purely technocratic approaches—incorporating political and social dimensions into indicator and target design. Furthermore, addressing structural inequality causes—rather than symptoms—is imperative for "Leave No One Behind" to be genuinely effective. Education emerges as an integrating force—fostering critical thinking and civic participation in managing socio-environmental challenges.

Criticisms of the 2030 Agenda—such as LNOB's vagueness and failure to interrogate inequality sources—reveal that purely "top-down" or technocratic governance is inadequate. Manufactured risks' complexity and science and technology's ambivalence necessitate governance that is transparent, participatory, capable of reconciling conflicting interests, and able to mobilize diverse actors. Governance must become a "learning mechanism"—continuously reflexive and adaptive to emerging uncertainties.

THE PRODUCTION OF MANUFACTURED RISKS IN REFLEXIVE MODERNITY AND THEIR IMPACTS ON THE SDGS

Reflexive modernity is characterized by producing risks intrinsic to its development—rather than mere accidents or externalities. This thesis is central to both Ulrich Beck and Anthony Giddens. Beck contends that industrial society—focused on wealth production—has given way to a risk society where risk distribution no longer aligns with traditional social differences. These risks are often invisible, complex, and difficult to attribute—such as environmental disasters, daily nuclear threats, and global epidemics.

Giddens coins "manufactured risks" to describe those directly resulting from human knowledge and technology's impact on nature. Unlike external risks (e.g., droughts, earthquakes), manufactured risks are products of human intervention and technological advancement. Reflexive modernity's "dark side" reveals that unanticipated consequences of industrial labor—and the destructive potential of productive forces—constitute profound dangers. Catastrophe arises not from isolated errors but from systems that amplify human error into incomprehensible destructive power.

This logic of manufactured risk production directly affects the ability to meet various SDGs. For example, SDG 13 (Climate Action) and SDG 15 (Life on Land) are intrinsically impacted by manufactured risks like industrial pollution, large-scale deforestation, and natural resource depletion—all consequences of unsustainable development models. Similarly, SDG 3 (Good Health and Well-Being) is profoundly influenced by risks such as air and water pollution, hazardous chemical use, and epidemic emergence—many directly or indirectly resulting from industrial and technological activity.

Science and technology's ambiguity lies in their simultaneous role as essential for progress and sources of manufactured risks. While indispensable for pursuing SDGs (e.g., SDG 9's emphasis on sustainable industry and infrastructure), they also serve as primary vectors for manufactured risk. The 2030 Agenda—by advocating innovation and technological development—risks succumbing to the reflexive modernization trap: uncritical technological solutions—absent participatory, critical governance—may inadvertently create new risks or exacerbate existing inequalities. If modernity inherently generates risks (Beck) and technology is a main vehicle for manufacturing them (Giddens), unreflective technological advocacy for SDGs can prove counterproductive. It necessitates technology assessment that transcends technical efficacy—accounting for long-term social and environmental impacts and equitable benefit-burden distribution. Fundamentally, the question is not whether to use technology but how and for whom it is designed and deployed—ensuring solutions do not become new problems or reinforce the inequalities the Agenda seeks to mitigate.

THE AMBIVALENT ROLE OF SCIENCE AND TECHNOLOGY IN RISK MANAGEMENT AND SUSTAINABILITY PROMOTION

Science and technology (S&T) occupy an ambivalent position in contemporary society—particularly regarding risk management and global sustainability. On one hand, they are undeniably engines of progress—offering essential tools and knowledge to identify, monitor, and mitigate humanity's challenges. Innovations like clean energy, advanced sanitation systems, vaccines for epidemic control, and early-warning systems for natural disasters exemplify how S&T provide critical solutions for SDGs. Technological transformation and innovation are considered pivotal to enhancing human well-being and reducing environmental harm from economic growth.

On the other hand, unregulated or growth-centric S&T contributes significantly to creating and exacerbating risks. As Risk Society theory highlights, ecological, chemical, nuclear, and genetic hazards are often "manufactured" by industrial and technological activities. This duality—S&T as both problem source and solution provider—epitomizes reflexive modernity's central dilemma.

Sheila Jasanoff's concept of "regulatory science" exemplifies this complexity. Unlike traditional academic science, regulatory science operates amid uncertainty, scarce knowledge, and significant

political and temporal pressures—rendering it a field rife with controversies rather than absolute truths. Recognizing that science is not a neutral entity but is "theoretically loaded" and underdetermined (i.e., observations depend on assumptions, and multiple theories can explain the same phenomenon) is crucial. This perspective challenges exclusive reliance on scientific expertise as the sole path to solving global problems.

Science and technology's ambivalence within Risk Society and the 2030 Agenda demand a paradigm shift in governance. Rather than applying science instrumentally, one must democratize its production and application—acknowledging its limitations and incorporating lay knowledge and public deliberation. If science is "theoretically loaded" and underdetermined, and if manufactured risks are complex and unpredictable, then exclusive reliance on expertise for SDGs is insufficient. Regulatory science's uncertainty requires S&T governance for sustainability to be transparent, participatory, and controversy-capable — integrating diverse viewpoints. This underscores Beck's "subpolitics," advocating for actor participation beyond conventional politics, and the democratization of decision-making — enabling civil society and other stakeholders to shape S&T directions and risk management. Public participation is not merely a democratic ideal but a pragmatic necessity for navigating contemporary risks' complexity and uncertainty.

CHALLENGES AND OPPORTUNITIES IN GOVERNING THE 2030 AGENDA AMID GLOBAL UNCERTAINTIES

Governing the 2030 Agenda for Sustainable Development is a complex endeavor—operating within a Risk Society characterized by inherent uncertainties where action consequences are often unpredictable and accountability assignment is intricate. To implement SDGs effectively, robust mechanisms and structures must be established to foster cross-sector coordination, engage multiple stakeholders, and ensure transparency at all levels. Governance must address global challenges' complexity—requiring interaction among a broad spectrum of actors: government, academia, industry, entrepreneurs, civil society, and development partners.

A key challenge is the tendency toward technocratic approaches that neglect sustainability's political and social dimensions. For instance, SDG indicator definition was fraught with political disputes and financial directives—yielding metrics only partially reflecting the Agenda's qualitative and transformative ambitions. This is evident in the "Leave No One Behind" principle's vagueness—although well-intentioned, it lacks a clear official definition of "left behind," generating implementation imprecision and disputes over inclusion criteria. Moreover, the current 2030 Agenda formulation does not question structural inequality sources—focusing more on symptom mitigation than on tackling exclusion and vulnerability's root causes.

However, this uncertainty also presents opportunities for more reflexive, adaptive governance. Moving beyond purely technical approaches necessitates incorporating political and social dimensions in sustainability policies' design and implementation. Governance must address structural inequality causes, not merely symptoms, for LNOB to be truly effective.

Critiques regarding the 2030 Agenda's failure to question inequality sources and LNOB's vagueness indicate that purely "top-down" or technocratic governance is inadequate. Manufactured risks' complexity and science and technology's ambivalence call for transparent, participatory governance—able to align conflicting interests and mobilize diverse actors. This implies governance as a "learning mechanism," continuously reflexive and adaptive to new uncertainties. In a Risk Society context, governing the 2030 Agenda cannot be a linear, purely technical process; it must be continuous learning and adaptation—recognizing expertise limitations, promoting diverse actor participation, and willing to question development fundamentals.

Education emerges as a crucial integrating force—fostering critical thinking, scientific literacy, and civic participation in managing socio-environmental challenges. By integrating SDGs into curricula and encouraging interdisciplinarity, education can empower individuals to become agents of change—capable of reflecting on their actions and actively participating in socio-political processes for a more sustainable society. Effective 2030 Agenda governance thus requires a holistic approach—combining scientific expertise with public deliberation, accountability, and continuous adaptation in the face of an uncertain future.

DEBATE AND DISCUSSION

INTERPRETATION OF FINDINGS AND THEORETICAL CONTRIBUTIONS

Our critical analysis of STS studies, Risk Society theory, and the 2030 Agenda reveals essential interpretations concerning contemporary global challenges' nature. The principal conclusion is that sustainability transcends a mere environmental or economic issue; it is deeply social and political—intrinsically tied to how society produces knowledge, navigates uncertainty, and distributes risks and benefits.

The research demonstrates that science and technology—though celebrated as progress engines and SDG enablers—are ambivalent. They are not neutral entities but social constructs co-producing both benefits and manufactured risks. This insight challenges the optimistic, instrumental view of S&T often underlying 2030 Agenda implementation. Our analysis indicates that reflexive modernity, by generating intrinsic risks, poses fundamental challenges to SDGs—particularly those reliant on technocentric approaches.

The study's primary theoretical contribution is formulating an analytical framework that transcends fragmented views of global problems. By integrating STS critiques on science's nonneutrality, Risk Society's notion of self-producing dangers, and 2030 Agenda implementation criticisms, we offer a holistic, deeper lens. This integrated framework argues that technical or economic SDG solutions are insufficient unless they address social and political dynamics underlying risk production and unequal impact distribution. The research advances the field by providing a conceptual structure for a more nuanced analysis of theoretical pillars' tensions and synergies—emphasizing the necessity for intrinsically reflexive, socially engaged S&T governance.

CRITICAL CONFRONTATION WITH EXISTING LITERATURE AND STUDY LIMITATIONS

Our findings align with existing literature critiquing simplistic views of scientific-technological progress and 2030 Agenda implementation. STS notions such as "theoretical load of observation" and "underdetermination" reinforce discussions on science's nonneutrality—echoing authors like Kuhn, Bloor, and Collins. Likewise, our interpretation of manufactured risks (Giddens) and Beck's Risk Society thesis resonates with works examining modernization's unintended consequences.

However, our study distinguishes itself by explicitly, critically integrating these pillars with the 2030 Agenda. While many works treat SDGs instrumentally or descriptively, our research deepens critiques—highlighting LNOB's vagueness and the Agenda's failure to interrogate structural inequality sources. Incorporating Jasanoff's regulatory science and Beck's subpolitics critiques adds complexity to understanding S&T governance for sustainability—explaining why proposed solutions may falter amid uncertainty and political dispute.

A primary limitation is the study's exclusively theoretical-bibliographic nature. The absence of empirical primary data on national implementation or case studies precludes direct hypothesis validation in practical scenarios. This research does not aim to quantify phenomena or conduct field hypothesis testing, but rather to build a robust conceptual framework. This limitation is also an asset: it permits a depth of conceptual and theoretical analysis difficult to achieve in empirical studies focused on data collection. Critiquing Beck's "implementation imprecision" of subpolitics and Giddens's scant empirical measurement of reflexivity reveals a theory-practice gap. By acknowledging its theoretical stance, this study establishes a foundation for future empirical research to test our proposed hypotheses and framework in real-world 2030 Agenda contexts—filling this gap and contributing to a more comprehensive, applicable understanding of sustainability challenges.

IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICAL APPLICATIONS

Our findings hold significant implications for researchers in sustainability, governance, and STS fields. Future studies should pursue empirical investigations into SDG implementation—particularly in developing countries—from the Risk Society and STS perspectives. Such research could examine how manufactured risks manifest across various geographic and social contexts, how S&T policies for sustainability are formulated and implemented, and stakeholders' participation and accountability levels.

Another promising avenue is evaluating participatory governance approaches' effectiveness in risk mitigation and equity promotion within SDG implementation. Case studies on "citizen science" initiatives or "constructive technology assessment" (CTA) could yield valuable insights into integrating lay knowledge and diverse social perspectives into S&T decision-making for sustainability. This research underscores the necessity for a reflexive modernization of the 2030 Agenda—going beyond mere metric quantification to include critical self-evaluation and continuous adaptation to development's inherent uncertainties and risks. Critics' observations on the Agenda's failure to question inequality sources and LNOB's vagueness suggest the Agenda may not be sufficiently reflexive for Risk Society challenges. By integrating Beck's and Giddens's theories, we imply the 2030 Agenda must embed self-analysis and adaptability—recognizing its own interventions can generate new risks or perpetuate inequalities. Consequently, future research should assess policy "reflexivity" and practical applications fostering public deliberation and accountability.

Practically, our study's recommendations target policymakers, NGOs, and civil society. Key suggestions include:

Adopting a Reflexive Governance Approach: SDG implementation policies must acknowledge S&T's ambivalence and science's social construction. This entails moving beyond purely technical solutions to incorporate critical analysis of values and interests shaping technological development.

Strengthening Participation and Transparency: Establish robust multi-sector participation and transparency in S&T policy formulation and evaluation for sustainability. This includes creating deliberation forums that integrate scientific expertise with lay knowledge and affected communities' perspectives.

Questioning Sources of Inequality: Implement the 2030 Agenda with a sharper focus on structural inequality sources, not merely symptoms. This requires policies challenging unsustainable production and consumption models—ensuring equitable distribution of development's benefits and burdens.

Investing in Critical Citizenship Education: Reinforce education for sustainable development—equipping citizens to think critically about S&T and engage actively in socio-environmental challenge management.

This study calls for S&T governance that acknowledges its limitations and potential risks—committing genuinely to building a more equitable, sustainable future amid escalating uncertainties.

CONCLUSION

This investigation critically analyzed STS studies, Anthony Giddens's and Ulrich Beck's Risk Society theory, and the 2030 Agenda for Sustainable Development. Our synthesis reaffirms the central argument: modernity, in its advance, not only yields progress but also produces intrinsic risks—risks the 2030 Agenda aims to address but not always in a structurally reflexive manner. Science and technology, although essential for achieving SDGs, prove ambivalent—serving as both solution sources and manufactured risk vectors.

The study's significance lies in contributing to global sustainability governance by demystifying science and technology's neutrality and exposing 2030 Agenda gaps. We demonstrate that reflexive modernity—with its inherent risk production—imposes fundamental challenges to SDG realization; technocentric approaches alone are insufficient. LNOB's vagueness and indicator design's technocratic nature limit the Agenda's effectiveness—perpetuating inequalities by failing to challenge structural roots.

Unlike the detailed interpretations elaborated in the discussion, this conclusion synthesizes the core argument. The study offers a forward-looking perspective—recommending future research and practical strategies. To advance, S&T governance for sustainable development must adopt a more reflexive, participatory stance—continuously evaluating S&T impacts, engaging diverse stakeholders in decision-making, and holding actors accountable for generated risks. Future inquiries should empirically examine SDG implementation through a Risk Society lens across varied contexts—assessing participatory approaches and critical citizenship education's role in fostering truly equitable, resilient sustainability.

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SOME GAMES FOR TEACHING GEOMETRY IN THE EARLY YEARS OF ELEMENTARY SCHOOL

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Josielem da Silva Lindoso[1] and Waléria de Jesus Barbosa Soares[2]

ABSTRACT

This research aims to contribute to the teaching practice of educators who teach the mathematics curriculum component in the early years of elementary school. Characterized as bibliographic and exploratory research with a qualitative approach, it seeks to identify activities that incorporate playfulness in the teaching of geometry for the early years. The suggested activities involve games covering plane geometry and/or spatial geometry. As theoretical foundations, we draw on Huizinga (2004); Smole and Diniz (2007); Malaquias (2013); and Massa and Ribas (2016), which help us understand the importance of using games for teaching mathematics and thereby select them for geometry instruction. We conclude that it is necessary to consider integrating games into mathematics lessons, as we believe it is possible to propose and deliver geometry instruction grounded in playfulness, which contributes to the teaching–learning process of mathematics in the early years.

Keywords: Teaching; Mathematics; Resources; Games.

[1] E-mail: josilindoso.jl@gmail.com
[2] Prof. Dr.
E-mail: walleriajotabes@gmail.com

INTRODUCTION

During elementary school, it is essential that students have classroom experiences that capture their attention for Mathematics lessons. A teacher who adopts, for example, a game-based methodology encourages active student participation. Dividing the class into groups and solving problems through rule-based games that yield a winner is fundamental for fostering an appreciation of Mathematics.

Designing these ludic activities is challenging for the mathematics teacher.

> Teaching Mathematics as a school subject has proven challenging for educators, given that many students consider it difficult to learn—perhaps because, when taught by traditional methodology with only content presentation and calculation exercises, it feels overly abstract, especially for elementary students who are still developing formal operations, according to Piaget (Massa & Ribas, 2016, p. 2).

The teacher's main challenge is to keep students motivated—a concern across all disciplines, not just the exact sciences. Making learning more meaningful and combating resistance to Mathematics are essential actions for the desired teaching–learning process. Ultimately, the goal is that students not only learn, but also comprehend the material covered in class.

> The use of games in the classroom can be an effective methodological resource to motivate the teaching–learning of Mathematics. Consequently, mathematical games as a teaching tool can promote more engaging instruction and dynamic learning, making lessons more playful and challenging, thereby developing logical reasoning (Massa & Ribas, 2016, p. 2).

Just as games benefit student learning, they also play a fundamental role in the teaching process. The teacher–student relationship becomes more practical, relaxed, and less burdened, allowing both to fulfill their roles more effectively and achieve their objectives.

In this context, the primary objective of this research is to identify activities that incorporate playfulness into geometry instruction for the early years, making lessons more engaging and meaningful for students. After identification, we present how each activity contributes to the development of mathematical content in the early years. We then propose four games.

The main role of these games is to enable students to reflect on the problems discussed in class, seeking solutions through practical, playful engagement that addresses their challenges in an immersive way.

METHODOLOGICAL PATHWAYS

The methodological approach of this research was qualitative, since, in agreement with Bogdan and Biklen (1994, p. 47), "the direct source of data is the natural environment, with the researcher as the primary instrument." We also sought to understand the study object, expanding comprehension rather than explaining the phenomena (Rampazzo, 2005).

The research is also exploratory, linking the themes of playfulness and mathematics teaching in the early years of elementary school. According to Marconi and Lakatos (2003, p. 6), exploratory studies "are empirical investigations aimed at formulating questions or problems for: developing hypotheses, increasing the researcher's familiarity with an environment, fact, or phenomenon, or clarifying concepts." We agree with Prodanov (2013), who emphasizes that exploratory research gathers information to increase familiarity with the subject.

As a technical procedure for data collection, we used bibliographic research, which, according to Gil (2002), is conducted using existing material, primarily books and scientific articles, to foster greater familiarity with the problem and stimulate comprehension.

The research followed these stages:

1. Literature review on the research theme, including articles, dissertations, books, and curricular documents such as the National Curricular Parameters (PCN) and the Common National Base Curriculum (BNCC);
2. Selection of texts on playfulness in mathematics teaching, focusing on geometry;
3. Research and selection of activities based on playful geometry instruction to develop plane and spatial geometry concepts and knowledge for early elementary students.

Search engines used included Google and Google Scholar, as well as physical and digital libraries.

RESULTS AND DISCUSSION

CHALLENGES OF TEACHING MATHEMATICS AND GEOMETRY IN THE EARLY YEARS

Mathematics is an ancient science, estimated to have originated in Ancient Egypt, although prehistoric humans already used concepts of counting and measuring. Thus, mathematics emerged from humans' relationship with nature and the need to quantify and measure objects. Geometry, part of mathematical knowledge, has also been present in human life since antiquity.

In school geometry, there is often a disconnect between students and the mathematical objects taught, leading to monotonous and seemingly purposeless lessons. It is necessary to contextualize mathematics, as many perceive it as highly abstract and call for more "concrete" approaches linked to everyday life.

One reason geometry is seen as abstract lies in how the subject is taught, often following the order of presentation found in mathematical texts rather than tracing how a concept developed and the questions it answers.

> Although mathematical objects may seem especially abstract, they vividly illustrate the link between abstraction and concrete reality. Counting objects, for instance, naturally demonstrates that the abstract number 5 corresponds to any collection of five items—bananas, people, stones, regular polyhedra, and so on. In fact, knowledge requires abstraction (Machado, 2014, p. 50).

According to Groenwald and Timm (2002, p. 21), “teaching mathematics is developing logical reasoning, stimulating independent thought, creativity, and problem-solving skills.” Playful practices support learning by encouraging greater interest in mathematical content. Play allows students to assimilate geometry concepts in a fun context with peers.

But who teaches mathematics in the early years of elementary education? A significant portion of teachers working in this cycle holds only pedagogical training: they have a degree in Pedagogy, with no additional licensure. Thus, when they are required to teach various subjects, a fundamental question arises: how to teach specific content? Or even more directly, how to teach mathematics?

Although their initial training in higher education prepares them to be polyvalent, many of these teachers believe that what they learned in college/university does not sufficiently prepare them to teach specific content areas in the early years of elementary school.

Since mathematics is a science that requires observation and understanding, learning geometry must be achieved through collective effort. Teachers who teach mathematics/geometry in the early years must develop educational resources based on the competencies and objectives that should be attained in this educational cycle (BRASIL, 2018). In this sense, the teaching of geometry needs to be contextualized to meet the social needs of each era and the educational needs of students.

Therefore, for the teaching of mathematics/geometry to focus on meaningful learning, teachers must understand that each individual learns and evolves in different ways. For this reason, teachers must be prepared, continually seeking to innovate their methods and developing more engaging mathematical activities without neglecting the mandatory curriculum content for the early years.

LEARNING MATHEMATICS THROUGH PLAYFULNESS: IS IT POSSIBLE?

What does playfulness mean? The word "ludic" comes from the Latin ludus, which, according to Huizinga, “encompasses children's games, recreation, competitions, liturgical and theatrical representations, and games of chance” (Huizinga, 2004, p. 41). For Malaquias (2013), the impulse to play is a natural characteristic of children.

> [...] playfulness naturally induces motivation and fun. It represents human freedom of expression, renewal, and creation. Playful activities allow children to creatively rework feelings and knowledge, building new possibilities for interpreting and representing reality according to their needs, desires, and passions. (BRASIL, 2012, p. 6).

Regardless of chronological age, playfulness is present throughout an individual's life. However, it should not be restricted solely to moments of leisure but should also contribute to moments of creative development, social interaction, and linguistic, cognitive, motor, and affective domain (Iavorski, 2008).

According to Luckesi (2015, p. 6), playfulness is an internal and personal experience. We recognize that playfulness is a fundamental component of human development, widely incorporated into educational practices. In the educational context, play fosters interest in other activities, enabling the use of reasoning to solve problem situations and expanding students' mathematical knowledge, while also stimulating imagination.

Playful activities are powerful tools for teaching mathematics, as they stimulate creativity, encourage students to face challenges, and promote socialization. In mathematics, playfulness can include games, concrete materials, songs, and rhymes to teach mathematical concepts.

However, it is not enough to simply play, sing, or engage in games without intentionality or educational objectives. For example, when we talk about games, we agree with Kishimoto et al. (2017) apud Fromberg (1987, p. 36), that a game should include the following characteristics: (a) symbolism: representing reality and attitudes; (b) significance: enabling the relation or expression of experiences; (c) activity: the child does things; (d) voluntary or intrinsically motivated: incorporating motives and interests; (e) rule-governed: subject to implicit or explicit rules, and (f) episodic: with goals developed spontaneously.

We emphasize here that we understand games as a pedagogical resource that provides students with a favorable environment for learning mathematics (Smole; Diniz; Milani, 2007). Furthermore, as highlighted by the BNCC, they are voluntary activities conducted within time and space constraints, enjoyable for students, and whose rules can be altered or modified before the activity begins (BRASIL, 2018).

When we choose to use games as a playful teaching strategy for mathematics lessons, teachers must keep in mind the need to facilitate learning. Thus, students in the early years should find joy in learning. We then understand that:

> [...] for Mathematics and its exercises, often the cause of fear and insecurity, nothing is more appropriate than the use of games to work on mathematical concepts and enable students to genuinely grasp them. Games are the means to make mathematics enjoyable and the discovery of solutions pleasurable, as they truly are, although students have not yet had the opportunity to perceive mathematics in this way due to its intimidating character. The discovery and search for solutions provide children with the pleasure of learning. The challenges contained in playful situations can help not only to build mathematical knowledge but also to make students feel challenged to solve problems and puzzles. (Nunes; Saraceni, 2013, p. 28).

The game should help students in the early years think mathematically. Even though there is an element of fun, the ultimate goal remains learning.

SUGGESTIONS FOR MATHEMATICAL ACTIVITIES FOR THE EARLY YEARS

Following the initial reflections presented in this research, we selected four mathematical games focusing on plane and spatial geometry. Our aim is to offer activity suggestions for teachers working in the early years of elementary education.

Activity 1: Hex Game*

This game helps in identifying and recording similarities and differences among the geometric shapes used in the game. In other words, it aids in shape recognition and also contributes to naming figures such as hexagons, trapezoids, triangles, squares, rhombuses, and parallelograms; counting vertices and sides; composing and decomposing figures; and visual discrimination and memory.

One advantage of using this game with students is that it fosters spatial awareness and skills essential for geometric thinking, particularly visual, verbal, drawing, and logical abilities (Smole; Diniz; Cândido, 2007). For this game, we highlight:

Components: Game board and 36 colored geometric pieces.

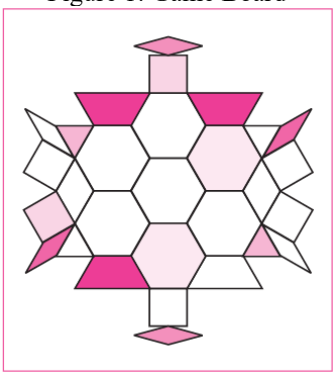
Objective: To be the last player to place one of the available pieces on the board. It is not necessary for the board to be completely covered with pieces.s.

Game rules:

- The class should be organized into pairs.
- The pieces should be spread around the board, accessible to all players. Next, decide who will start.
- The chosen player will select one, two, or three pieces of different colors to place on the board. Once they start placing the pieces, no exchanges are allowed.
- On the board, pieces must be placed without covering the lines that delineate the geometric shapes. The entire space does not need to be covered, leaving room for other pieces.
- Once pieces are placed, they cannot be removed or repositioned.
- The winner is the player who manages to place the final piece(s) in the available spaces or if the opponent cannot fit all the pieces they selected.

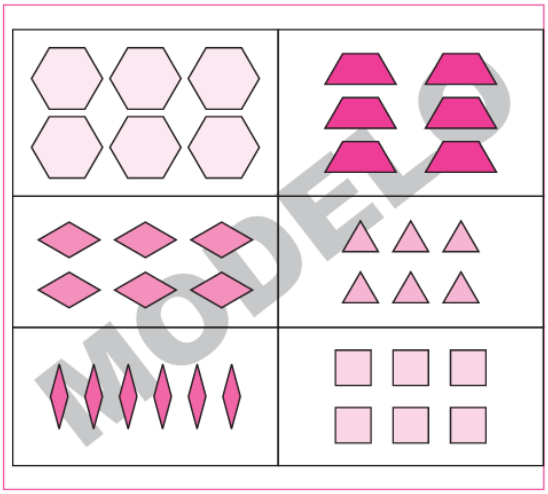
Throughout the game, teachers can pose questions to help students choose their pieces and better understand the game at each round. Sample questions include: How many ways can we cover the trapezoid, the rhombus, or the hexagon?

Figure 1: Game Board



Source: Smole; Diniz; Cândido, 2007.

Figure 2: Game Pieces



Source: Smole; Diniz; Cândido, 2007.

At the end of the game, students can be asked to create a drawing to document their gameplay experience. Drawing a classroom experience is a way to record significant moments, giving the teacher insight into which aspect of the game each student focused on (Smole; Diniz; Cândido, 2007).

This game helps students develop visual, verbal, drawing, and logical skills. Visual skills involve the ability to interpret diagrams and schematics, identify shapes, and visualize their properties. Verbal skills involve expressing perceptions, elaborating and debating arguments, justifications, or definitions, describing geometric figures, and using specific geometry terminology.

Drawing skills refer to the ability to communicate ideas through drawings and diagrams, including tasks like constructing figures using a ruler. Logical skills involve analyzing and evaluating arguments and definitions, identifying valid or invalid arguments, presenting counterexamples, and understanding and creating demonstrations.

Activity 2: Property Card Game

This game helps students identify plane figures and their properties, record similarities and differences between them, develop geometry-related vocabulary, and identify and count vertices/sides in some plane figures (Smole; Diniz; Cândido, 2007).

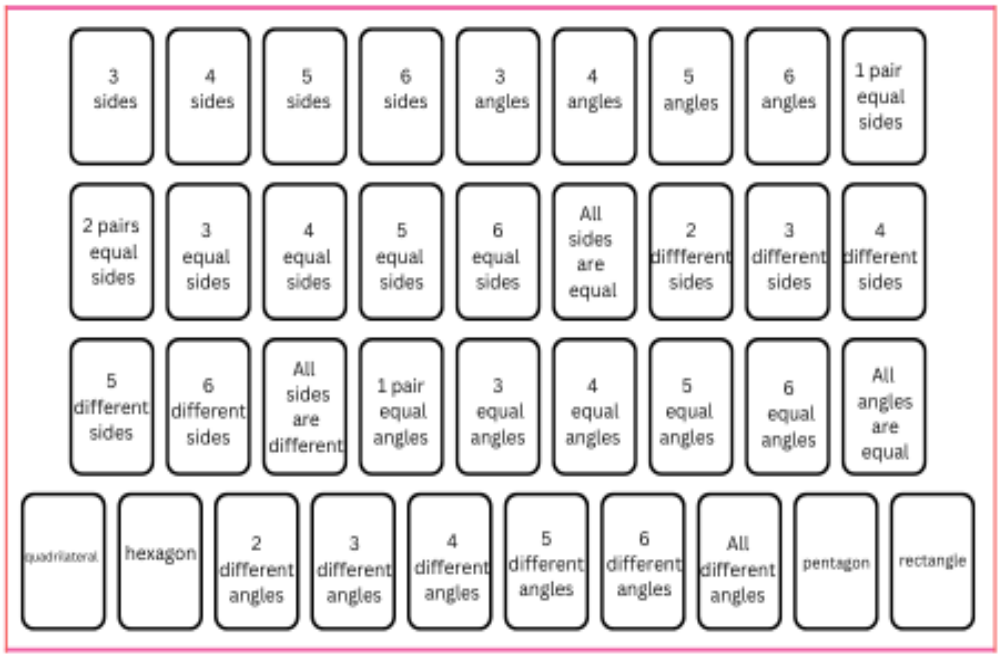
Components: 14 cards, each with a plane geometric figure, and 37 cards, each with a geometric property.

Objective: Score the highest number of points by the end of the game.

Game rules:

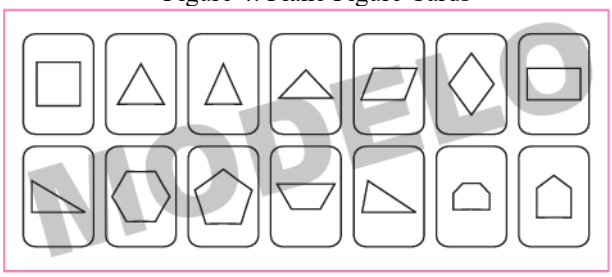
- The class is organized into groups of four players.
- A dealer places the deck with plane figure cards face down in the center of the table and deals five property cards to each player.
- The dealer then turns over the top card of the deck and places it face up for all players to see. Anyone with a property card related to the figure turns over their card and earns points if correct. Multiple players can score in a single round.
- Property cards are then collected by the dealer, shuffled, and five new cards are dealt to each player. The next figure card is revealed.
- The game ends when all figure cards are used.
- The winner is the player with the most points

Figure 3: Property Cards



Source: Smole; Diniz; Cândido, 2007.

Figure 4: Plane Figure Cards



Source: Smole; Diniz; Cândido, 2007.

After the game, teachers may ask students:

- What are all the geometric properties of the triangle that appear on the cards?
- What are the names of the plane figures shown on the cards?
- What properties are shared by squares and rectangles?
- Find a property that applies to three different figures.
- Create a riddle and exchange it with a classmate.

The "Property Card Game" offers significant educational benefits. While playing, students develop their ability to identify plane geometric figures and their properties, such as the number of sides, vertices, and symmetries, fostering a deeper understanding of geometric concepts. Additionally, the game helps build technical geometry vocabulary, familiarizing students with the correct terms to describe shapes and their features.

Group interaction should be encouraged, fostering a collaborative environment where students work together to apply knowledge in a practical and fun way. The game's dynamics, involving quick thinking and property comparison, stimulate critical thinking and the ability to make connections between different geometric concepts, making learning more meaningful and engaging.

Activity 3: Solid Figures Scavenger Hunt

The "Solid Figures Scavenger Hunt" game aims to help students recognize and differentiate the main geometric solids in a practical and fun way. By bringing everyday objects that represent geometric shapes such as spheres, cylinders, and cones, students can visually and physically explore the characteristics of these solids.

Objective of the game: To identify and differentiate geometric solids using objects brought by students.

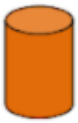
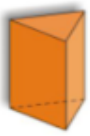
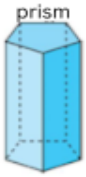
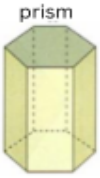
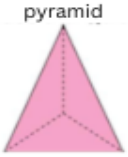
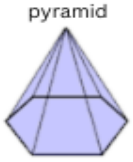
Components: Objects, packaging, containers, etc., shaped like identifiable geometric solids.

Game rules:

- The game should be conducted in groups of 4 or 5 students.

- Each student group must bring to school objects, packaging, containers, etc., that resemble geometric solids with the intention of differentiating these shapes.
- Points are awarded according to a specific table where each type of geometric solid has a designated score.
- For the point count, up to three examples of each geometric solid will be considered..

Figure 5: Points Table

Geometric Solid	sphere 	cylinder 	cone 	cube 
Points	3	3	5	5
Geometric Solid	parallelepiped 	retangular-based prism 	pentagonal-based prism 	hexagonal-based prism 
Points	3	7	10	10
Geometric Solid	trinagular based pyramid 	square based pyramid 	pentagonal based pyramid 	hexagonal based pyramid 
	10	8	10	10

Source: Gomes; Franco, 2013.

In addition to promoting learning about geometry, the game encourages teamwork, careful observation, and creativity while fostering the development of classification and shape identification skills in the surrounding environment. The activity also promotes healthy competition, motivating students to engage more deeply with the task and to explore the content in an active and collaborative manner.

Activity 4: Geometric Bingo

"Geometric Bingo" is an educational game designed to reinforce learning about geometric solids and their planar representations. The game enables students to differentiate and establish relationships between spatial figures and their two-dimensional representations in an interactive and enjoyable way.

Objective of the game: To assist students in recognizing and differentiating geometric solids and their nets, promoting understanding of the relationships between spatial figures and their planar representations.

Components: Bingo cards with drawings of geometric solids, markers (such as beans, corn kernels, bottle caps, etc.), information cards with descriptions of geometric solids, and a container to hold the cards.

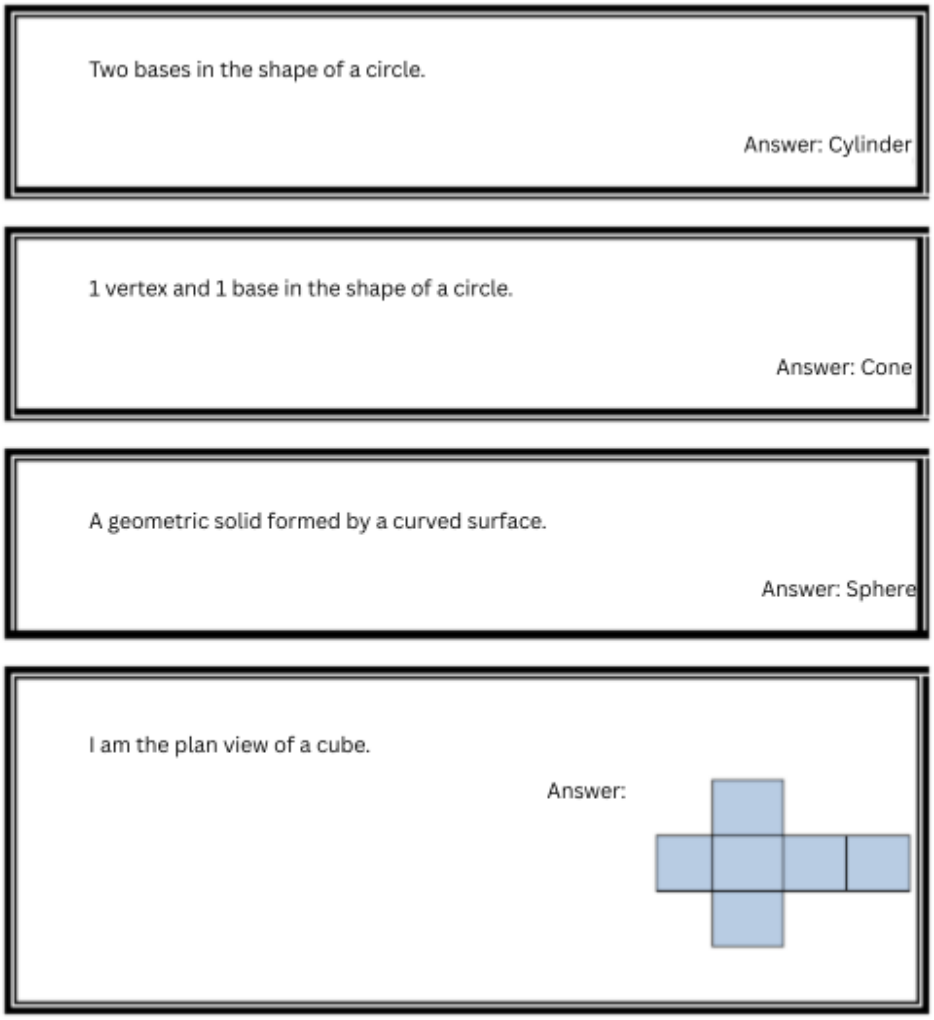
Game rules:

- Each student will receive a bingo card featuring different geometric solids and their corresponding nets, allowing them to identify and establish connections between spatial figures and their planar representations.
- The teacher will draw a card containing a description of a geometric solid and read it aloud.
- Students who have the corresponding solid or its net on their bingo card will mark it.
- The winner will be the first student to complete their bingo card. Once this happens, the student should loudly say "bingo" to announce their victory.

Figure 5: Examples of question cards

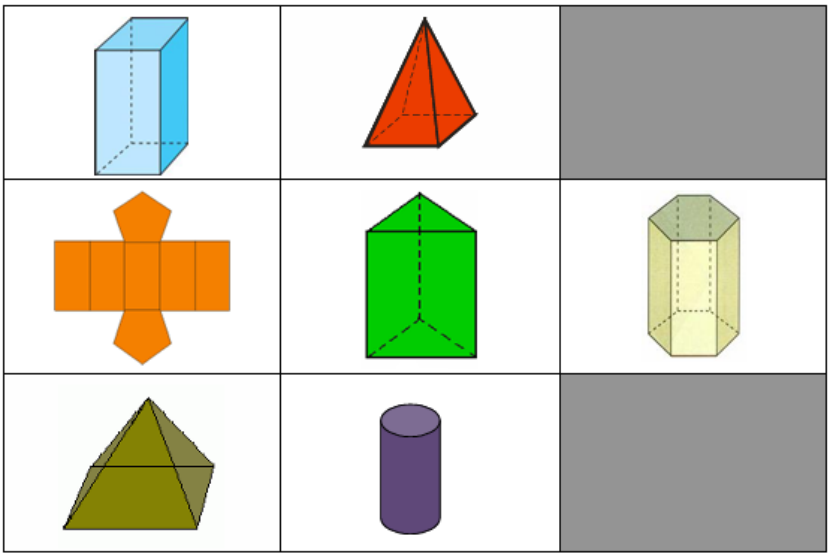
Source: Gomes; Franco, 2013.

Figura 6: Examples of question cards



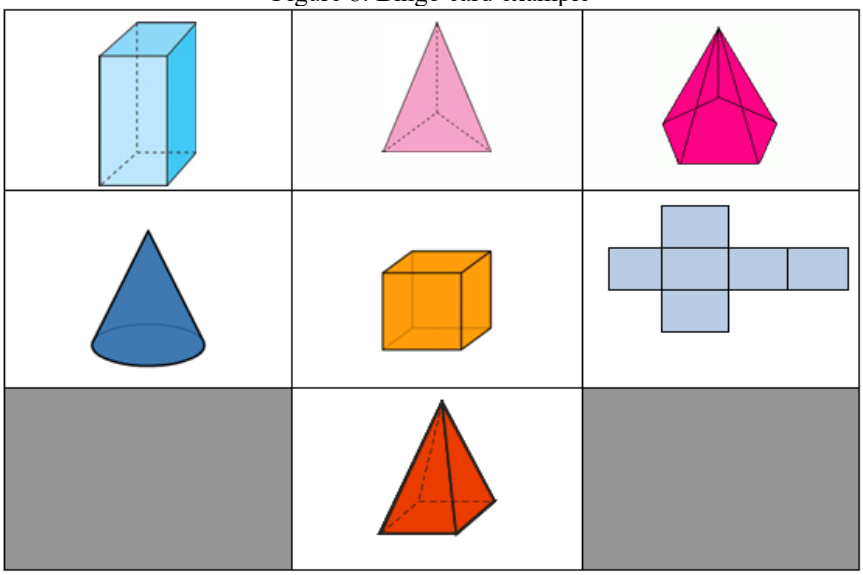
Source: Gomes; Franco, 2013.

Figure 7: Bingo card example



Source: Gomes; Franco, 2013.

Figure 8: Bingo card example



Source: Gomes; Franco, 2013.

The game contributes to student learning by allowing them to identify and relate geometric solids to their nets in a practical and enjoyable way. Moreover, it promotes memorization, logical reasoning, and attention to detail while encouraging interaction among peers and active participation in the learning process, making geometry more engaging and accessible.

FINAL CONSIDERATIONS

The development of visual, verbal, drawing, logical, and technical vocabulary skills in geometry are just some of the contributions observed in each of the games presented. These characteristics initially reinforce the importance of incorporating games into Mathematics classes.

Through these tools, students are exposed to practical and concrete ways of applying abstract concepts, facilitating the assimilation of content. Furthermore, the use of games enables experiential learning, meaning that learning occurs through experiences and actions that consolidate knowledge in a more solid and lasting way. Thus, geometry—often seen as a difficult-to-understand area—becomes more accessible and interesting for students.

There are also other advantages that students may develop during the application of these games. By engaging students through questioning and inquiry, the games encourage them to think and reflect on the problems to be solved, stimulating the development of quick reasoning as they make connections between the explored possibilities. This fosters critical thinking, as students are challenged to evaluate different solutions to the same problem, reflect on their choices, and adjust their strategies as necessary. Additionally, this process helps develop problem-solving skills, which are essential not only in academic contexts but also in everyday situations.

Moreover, the dynamics of implementing a game offer students healthy group interaction, promoting, even within competition, a collaborative environment in the classroom. Rather than viewing competition as a barrier, games enable it to become a catalyst for cooperation, where students, working together, share knowledge, strategies, and solutions.

This collaborative environment not only facilitates collective learning but also contributes to building social skills such as communication and teamwork. It also enhances memorization and active student participation, making the teaching of geometry more captivating and effective. By engaging actively, students tend to retain information better and apply concepts more confidently across different contexts.

Therefore, by integrating games into Mathematics teaching—especially in geometry—a more dynamic and interactive environment is created, promoting learning in a more engaging and meaningful way. This not only improves academic performance but also prepares students to face future challenges more creatively and collaboratively, developing skills that go beyond simple mastery of technical content. The use of games thus stands out as a powerful strategy that can transform Mathematics teaching into a more enriching and enjoyable experience for everyone involved.

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Aurum EDITORA

CHAPTER 3

SCHOOL GEOGRAPHY IN THE PROVINCE OF MINAS GERAIS IN THE NINETEENTH CENTURY AND THE INSTITUTIONALIZATION OF BRAZILIAN GEOGRAPHY

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Eduardo José Pereira Maia[1]

ABSTRACT

This study aims to understand the history of school geography in the province of Minas Gerais from 1854 to 1889. It analyzes the process of the institutionalization of geography in Minas Gerais and, consequently, in Brazil during the second half of the nineteenth century. The thesis is based on the assumption that the teaching of geography was not confined to the Colégio Pedro II and that its development was not merely a simplification of academic and scientific knowledge. On the contrary, it was a slow process of disciplinarization, in which textbook authors and teachers from primary, normal, and secondary schools played a crucial role. This work also aimed to analyze the purposes of teaching geography beyond the prescriptive realm, in an investigation that combined the analysis of curricular prescriptions with everyday classroom practices. The main sources analyzed, in addition to legislation, included school curricula, educational board reports, tests and exams, meeting minutes and official opinions, all gathered from the Public Archive of Minas Gerais (APM); school textbooks on Geography and Chorography sourced from the Didactic Book Library of the Faculty of Education of the University of São Paulo (BLD/FEUSP), the National Library, the State Library of Minas Gerais, and the Digital Library of the Federal Senate; the Pedro II School Memory Center (NUDOM); and other documents obtained through the Brazilian Schoolbook Database (LIVRES).

Keywords: Institutionalization; School Geography; Nineteenth Century.

[1] PhD in Education and Social Inclusion
Federal University of Rio de Janeiro
E-mail: eduardomaia@igeo.ufrj.br
ORCID: https://orcid.org/0000-0003-2702-3459

INTRODUCTION

This work is the result of research conducted in subsequent years at the Laboratory for Research in Geography and Education (LAGE/UFRJ). The objective was to study the history of school geography from 1850 to 1889. The temporal framework was defined based on the creation of secondary schools in the provinces of the Empire during the second half of the nineteenth century, with particular emphasis in this text on the Liceu Mineiro. A careful literature review on the subject revealed that researchers dedicated to the history of geography and school geography have not prioritized the study of educational institutions, with the exception of the Colégio Pedro II, regarded as a model and disseminator of knowledge throughout the provinces of the Empire.

Two key issues emerged from the analysis of research in school geography. The first concerns the process of the geography schooling as a landmark for understanding the history of geography in Brazil. The second pertains to the methodological demands regarding the selection of research sources. As school geography was considered a minor, insignificant subject, and an exclusive product of legislation, research sources were largely restricted to official curricula. Few investigations ventured beyond imperial decrees. One exception was the study of didactic manuals which, due to their material nature as school artifacts (FORQUIN, 1993), received more attention from scholars of geography education (2020).

Building on these works and existing research, we present an alternative approach: to utilize sources that, for various reasons, were neglected—especially those until recently considered rare or even nonexistent, such as tests, exams, and student activities.

This research aimed to investigate the geography schooling in Brazil during the second half of the nineteenth century, interpreting "schooling" as "the process of producing social references, meanings, and knowledge transmission" within the school environment (FARIA FILHO, 2002). This interpretation is crucial for understanding the history of the discipline of geography—central to this research—which finds in the school its primary vehicle for the dissemination of geographic knowledge and discourse.

In general, school subjects are identified and justified in four main ways, originating from knowledge recognized outside of the school setting. Several factors contribute to the institutionalization of school subjects. First, a subject is the collective activity of those who practice it. The geography that is taught, therefore, is shaped by what teachers and textbook authors decide to teach. They determine the purposes (CHERVEL, 1990) and create a positive, utilitarian image. In this context, success is achieved when there is a favorable response from society, and—regarding geography—the recognition of its value as indispensable knowledge for understanding territory, a cornerstone for building a modern and civilized nation. Second, a subject differentiates itself from others by its object of study—that is, its themes, subject matter, or specific content. It is a field that becomes delineated and is qualified by a distinctive vernacular or specialized lexicon. Third, a subject adopts particular teaching methodologies dictated by

the nature of the content to be taught. In geography's case, this includes the use of maps, globes, atlases, images, and fieldwork. Fourth, a subject is defined by the ways it is manifested across various levels of education, as well as by the effects of geographical knowledge learned within and outside of school settings.

SCHOOL GEOGRAPHY AND RESEARCH – METHODOLOGY

In analyzing research on school Geography and school knowledge, I have highlighted two key issues that deserve greater attention. One is the process of Geography schooling as a foundational aspect in understanding the history of Geography in Brazil. However, studies have generally not considered the school-based form of Geography as knowledge with the potential for in-depth investigation. School knowledge was often deemed inferior and, for this reason, was largely neglected in academic research.

In this context, the second issue relates to the methodological demands involved in selecting research sources. Since school Geography was regarded as a lesser, insignificant form of knowledge and merely a product of legislation, source selection was often limited to official curricula. Few studies have ventured beyond imperial decrees. An exception is made for textbooks, which—by virtue of their physical form as educational artifacts[2], have received more attention from researchers in the history of Geography. In light of this and existing research, I proposed an alternative analytical path: to use sources that, for various reasons, had been forgotten—especially those that were until recently considered rare or even nonexistent, such as tests, exams, and student activities.

As research sources, I used imperial and provincial legislation, didactic manuals, periodicals in circulation during the period, and especially exams, tests, and official evaluations, which more precisely indicate the content taught in schools. The sources were researched in two sets of collections, which I classified as general and specific. The specific collection refers to the official documentation of schools in Minas Gerais, primarily housed at the Arquivo Público Mineiro (APM). The general collection includes the Brazilian Historical and Geographical Institute (IHGB), the National Library (BN), the Royal Portuguese Reading Cabinet, the National Historical Archive, the State Library of Minas Gerais, the Digital Library of the Federal Senate, the Memory Center of Colégio Pedro II (NUDOM), the Textbook Library of the School of Education at the University of São Paulo (BLD/FEUSP), and the LIVRES database of the Memory Center for Education at FEUSP.

In examining documents from secondary school institutions in the Province of Minas Gerais,

[2]The concept of the textbook as a school artefact is part of what Jean-Claude Forquin (1993, p. 167) called "the set of cognitive and symbolic contents which, selected, organized, 'normalized' and 'routinized' under the effect of didactic imperatives, usually constitute the object of deliberate transmission within schools". Textbooks were therefore produced for the school world with the aim of collaborating in the teaching process in a systematized way.

located at the APM, I focused on materials referring to the Geography chair, primarily from the period between 1854 and 1889. The year 1854 marks the establishment of the Liceu Mineiro[3] and other educational institutions, while 1889 was chosen as the endpoint based on the significant number of documents that reflect the state of Geography education in Minas Gerais during the second half of the 19th century. It is also worth noting that by this time, in addition to the Liceu Mineiro, over two dozen secondary institutions were functioning regularly in the province. Numerous secondary institutions were created, annexed, and closed throughout the period. Documents from various schools, seminaries, and the Liceu Mineiro all confirmed the presence of an active Geography chair

In this research, I present a twofold approach: the first, the documentary sources that represent official guidelines; the second, documents produced as a result of those guidelines, which are embedded in everyday pedagogical practices. As a framework, I considered eight aspects:

1. The presence of the discipline in curricula, considering the frequency of Geography in official programs, legislation, and public instruction reports;
2. The designation given to the Geography discipline, taking into account the terminology used during the period and its qualifiers;
3. The content covered in Geography or considered geographical, and how the prescribed content appeared in curricula, textbooks, and programs;
4. The weight of Geography in the programs, considering the time allocated to the subject within the school calendar;
5. The explicit and implicit objectives of the subject;
6. The discourses that authorize and legitimize it as a school subject;
7. Teacher training, particularly as assessed in public service exams and also in academic theses;
8. Records of daily school practices: tests and exams, official evaluations, or other possible documentation.

THE INSTITUTIONALIZATION OF BRAZILIAN GEOGRAPHY – LITERATURE REVIEW

A careful review of the relevant literature reveals that researchers dedicated to the history of Geography have not analyzed the educational institutions of the Empire, with the exception of Colégio Pedro II, which has been considered the model and disseminator of knowledge in the provinces of the Empire.

[3]According to the legislation, these establishments had to teach Grammar and Philology of the National Language; Latin Grammar and Poetry; French; English; Geography; History; Philosophy, Rhetoric, Elementary Mathematics and Pharmacy from the 1st year.

The existing research generally follows the classical narratives in the history of Geography, including works by Pasquale Petrone (1979), Carlos Augusto de Figueiredo Monteiro (1980), Nelson Werneck Sodré (1982), Manuel Correia de Andrade (1992), José Veríssimo Pereira (1994), Raquel Maria Fontes do Amaral Pereira (1999), and Ruy Moreira (2010). These authors contend that Geography teaching in Brazil was only institutionalized starting in the 1930s and thus suggest that historical studies of this discipline should only focus on the period beginning in that decade. What existed prior to this, they argue, should be classified as the history of geographical thought.

I therefore present some factors I consider to be responsible for the institutionalization processes of school subjects. In general, school disciplines are identified and justified in four main ways based on knowledge that is recognized outside the school environment.

The first factor is that a discipline is the collective activity of the people who practice it. Hence, the Geography that is taught is shaped by what teachers and textbook authors choose to teach. They define its aims and build a positive and utilitarian image of the subject. This is successful when there is a favorable response from society and, in the case of Geography, when it is recognized as essential knowledge for understanding the territory—a foundation for building a modern and civilized nation.

The second factor is the distinction between disciplines, based on their object of study—in other words, their themes, subjects, or specific content. This refers to a field that becomes defined and is characterized by a particular "vernacular" or specialized lexicon.

The third factor lies in the use of particular teaching methodologies, which are shaped by the object being taught. For Geography, this includes maps, globes, atlases, images, and so on.

The fourth factor is how the discipline manifests in activities conducted across different levels of education, as well as the broader impacts of geographic knowledge learned in school and beyond the school setting.

However, Geography during the imperial period has been framed as a kind of "pre-history" of the discipline that would later be institutionalized with the creation of undergraduate Geography programs at the School of Philosophy, Literature, and Human Sciences at the University of São Paulo in 1934 and at the University of the Federal District in 1935. This perspective led to a mistaken interpretation—that to understand Brazilian Geography, one must first look to its academic foundations, viewing school Geography as merely the vulgarization of a greater knowledge. This is the process Yves Chevallard (1991) termed didactic transposition.

In analyzing research on school Geography and school knowledge, I have again highlighted two issues in need of further attention. One is the process of Geography schooling as a foundation for understanding the history of Geography in Brazil. Yet the studies have generally overlooked the school-

based form of Geography as a meaningful area of investigation, and school knowledge has been judged inferior—hence why it has been widely neglected.

SCHOOL GEOGRAPHY IN 19TH-CENTURY MINAS GERAIS – RESULTS

This study seeks to demonstrate that Geography "became an academic discipline" through the school system, as argued by Yvor Goodson (1990). The prevailing notion—that understanding Brazilian Geography requires first analyzing its academic science base and treating school Geography as a simplified version of a superior body of knowledge (a process Yves Chevallard [1991] termed didactic transposition)—is considered mistaken in this context. We contend that the school-based version of geographical knowledge was not designed merely to serve a supposedly higher interest stemming from that concept. Rather, geographical knowledge—though still in its formative stage—was already becoming a structured school subject during the 19th century. We also assert that even the academic format of 20th-century university courses in Geography ultimately derived from the school-based version developed in the 19th century.

To answer the question of how geographic knowledge was organized as a school subject during the Empire, we used sources such as tests, exams, student activities, and institutional guidelines from schools in the Province of Minas Gerais. These documents allowed us to identify the educational purposes of this knowledge—purposes that extended beyond simply preparing students for the Empire's military and professional academies, a requirement already formalized in legislation from 1831. To that end, we investigated the geographic knowledge—or content—present in school curricula, textbooks, exams, and instructional manuals used in schools.

The choice to focus on the province of Minas Gerais was based on two main reasons: first, because it was one of the most important provinces of the 19th century—an influential political center that, despite its prominence, was still expected to submit to the decisions of the Court; and second, because of its history of urban organization. The experience of mining and urban activity, along with the presence of religious seminaries, led me to believe that the presence of Geography in schools in Minas Gerais either coincided with or even predated its presence at Colégio Pedro II. The focus of this research was on the educational purpose of school practice.

We deduced that, since specific content appeared in exams and tests, this material must have, in fact, been taught. Knowledge and practice—two dimensions of the schooling process—are, according to Faria Filho (2002), key components of the educational phenomenon and the foundation of our argument. For the analysis of this school content—defined and developed over time as school-level geographical knowledge, and thus forming the core of geographic science in the 19th century—we selected the following indicators:a) the formation of the planet Earth; b) the real and precise dimensions of the planet;

c) the construction of a repository of information about different places; d) cartography and graphic representation; e) the creation of more accurate charts and maps; f) a rational explanation of the world, in contrast to theological views; g) understanding of power structures and the organization of states through territory; h) soil productivity and the location of natural resources; i) population distribution and composition; j) environmental conditions for recognizing, locating, and distributing species; l) the distribution of natural phenomena. By rejecting the idea of a school subject as mere didactic transposition, we conceive of school subjects as relatively autonomous epistemological entities. We shift emphasis away from external decisions and legitimations, turning instead to the school itself, embedding the knowledge it produces within a school culture (JULIA, 2002). School subjects are shaped within this school culture and have specific goals that are often not reducible to those of their academic counterparts. While we cannot deny that a school discipline may originate from an academic tradition, the concept of reference science or didactic transposition is not the only explanation for the construction of a discipline. In fact, the school context is, in many respects, vastly different from the university context—as was the case for Geography from the 19th century until the 1930s. Goodson (1990) argues: "school subjects are often divorced from their base disciplines or may not even have one" (p. 234). Many school subjects, therefore, precede their supposed parent disciplines.

Studies on school subjects emphasize the particularly creative nature of the school institution, as opposed to the mere simplification of scientific knowledge, as Chevallard (1991) proposed. By emphasizing the school, we bring school subjects—and consequently their content—to the forefront, since content is the core element through which subjects are formed. The concern lies in the idea of vulgarization, which strips school subjects of their autonomous existence by assuming that subject formation is merely the result of combining pedagogical methods with scientific knowledge. Rather than linking the history of disciplines to external categories, Chervel suggests focusing on the school itself to discover "the principles of a specific investigation" (CHERVEL, 1990, p. 184). To understand the development of Geography in Brazil without considering the provinces—and by treating Colégio Pedro II as the sole reference—is to ignore the role played by various Brazilian regions in building national history. For this reason, by choosing the school subject of Geography in the provincial schools—especially those in Minas Gerais, which provided the majority of the research sources—I sought to make a theoretical and methodological effort to connect regional and national contexts. This study, as stated earlier, presents a twofold approach: one based on documentary sources that reflect official orientations, and another based on documents generated from pedagogical practices. The research followed a framework consisting of eight aspects: The presence of the subject in school curricula, analyzing how often Geography appeared in official programs, legislation, and public instruction reports; The terminology used for the subject "Geography" and its descriptors; The topics considered part of

Geography and how prescribed content appeared in curricula, textbooks, and programs; The weight given to the subject within school timetables; The explicit and implicit objectives of the subject; The discourses that authorized and legitimized it as a school subject; Teacher training, specifically through public service exams and academic theses; Records of school practices, such as exams, evaluations, and other available documentation. Through a critical historiographical review, we outlined an overview of existing studies that contain key interpretations of the history of this subject and that continue to serve as the primary reference for teachers and researchers. In tracing the history of Geography, I aim to show that, despite a vast literature, significant gaps remain. One such gap lies in understanding that the process of Geography schooling is also a process of institutionalization. This reveals the need for updated analysis, incorporating new sources and diverse research theories and methodologies. References found in tests and exams cite textbooks recommended by curricula and manuals intended for school use. This suggests that the subject was not only present in teaching materials but also played an active role in the literate culture of the Empire. We recognize that Geography education was not confined to Colégio Pedro II and that its development did not result from a simple dissemination of academic or scientific knowledge. On the contrary, it was a gradual process of disciplinarization in which textbook authors and teachers in primary, normal, and secondary schools played a crucial role. This reflects the importance attributed to national territorial knowledge during that period. The significant number of Brazilian-authored Geography textbooks circulating in the Empire during the second half of the 19th century challenges the notion that Geography education in Brazil depended exclusively on foreign authors. The diffuse body of geographic knowledge was being consolidated into a school subject. I emphasize the interactive nature of the subject. These conclusions stem from an exhaustive and meticulous investigation that not only extends the debate around these questions but also advances a stage in the discussion that has been underway for decades.

In this research, I argue that the school-based version of geographic knowledge was not designed to serve a supposedly higher interest through didactic transposition. Rather, geographic knowledge, even in its formative stages, developed into an organized school discipline during the nineteenth century. I also contend that the academic structure of twentieth-century university geography courses was a consequence of the school-based version established in the previous century.

With this perspective, I examined school geography in terms of the school's own objectives and sought to understand the content and pedagogical methods employed—distinct but interconnected elements. According to André Chervel (1990), methods are internal components of teaching and are thus part of the school's overarching educational mission:

> "[...] the entirety of these aims defines the school's educational function. Only a portion of them requires it to deliver instruction. But this instruction is fully integrated into the educational framework that governs the school system, or the particular branch studied. School subjects lie at the center of this structure. Their function is to place instructional content at the service of educational purposes." (p. 188)

Therefore, in studying the history of school disciplines, one must analyze their content and methods in light of their "objective aims," tangible outcomes, and "actual purposes." To grasp these aims, we needed to analyze laws and decrees, official discourses printed in curricula, study plans, and teaching materials. However, it is Chervel himself who urges us to distinguish between official aims and actual purposes. The school does not merely reproduce external knowledge; it appropriates, transforms, and recreates its own knowledge and culture. In doing so, school subjects come into being.

Following Chervel's (1990) guidance, I have given special attention to content, considering that it is the specific content of a subject that differentiates it from others and makes it unique in a historical context. As Chervel puts it:

> "[...] all disciplines, or nearly all, present themselves as a body of knowledge, endowed with internal logic, structured around specific themes, organized into clearly distinct successive stages, and culminating in a few simple and clear ideas." (p.203)

Thus, studying the content of a school subject involves more than examining what is explicitly stated; it requires an investigation into the materials produced during the educational process. Once again, Chervel emphasizes the need to consider a combination of variables that constitute the complexity of school subjects. Among these, he includes classroom exercises, which serve a monitoring function, and final exams, which weigh heavily on the development of the subject.

To determine how geographic knowledge was structured as a school discipline in Minas Gerais in the nineteenth century, I sought to identify the educational purposes, as defined by Chervel (1990), of that knowledge. Specifically, I aimed to identify the goals of geography instruction beyond its role in preparing students for entrance exams to the Empire's academies, as mandated by legislation in 1831. For this purpose, I analyzed the geographic knowledge and content featured in school programs, textbooks, and assessments. The choice of Minas Gerais was due to two key reasons: its significance as one of the leading provinces of the nineteenth century—despite being politically influential, it was treated as subordinate to the imperial court—and its history of urban development. The region's experience with mining and urban life, along with its religious seminaries, led me to believe that geography's presence in Minas Gerais schools was either simultaneous with or prior to that in Colégio Pedro II.

CONCLUSION

Addressing the history of Geography in the Province of Minas Gerais thus entailed repositioning the methodological conceptions behind analyses considered "regional," in the sense that the whole cannot be fully understood without its parts. This approach broadened the understanding of Geography on a national scale, particularly by challenging long-standing conceptions that portrayed school Geography as a by-product of superior, scientific, and academic knowledge. It also destabilized the notion of Colégio Pedro II as the exclusive and pioneering model of excellence in Geography education.

The results of this theoretical and methodological approach questioned dominant interpretations in the field of the history of school Geography.

The breakthrough occurred by shifting the focus away from external influences and simultaneously combining the analysis of prescriptive frameworks with that of school practices. This allowed us to demonstrate that, in Minas Gerais during the 19th century, Geography occupied a prominent place among school subjects. The frequent presence of the discipline was observed across all educational levels—primary, secondary, and teacher training institutions—as evidenced in the many sources examined: tests and exams, in addition to the legislation that legitimized the educational discourse surrounding Geography. Within the school environment, social recognition of the subject was expressed through the knowledge of Brazilian and world territories. This knowledge became synonymous with Geography.

By analyzing school-generated sources, more precise answers emerged to long-standing questions. Perhaps the most important of these was: what content was actually taught in Geography classes at the end of the 19th century?

The data revealed that there was a strong concern with the Geography of Brazil. However, elementary knowledge of geographic science and broad content on universal geography were not neglected.

Content related specifically to the Province of Minas Gerais was also clearly present, especially in teacher training schools and in primary education.

This research found that, to a large extent, content was selected and organized by the teachers themselves—who were also responsible for writing and producing textbooks. It also confirmed that legislation was not the sole determining factor in teaching practices. In many cases, the law simply formalized what society already demanded. In the case of Geography, for instance, practices were already occurring in schools before they were legally established. The presence of Chorography and Cosmography in school content illustrates this point: long before legislation mandated their teaching, they were already part of school instruction.

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THE ART OF READING: THE FORMATION OF THE READER FROM THE PERSPECTIVE OF THE BRAZILIAN NATIONAL COMMON CORE CURRICULUM (BNCC)

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Andréia Pacheco de Almeida[1], Aurora de Castro Pantoja[2], Cindy Izabelle Hage Pantoja[3], Elizete Ferreira Morais Barbosa[4], Nayara Karine Silva de Souza[5], Thácila Mikaellen Mendes da Cunha[6] and Zuziane Ferreira da Rocha[7]

ABSTRACT

The article explores the challenges and possibilities of literature teaching in Brazilian public schools, with a focus on the final years of Elementary Education, particularly within the state school system of Pará. This is a bibliographic and documentary research that draws upon the analysis of the National Curriculum Parameters (PCNs), the National Common Core Curriculum (BNCC), and the Reference Curriculum Document of Pará (DRC/PA). The study connects these official guidelines with theoretical contributions from authors such as Cosson, Lajolo, Kleiman, and Soares. The methodology is based on interpretative content analysis, complemented by data from the Pará State Educational Assessment System (SisPAE). The findings indicate that literature instruction is still largely guided by fragmented practices and a reliance on textbooks, which undermines the development of critical and engaged readers. The marginal position of literature in the curriculum, combined with the reading difficulties identified by SisPAE, reinforces the urgency of integrated pedagogical strategies that promote both critical and aesthetic engagement with literary texts. The article advocates for an approach to literature that preserves its formative and humanizing potential, emphasizing reading practices that involve the school, family, and community. It concludes that literature teaching must be understood as a cultural and political act, essential for citizenship formation, and that it requires investments in public policies, library collections, and teacher training.

Keywords: Literary reader; BNCC; Literary literacy; Basic education; Literature.

[1] Master's students in the Postgraduate Program in Teaching Portuguese Language and its respective Literatures - Pará State University (UEPA)
E-mail: andreia.p.almeida2025@gmail.com
[2] Master's students in the Postgraduate Program in Teaching Portuguese Language and its respective Literatures - Pará State University (UEPA)
E-mail: auroradecastropantoja@gmail.com
[3] Master's students in the Postgraduate Program in Teaching Portuguese Language and its respective Literatures - Pará State University (UEPA)
E-mail: cursoderedacaoprofcindyhage@gmail.com
[4] Master's students in the Postgraduate Program in Teaching Portuguese Language and its respective Literatures - Pará State University (UEPA)
E-mail: prof.elizetemorais@gmail.com
[5] Elementary school teacher.
E-mail: professoranayarakarine@gmail.com
[6] Master's students in the Postgraduate Program in Teaching Portuguese Language and its respective Literatures - Pará State University (UEPA)
E-mail: thacilamendes96@gmail.com
[7] Master's students in the Postgraduate Program in Teaching Portuguese Language and its respective Literatures - Pará State University (UEPA)
E-mail: Zuzianerocha2@gmail.com

INTRODUCTION

The cultivation of readers in Basic Education has remained one of the most persistent and essential challenges in the Brazilian educational field. Amid constant social, technological, and cultural changes, literary reading stands out as a formative practice capable of broadening horizons, developing critical thinking, and promoting literacy in its deepest, most humanizing dimension (Candido, 1995; Cosson, 2009). The Brazilian National Common Core Curriculum (BNCC), ratified in 2017, reinforces this perspective by establishing reading as the structuring axis of Portuguese Language instruction and by emphasizing the appreciation of literature as an aesthetic and formative experience (Brazil, 2017).

The proposal of literary literacy, as advocated by authors such as Cosson (2014) and Coenga (2010), involves not only exposure to canonical texts or the development of technical reading skills but, above all, the immersion of students in meaningful practices that engage sensibility, reflection, and critical appropriation of literary language. This conception aligns with the National Curriculum Parameters (PCNs), which since the 1990s have pointed to reading as a fundamental axis in the formation of students' communicative competence (Brazil, 1997; 1998).

This article aims to discuss the possibilities and challenges of forming the literary reader in the context of Basic Education, based on the orientations of the BNCC and the perspective of literary literacy, articulating theoretical foundations with pedagogical practices that value literature as an instrument for the integral formation of the subject. For this purpose, it draws on contributions from authors such as Bakhtin (1986), Kleiman (1995), Lajolo (1986), and Soares (1999), as well as on official documents and current research that analyze the school's role in democratizing access to reading and in constructing reading subjects.

METHODOLOGY

This study was carried out through bibliographic and documentary research, aiming to analyze the directives, guidelines, and recommendations present in official Brazilian educational documents, such as the National Common Core Curriculum (BNCC) and the National Curriculum Parameters (PCNs). The investigation also relied on a review of academic literature focused on reading instruction and literary literacy in Basic Education.

The theoretical framework was constructed from works by authors who discuss the social function of reading and the role of literature in forming critical readers, such as Bakhtin (1986), Lajolo (1986), Cosson (2009, 2014), and Kleiman (1995, 2000). These scholars were essential for understanding literary literacy as a formative and transformative social practice, as well as for reflecting on literature teaching in diverse school contexts.

Additionally, the research included the analysis of public educational assessment data, such as the results of the Pará Basic Education Assessment System, in order to reflect on students' reading competency levels and their implications for the teaching–learning process. The analysis of these indicators allowed for contextualization of the challenges of functional illiteracy in Brazil, highlighting its impacts on the formation of autonomous, critical readers fully integrated into their social milieu.

The adopted methodology was interpretative content analysis, aiming to identify in the curricular documents and the academic production the main contributions and limitations of proposals related to reading and literature instruction. The interpretative approach enabled a confrontation between the studied literature and the practices suggested in the official documents, allowing for the identification of concrete possibilities and persistent challenges for the consolidation of a literary education that contributes to students' critical, sensitive, and emancipatory formation.

RESULTS AND DISCUSSION

This article analyzes the formation of the literary reader in the public Basic Education network of the state of Pará, specifically in the final years of Elementary Education. The research seeks to demonstrate how reading instruction, in the context of the Literature discipline, is guided by the main official documents: the National Curriculum Parameters (PCNs), the National Common Core Curriculum (BNCC), and the Reference Curriculum Document of Pará (DRC/PA).

The PCNs, published in the 1990s, aim to reformulate teaching across Brazil, seeking to improve the quality of Basic Education. These documents serve as fundamental guidelines for guiding teachers' work in the classroom, offering a basis for organizing pedagogical practices.

The BNCC, in turn, was developed in compliance with the National Education Guidelines and Framework Law (LDB – Law No. 9.394/1996). Its purpose is to steer the curricula of the federal units' educational systems and networks, as well as to guide the pedagogical proposals of public and private institutions from Early Childhood Education through Elementary and High School (MEC, 2017).

The Reference Curriculum Document of Pará (DRC/PA) for the final years of Elementary Education, ratified by the State Education Council, reaffirms the importance of curricular organization in alignment with the BNCC. It highlights fundamental aspects such as Integral Development, Active Learning, and Progression of Learning, prioritizing pedagogical practices that value students' active participation through diverse linguistic and cultural experiences.

Based on the orientations contained in these official documents, we discuss how literature and literary texts are addressed in the final years of Elementary Education. The BNCC establishes that it is essential to "recognize that literary texts belong to the world of the imaginary and present a playful, enchanting dimension, valuing them in their cultural diversity as an artistic heritage of humanity"

(BNCC, 2017, p. 95). This premise highlights the appreciation of the imaginary world that students bring to the school context, providing enriching contact with different cultures.

The formation of the literary reader during schooling is closely linked to the curricular organization into five knowledge areas—Languages, Mathematics, Natural Sciences, Human Sciences, and Religious Education—which must be included in schools' curricula, as established by the BNCC (2018). Although each area preserves its particularities, Opinion CNE/CEB No. 11/2010 emphasizes the importance of integrating knowledge across different curricular components, considering each school phase's pedagogical demands and the characteristics of its students.

The school's role in the formation of the reader is essential from the earliest years of schooling. Reading practice, more than mere decoding of alphabetic signs, allows students to expand their understanding of the world, connecting personal and collective experiences with the social context in which they are inserted.

According to Soares (1999), literacy is the condition of one who not only knows how to read and write but also practices and values the social use of writing. Thus, mere alphabetization is not sufficient for an individual to master the reading and writing practices of their social milieu. For Cosson (2009), literature must be taught in school as a social practice. He argues that:

> "Literary literacy is a social practice and, as such, the school's responsibility. The question is not whether the school should or should not school literature, as Magda Soares rightly alerts us, but rather how to do so without stripping it of its character, without turning it into a simulacrum of itself that negates more than it affirms its power of humanization" (Cosson, 2009, p. 23).

Thus, the schooling of literature must maintain its essence, preserving its power of transformation and humanization in the educational context. Considering the importance of the relationship among Literature, human formation, and language study, one understands the humanizing role that Literature teaching exercises in forming the reader, whose objective is to become fully literate. Given that, in schools, activities involving reading and writing form the basis of learning from the earliest grades, it is essential that all students have access to these practices to reach the level of a competent reader.

In Pará, the Pará State Educational Assessment System (SisPAE), implemented in 2013, serves as an important instrument to diagnose students' learning levels and guide public educational policies. Recent SisPAE data indicate that, despite advances, a large portion of students in the final years of Elementary Education still exhibit difficulties in critical reading and text interpretation, reflecting challenges similar to those observed nationally.

These results show that many students do not reach the basic competencies expected for their school stage, especially concerning literary reading, which directly impacts the formation of the reader as both consumer and critic, as oriented by the BNCC. This underscores the need for more effective

pedagogical practices that go beyond decoding and promote contact with cultural diversity and sense-making in literary texts.

The PCNs determine that the text must be the primary object of language study, valuing its artistic and cultural dimension; however, the reality in schools shows that work with literature remains fragmented and subordinated to textbooks, limiting the transformative potential of literary teaching.

The absence of Literature as a central discipline in Pará's school curriculum reinforces this weakness, creating gaps that compromise the formation of critical and autonomous readers. To reverse this scenario, it is imperative that schools promote actions encouraging literary reading, using libraries, collections, reading groups, and projects involving students, teachers, and families.

Moreover, SisPAE plays a fundamental role not only in assessment but also in indicating paths for improving pedagogical practices by identifying students' main difficulties. This enables the creation of more targeted strategies to strengthen reading formation, especially in the context of literary reading, which must be expanded and valued to ensure quality, inclusive, and humanizing education.

FINAL CONSIDERATIONS

The analysis of the formation of the literary reader in Pará's public education network, especially in the final years of Elementary Education, highlights the importance of Literature teaching as an essential component for students' integral development. From official documents such as the PCNs, the BNCC, and the DRC/PA, it is evident that literature must be valued not merely as a decoding exercise but as a social and cultural practice that humanizes and broadens students' critical outlook on the world.

SisPAE data reveal that many students still face difficulties in basic reading competencies, demonstrating that educational policies need constant evaluation and adjustment to ensure the effective formation of critical and engaged readers. It is essential that pedagogical practices transcend the fragmented, utilitarian use of textbooks, fostering school environments rich in textual diversity, shared reading, and social interaction.

The school has the irreplaceable role of articulating literature with students' everyday lives, encouraging engagement with different cultures and texts that stimulate imagination and critical thinking. In this regard, strengthening libraries, reading projects, and continuous teacher training are indispensable strategies to achieve better results.

Furthermore, the articulation between school and family should be fostered so that reading becomes a living, continuous practice, expanding students' cultural repertoire and contributing to the formation of autonomous, conscious citizens.

Thus, it is reaffirmed that the formation of the literary reader must be understood as a dynamic process requiring the active participation of the entire school community and public policies committed to

educational quality. The challenge is to ensure that Literature teaching retains its humanizing essence and constitutes a fundamental instrument for knowledge construction and social transformation.

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THE CHALLENGES, LIMITS, AND POSSIBILITIES OF INCLUDING NEURODIVERGENT STUDENTS IN SCIENCE AND BIOLOGY EDUCATION IN THE MUNICIPALITY OF CAJAZEIRAS - PIAUÍ - BRAZIL

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Flávia Dallyne Pereira Lima da Silva[1], Lucas Costa da Silva[2], Maria Gardênia Sousa Batista[3] and Nancy Nayra Coutinho Freitas Marques[4]

ABSTRACT

Brazilian legislation ensures that all individuals must have access to the regular education system, including neurodivergent individuals. This study aims to analyze the inclusion of neurodivergent students in science and biology education in regular public state schools in the city of Cajazeiras, Piauí. This research is exploratory, applied, and qualitative in nature, aiming to understand the dynamics, behaviors, and interactions within the educational environment. This methodology was chosen to achieve direct immersion in the context studied, allowing for the capture of nuances that other forms of data collection might not reveal. The results will be presented in word clouds created through Tagul and subsequently critically analyzed based on the researcher's personal observation and perception. The inclusion of neuroatypical students in science and biology education in the city of Cajazeiras, Piauí, presents a complex scenario, full of challenges, but also vast possibilities. For this inclusion to be effective, it is essential that schools and educators be prepared to adapt methodologies, materials, and the learning environment itself. One of the main challenges lies in teacher training.

Keywords: Inclusion; Neurodivergent; Science and Biology Teaching; Piauí.

[1] Graduate student of Biological Sciences
through the Institutional Program for the Promotion and
Induction of Innovation in Initial and Continuing Training of
Teachers and School Principals – PRIL - UESPI- Simões - Piauí - Brazil
[2] Graduate student of Biological Sciences
through the Institutional Program for the Promotion and
Induction of Innovation in Initial and Continuing Training of
Teachers and School Principals – PRIL - UESPI- Simões - Piauí - Brazil
[3] Professor, PhD in the Biological Sciences Program
Universidade Estadual do Piauí (State University of Piauí) - UESPI
LATTES: http://lattes.cnpq.br/118410980618896
ORCID: https://orcid.org/0000-0001-8281-1277
[4] Professor, Master. Biologist. Psychologist
Faculdade Malta e Três Marias
SEDUC-PI: Piauí State Department of Education
Maranhão State Government Department of Education
E-mail: skinnernancynayra@gmail.com

INTRODUCTION

In the hope of meeting the needs of a group of individuals who have gained social visibility through their struggles for accessibility, education has been moving toward a reformulation of traditional teaching. Experiences of success and school challenges are based on the expectation of training professionals prepared for an egalitarian world, where social obstacles imposed by prejudice are overcome (Gadotti, 2000).

Based on this, the Brazilian National Common Curricular Base (BNCC) recognized that Basic Education aims to form the human being in an integral manner, implicitly opposing a purely cognitive view. This educational innovation adopts a pluralistic stance, encompassing various aspects of students' lives, recognizing them as individuals capable of learning through the embrace of their particularities and diversities for full and integral development (Brazil, 2015, p. 16).

In this context, the school must be a learning institution with a democratic and inclusive vision, having the duty to confront and act against discrimination and prejudice, embracing empathy for differences and diversities (Brazil, 2015, p. 16). In Brazil, the Brazilian Law for the Inclusion of Persons with Disabilities (Law No. 13.146), enacted in July 2015, provides for access to inclusive education capable of developing sensory, cognitive, social, and physical skills for neuroatypical students.

According to Ortega (2009), neurodiversity must be understood as human subjectivity and not as a disease. Based on this premise, individuals with Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), dyslexia, dyscalculia, among others, must be seen as unique subjects, as advocated by the BNCC.

Although research highlights the benefits of inclusion, this topic still presents challenges, especially regarding curricular adaptations suited to the specific needs of neuroatypical students, particularly in biology teaching practices. According to Carvalho (2018), inquiry-based teaching is a method capable of providing plausible means of learning, as it positions the student as a thinking and critical subject in the process, enabling argumentation, knowledge construction, and content assimilation.

The school is a social setting for interaction among individuals, with the duty to socialize knowledge and provide conditions, based on legislation, for the construction of comprehensive education for all.

Based on this, tests or activities applied to students requiring educational support should not be the same for all students in the classroom, often pre-made and available on question bank websites. Instead, they should consider educational specificities and be adapted to break the paradigm of traditional education, offering access possibilities to inquiry-based biology teaching.

According to Vilaronga, Mendes, and Zerbato (2016), traditional education is inefficient as it replaces a curriculum that should be accessible with a challenging learning process lacking support for

educational specificities. Therefore, when teachers encounter neurodivergent students in their classrooms, they must enrich their knowledge regarding the necessary curricular adaptations for the teaching-learning process. Seeking inclusive strategies, regardless of the condition, yields positive results in the educational process for all students.

The absence of this individualized attention from teachers toward neuroatypical students may be related to excessive workload, as well as classrooms filled with students with low academic performance and diverse/specific learning conditions (Vilaronga; Mendes; Zerbato, 2016). However, continued teacher training, an efficient organizational culture, and the presence of public policies recognizing inclusive education as a right are determining factors for neurodivergent students to be part of a fairer and more equitable society, enabling them to reach their highest potential.

According to Odom and Wong (2015), effective pedagogical practices result from activities involving interventions combined with collaborative classroom participation. Teachers must be attentive to goal setting, assertive communication, task adaptation, and most importantly: accepting the student as a capable individual, part of the learning process, requiring an Individualized Educational Plan (IEP) based on educational specificities. Ponte (2002) adds that even when teachers promote reflective pedagogical practices, the use of structured approaches yields satisfactory results that go beyond teaching, learning, and assessment for neurodivergent students.

Given the above, for neuroatypical students to actively participate in society with constitutionally guaranteed rights, a social and educational reform is necessary. One of the major challenges faced in Basic Education institutions is the lack of curricular adaptation and flexibility, as well as individualized pedagogical practices in biology teaching, as advocated by the National Policy on Special Education (PNEE) from the perspective of Inclusive Education (Brazil, 2001).

Therefore, biology teachers, in their pedagogical practices, must become mediators of the teaching-learning process, capable of including all students through feasible strategies and curricular adaptations, such as: developing inclusive pedagogical materials for biology teaching, referring students to learning support in Specialized Educational Services (AEE), adapting tests and content, providing individualized attention, among others.

This study presents a report on the challenges, limits, and possibilities in the inclusion of students with disabilities in science and biology education in schools in Cajazeiras – Piauí.

METHODOLOGY

The methodology employed for the development of this research was based on personal observation in classrooms in the city of Cajazeiras – Piauí. This qualitative approach was used to understand the dynamics, behaviors, and interactions within the educational environment. This

methodology was chosen to allow for direct immersion in the studied context, enabling the capture of nuances that other data collection methods might not reveal.

The results will be presented through word clouds created using **Tagul** (https://wordart.com/create), followed by a critical analysis derived from the researcher's personal observation and perception.

RESULTS AND DISCUSSION

The results of this research were obtained through personal observation. Figure 01 visually presents the most recurring themes. Patterns of frequency and central ideas that emerged from the observations are identified. Through the word cloud, qualitative data are presented in a clear visual representation, where the words that appear most frequently in the observation notes (and therefore are larger in the cloud) represent the most prominent concepts, objects, actions, or characteristics observed in the classroom.

Figure 01: Cloud of Observed Words in the Classroom. (in Portuguese)

Source: Authors, 2025.

Key terms include knowledge, practice, respect, teaching for all, diversity, difficulties, potentialities, prejudice, needs, resources, family, experience, adequate training, inclusive environment, attitudinal barriers, disabilities, disorder, materials, and challenges. Word size reflects term frequency.

It can be observed that the greatest challenge in promoting adapted biology teaching is related to numerous aspects, among which the lack of teacher training stands out—identified here as knowledge—both initial and continuing, combined with the obstacles faced in accessing the regular curriculum (Oliveira, 2020).

The need for practical activities was also identified. In biology, the teacher must be capable of conducting investigative teaching with students with ASD, using, for example, hyperfocus and encouraging a desire to learn more in a specific area of interest. This demonstrates that teaching practices can be inclusive, keeping students motivated and engaged in the learning process. In this way, with more individualized and specific support, autonomy can be achieved (Ribeiro; Cristovão, 2018). From this perspective, Oliveira et al. (2020) showed that during Specialized Educational Assistance (AEE), investigative science teaching fostered engagement and motivation during classes.

Given this context, it is necessary to have an education in which teachers are capable of including students with ASD, ADHD, dyslexia, dyscalculia, etc., in a teaching scenario with equity, for scientific literacy, with equal conditions for access and permanence in school through the Individualized Educational Plan (IEP) for the biology discipline, so that they can articulate knowledge and experiences in accordance with the curriculum for each grade level. From this perspective, Couto (2005) emphasizes that the educator is the key to initiating educational reform processes, in which the main tool is continuing education, making them prepared to work with the complexity of teaching.

According to Figueredo (2002), inclusive education requires a flexible school for all students, offering quality education that respects differences and diversity. This educational institution must expand its political stance, reclaiming the idea of equity in schools.

Regarding the social function of the school, Libâneo (2004, p. 47) states:

> "The main social and pedagogical function of the school is to ensure the development of cognitive, operational, social, and moral capacities through its commitment to curriculum dynamization, the development of thinking processes, participatory citizenship formation, and ethical education."

Based on this, we consider the importance of qualified biology teachers who can articulate essential knowledge and experiences for the construction of a systematized inquiry-based teaching that includes neuroatypical students in the school environment. Thus, the inclusion of these individuals in inquiry-based teaching allows students to become protagonists of their learning, becoming critical, reflective, and argumentative in the process of constructing their knowledge (Carvalho, 2013).

CONCLUSION

The inclusion of neuroatypical students in science and biology education in the city of Cajazeiras – Piauí presents a complex scenario, full of challenges but also vast possibilities. For this inclusion to be effective, it is essential that schools and educators be prepared to adapt methodologies, materials, and the learning environment itself. One of the main challenges lies in teacher training. Many professionals do not feel confident or qualified to deal with the diversity of needs of students with disabilities. The lack of

knowledge about different disabilities and appropriate pedagogical strategies can lead to a poorly inclusive education, where students with disabilities are marginalized from activities. Another critical point is accessibility. This goes beyond the physical structure of the school (ramps, adapted restrooms) and includes the accessibility of educational materials. Braille texts, audio materials, videos with subtitles and sign language (Libras), and adapted software are essential to ensure that all students have access to content. The lack of financial resources to acquire or adapt these materials is a significant barrier, especially in public schools. Curricular adaptation is an ongoing challenge. It is necessary to plan lessons that are challenging for all students, without excessively simplifying content for students with disabilities, but also without ignoring their difficulties. This requires an individualized approach for each student, understanding their potential and limitations.

Additionally, resistance from some members of the school community, including parents of students without disabilities, can hinder the inclusion process. Prejudice and misinformation remain barriers to be overcome. The limits of inclusion are often tied to the challenges themselves. The lack of adequate human and material resources is a significant constraint. Without support professionals (sign language interpreters, caregivers, mediators), full inclusion becomes unfeasible for some students.

The rigidity of the educational system, which often prioritizes standardization over individualization, also imposes limits. The pressure for results in standardized assessments can lead to neglect of the specific needs of students with disabilities. In cases of severe and multiple disabilities, the limit may be imposed by the need for much more specialized support, which regular schools are not always equipped to fully provide. In such cases, collaboration with health and social assistance services is crucial. Despite the challenges and limits, the possibilities for inclusion in science and biology education are vast and enriching for all involved. Inclusion promotes the development of socio-emotional skills in all students. Living with diversity teaches empathy, respect, and collaboration. Students without disabilities learn to value differences and support their peers, while students with disabilities develop autonomy and self-esteem. The need to adapt teaching stimulates teachers' creativity and pedagogical innovation. In seeking new ways to present content, educators may discover methodologies that benefit not only students with disabilities but the entire class. The use of visual, tactile, and experimental resources, for example, can make science and biology classes more engaging and accessible for everyone. Inclusion paves the way for personalized teaching, recognizing that each student learns at their own pace and in their own way. This leads to more flexible and adaptable teaching that values individuality. For neuroatypical students, inclusion in science and biology education provides access to scientific knowledge, which is fundamental for understanding the world and exercising citizenship. They can develop critical thinking, participate in experiments, and explore the fascinating universe of life and nature. The inclusion of students with disabilities in science and biology education is not merely a matter

of complying with the law, but of recognizing everyone's right to education and enriching the learning environment through diversity.

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AFFECTIVE RELATIONSHIPS IN THE CLASSROOM AS MOTIVATIONAL FACTORS FOR LEARNING BIOLOGY CONTENT

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Jamira Camanda Ribeiro Carvalho[1], Maria do Socorro Silva Carvalho[2] and Maria Gardênia Sousa Batista[3]

ABSTRACT

Affection is an indispensable element in human relationships and plays a decisive role in the teaching-learning process. Research shows that the affective aspect directly influences students' intellectual and emotional development, impacting their motivation, interest, and academic performance. Emotions, interpersonal bonds, and the school environment play a fundamental role in the development of individuals. Thus, the relationship between teacher and student, based on respect, dialogue, and empathy, contributes to a more welcoming and meaningful educational environment. This work argues that integrating the affective dimension into the school environment is essential for building a more humane and effective pedagogical practice, promoting the integral development of students.

Keywords: Affection; Teaching-learning; Interpersonal relationships; Emotions; Humanized education.

[1] Graduate student of Biological Sciences
through the Institutional Program for the Promotion and
Induction of Innovation in Initial and Continuing Training of
Teachers and School Principals – PRIL - UESPI- Simões - Piauí - Brazil
[2] Graduate student of Biological Sciences
through the Institutional Program for the Promotion and
Induction of Innovation in Initial and Continuing Training of
Teachers and School Principals – PRIL - UESPI- Simões - Piauí - Brazil
[3] Professor, PhD in the Biological Sciences Program
Universidade Estadual do Piauí (State University of Piauí) - UESPI
LATTES: http://lattes.cnpq.br/118410980618896
ORCID: https://orcid.org/0000-0001-8281-1277

INTRODUCTION

Affection is indispensable in human relationships, and the teaching-learning process is no exception. According to Oliveira (1998), the affective aspect profoundly influences intellectual development, potentially accelerating or slowing it down, and determining which content the intellectual activity will focus on. Based on this, affection acts as a facilitating and influencing element in the student's learning process within the classroom. Thus, "the affection between educator and learner is like a seed sown in fertile soil: it germinates with surprising speed and produces quality fruits" (BONFIM, 2011, p. 9). In other words, the way the teacher teaches, behaves, and works greatly impacts the evolutionary process and outcomes of their students."One sees clearly only with the heart. What is essential is invisible to the eye." This quote from The Little Prince by Antoine de Saint-Exupéry, although not directly about education, highlights the importance of sensitivity and affection, which are essential to the educational process.

According to Paulo Freire (1987), education is not a purely cognitive process but one that involves the whole person, including emotions, feelings, and values. He argued that education should be a liberating practice, enabling students to develop their creativity and critical capacity, and helping to build a more just and egalitarian society. From this perspective, a fundamental aspect that has gained prominence in the educational landscape is the role of affective relationships in the classroom. These relationships, which encompass positive and constructive interactions between teachers and students, as well as among students themselves, are crucial for creating a motivating and welcoming learning environment. The quality of these interactions can directly influence students' motivation, impacting their performance and attitude toward curricular content.

For Piaget, affectivity is a psychological state directly or indirectly linked to factors such as environment, interpersonal relationships, family, professional, and social settings. This psychological state directly influences behavior and the affective and cognitive development of individuals (GIMENEZ et al., 2021). Piaget also states that "affectivity is always interconnected with all moments lived by each being, which is diametrically reflected in feelings, values, stimuli, choices, emotions, states of tranquility, health—in short, in all emotional and physical fields of life" (GIMENEZ et al., 2021, p. 248).

According to Humberto Maturana, "Emotions are not correctly called feelings. From a biological standpoint, what we denote when we speak of emotions are dynamic bodily dispositions that define the different domains of action in which we move. When we change emotion, we change our domain of action." In this way, we observe how emotional factors and affinity are directly linked to the progress or regression of students. Fear, insecurity, or other social and family conflicts affect each individual differently, depending on their lived experiences, and it is innate to human beings to undergo such

reactions. However, when these are brought into the classroom and the teacher knows how to perceive and act differently, seeking affinity, they ensure the development of that individual in their subject.

Having emotional reactions is interesting because it keeps us vigilant and attentive. On the other hand, emotions can be harmful, leading to anxiety and prolonged stress, negatively interfering with the educational process (COSENZA; GUERRA, 2011). The school also plays a role in addressing affective factors with students, making it necessary to discuss this topic within the school environment. There are various ways teachers can assist students in this regard, both through interventions on the topic and in the organization of their content (TASSONI; SILVA-LEITE, 2011).For Wallon—a philosopher, physician, and psychologist—the school is a fundamental institution that enables individuals to learn principles of scientific culture, valuing relationships between teacher and student and the development of their potential. He guided his theory toward the development of the whole person, bringing psychology and pedagogy closer together to value the training of educators and promote educational environments conducive to the growth of learners in all aspects (SILVA, 2017).

From this perspective, it is worth highlighting Bronfenbrenner's intrinsic relationship with developmental psychology and the theory of the human development ecosystem. To understand this approach, he considers development a reciprocal process resulting from the interaction of various systems that compose it (BRONFENBRENNER, 1979). Thus, the transition between each of these environments and the relational quality established within them influences the developmental trajectory.

Analogously, it is irrefutable to emphasize the importance of this study within this research and for society as a whole. The way a student is treated in the school environment, especially in the classroom, is key to their performance. The individual must be emotionally understood to thrive—even the most restless or uncontrollable student may carry emotional burdens that need to be addressed beyond the academic content. Consequently, the environment influences, but coexistence determines. Therefore, it is essential for teachers to be equipped to understand and emphasize this issue, as it is indispensable for educational development and for building a better society.

According to Mahoney (ALMEIDA, 2005), the school is the medium for the development of both student and teacher, and the teacher-student relationship is a determining factor in the teaching-learning process, as both are affected by each other and by the environment in which they are situated. Furthermore, no knowledge, even that acquired purely through perception, is a simple copy of reality or entirely determined by the individual's mind. It is the product of an interaction between subject and object, provoked by the organism's spontaneous attitudes and external stimuli. This knowledge is, therefore, learning—the result of a relationship that never has a single direction, but is the outcome of interaction. And affectivity is the energy that drives human actions; without it, there is no interest and no motivation for learning (PIAGET, 1996, Apud GARCIA, 2014).

From this understanding—that affectivity is among the essential elements for human development—this bibliographic research was conducted to investigate the relationship between teachers' behavior in the classroom and students' motivation to study Biology content.

METHODOLOGY

A bibliographic survey was conducted via the Internet, seeking data from various Higher Education Institutions across the country, as well as databases from governmental organizations and professional associations. To carry out the search, keywords such as affectivity in biology teaching were used in order to identify works related to the topic. We selected research published in the form of theses, dissertations, scientific journal articles, and books, covering the period from 2000 to 2024.

Subsequently, after selecting the documents, we proceeded to classify them. The classification was based on criteria established from the document set and using descriptors employed in similar research, such as: year of publication; academic program; disciplines involved; grade level, educational cycle or stage; and main topics addressed. For this purpose, abstracts of the studies were read and, when necessary, the full content of the works was reviewed.

The work presented here is characterized as a bibliographic research of the state-of-the-art type. This genre of academic work involves research aimed at inventorying, systematizing, and evaluating the production in a specific area of knowledge. It entails identifying works produced in the field, selecting and classifying documents according to criteria and categories aligned with the researcher's interests and objectives, describing and analyzing the characteristics and trends of the material, and evaluating its main results, contributions, and gaps (MEGID NETO, 1999).

After data collection, the information obtained from the questionnaires was transcribed into Microsoft Word and Microsoft Excel programs, with the intention of assisting in the construction of a table used in the results and discussion section of this research.

RESULTS AND DISCUSSION

> "[...] affectivity represents the energetic source that mobilizes intelligence without altering it, just as a car's fuel causes the engine to function without modifying the machine."
> SARMENTO, 2013

From the studies conducted in this research, it was observed that learning requires two characters (the teacher and the learner) and a bond established between them (FERNANDEZ, 1991). We believe that we do not learn from just anyone; we learn from those to whom we grant trust and the right to teach. Paulo Freire (1996) already warned that "education is an act of love and courage," and that the dialogical

relationship between educator and learner is essential for true learning. The configuration of learning requires the presence of a peculiar nutrient: affectivity, which mobilizes the learner's pre-existing cognitive conditions (PIAGET, 1954).

> "From the moment students begin to trust the teacher, it is undeniable that learning performance will improve. Thus, bonds of respect and responsibility are created, driven by a meaningful exchange, where both parties engage in the pursuit of a common goal."
> Amorelli (2004)

Table 01 presents a synthesis of the results found in this research, followed by a discussion on affective relationships in the classroom as motivational factors.

Table 01 – Documents Analyzed

Title	Authors	Origin	Year	Summary	Source
AFETIVIDA DE NO PROCESSO ENSINO APRENDIZAGEM DE CIÊNCIAS E BIOLOGIA. [Affection in the Teaching-Learning Process of Science and Biology]	FRANÇA, Carolina T. S.	Institutional Repository of UFPB	2023	This research enabled an analysis of the importance of affection in the science and biology teaching process, contributing to a broader understanding of the role of affection in teaching-learning. It emphasizes the need to consider students' emotions and invest in teacher training that values the construction of positive affective relationships in the classroom.	https://repositorio.ufpb.br/jspui/handle/123456789/27311?locale=pt_BR
AFETIVIDADE E GOSTO PELA CIÊNCIA NO ENSINO FUNDAMETAL: O QUE DIZEM OS PROFESSORES DE CIÊNCIAS. [Affection and Interest in Science in Elementary Education: What Science Teachers Say]	ROSA, Cleci T.W. PACHECO, Julia N. DARROZ, Luiz, M.	V. 24 N. 72 (2023): TEIAS MAGAZINE N 72	2023	This study investigates the presence of affective elements in the daily lives of 10 science teachers in elementary education through semi-structured interviews with 10 questions. These questions	http://educa.fcc.org.br/scielo.php?script=sci_arttext&pid=S1982-03052023000100233

				address academic background, professional practice, classroom structure, perceptions of science teaching and its goals, the importance of affective dimensions during lessons, and student motivation.	
EMOÇÕES E AFETIVIDADES: IMPLICAÇÕES E PERSPECTIVAS NO ENSINO DE BIOLOGIA. [Emotions and Affection: Implications and Perspectives in Biology Teaching]	RODRIGUES, Antonia R. S. FRANÇA-NETO, Aldair SOBREIRA, Alana C. M. EDSON-CHAVES, Bruno.	Educar Mais Magazine	2021	This study aims to highlight the emotional and affective aspects directly involved in the teaching-learning process. The research was conducted specifically with biology teachers in public basic education, emphasizing that for student learning to be increasingly effective, teachers must be attentive to all important factors in the teaching-learning process, whether curricular, pedagogical, or emotional.	https://educacaopublica.cecierj.edu.br/artigos/20/41/afetivida- de-no-processo-de-aprendizagem
A AFETIVIDA- DE NO ENSINO DE CIÊNCIAS: UM ESTUDO EM UMA ESCOLA PÚBLICA. [Affection in Science Teaching: A Study in a Public School]	MENDES,Patrícia, P. MOREIRA, Maria C. A.	Práxis Magazine, v. 15, n.29	2023	The study investigated the influence of affection in teaching and learning processes among elementary students, who were protagonists of activities developed by	https://revistas.unifoa.edu.br/praxis/article/view/4350

				themselves and the researcher-teacher. The theoretical framework included Wallon and Vygotsky. The qualitative research was based on participant observation in the teaching of fungi and plants. Results showed increased student participation and improved affective relationships, leading to a more harmonious and caring classroom environment.	
A AFETIVIDADE NA RELAÇÃO PROFESSOR-ALUNO: UM ESTUDO DE CASO VOLTADO PARA O ENSINO DE BIOLOGIA. [Affection in the Teacher-Student Relationship: A Case Study Focused on Biology Teaching]	CARPIM, Camila S.	UFES - Federal University of Espírito Santo	2014	The affection manifested in the teacher-student relationship is an inseparable element of the knowledge construction process and is highly important for the quality of teaching-learning. This case study aimed to investigate the affective relationship between high school students at a public school in Vitória, Espírito Santo, and their biology teacher. It is considered essential for both teachers and school administrators to recognize and incorporate affection in pursuit of a more supportive school	https://labec.ufes.br/sites/labec.ufes.br/files/field/anexo/TCC CAMILA - FINAL.pdf

				environment that meets students' needs.	
A AFETIVIDADE E O CONVÍVIO EM SALA DE AULA: FATORES QUE INFLUENCIAM NA INTERAÇÃO PROFESSOR- ALUNO E NO PROCESSO DE ENSINO APRENDIZAGEM [Affection and Classroom Interaction: Factors Influencing Teacher-Student Relationships and the Teaching-Learning Process]	DINIZ, Jean Carlos A. SILVA, Regisnei A.O.	Federal Institute of Goiás	2011	This study analyzes the teacher-student relationship, considering factors that may affect social interaction in the classroom and identifying elements that contribute to positive relationships. The research was conducted with high school students and science/biology teachers at a state school in Jataí – Goiás, using focus groups. Results highlight factors that foster good relationships, such as mutual integration and emotional engagement, as well as clear boundaries.	https://periodicos.ifg.edu.br/index.php/semlic/article/view/345
HABILIDADES SOCIOEMOCIONAIS E AFETIVIDADE NO ENSINO DE CIÊNCIAS E BIOLOGIA: PESQUISAS E REFLEXÕES [Socioemotional Skills and Affection in Science and Biology Teaching: Research and Reflections]	PAGAN, Alice A. ARAÚJO, Yzila L.F.M.	Publishing House UFS	2019	This book seeks to understand cognitive work in a broader sphere that encompasses the whole human being. It proposes a reflection on affective discourse in science and biology teaching, presenting research that points to the potential of socioemotional skills in building a didactic approach aimed	https://www.livraria.ufs.br/produto/habilidades-socioemocionais-afetivida- de-no-ensi- no-de-ciencias-e-biologia-pesquisas-e-reflexoes/

				at forming individuals more connected to nature, both cognitively and affectively.	
O VÍNCULO AFETIVO NA RELAÇÃO PROFESSOR-ALUNO E SEUS EFEITOS NO PROCESSO DE APRENDIZAGEM EM BIOLOGIA. [Affective Bond in the Teacher-Student Relationship and Its Effects on the Biology Learning Process]	CAMARGO, Pâmela P.	LUME Repository, UFRGS	2017	This research aims to verify the presence or absence of affection in teacher-student relationships and whether these relationships influence student learning. The hypothesis confirms this influence.	https://lume.ufrgs.br/handle/10183/180458
AS RELAÇÕES AFETIVAS NA SALA DE AULA COMO FATORES MOTIVACIONAIS PARA A APRENDIZAGEM DOS CONTEÚDOS DE BIOLOGIA [Affective Relationships in the Classroom as Motivational Factors for Learning Biology Content]	PAULA, Ana Luiza N.B. CUNHA, Ana Maria de O.	USP - The University of São Paulo	2001	After presenting educators' arguments on the importance of considering affective aspects for successful student learning, this study investigates the relationship between teachers' behavior in the classroom and students' motivation to study biology. A direct relationship was observed between a pleasant classroom atmosphere, fostered by the teacher's kindness, and students' motivation to engage with the subject.	https://fep.if.usp.br/~profis/arquivo/encontros/enpec/iiienpec/Atas em html/o26.htm
A RELAÇÃO PROFESSOR- ALUNO	CARMIANATTI, Bruna.	LUME	2018	This research explores two under-	

E SUA INFLUÊNCIA NOS PROCES-SOS DE ENSINO E APRENDIZAGEM DE CIÊNCIAS NO ENSINO MÉDIO. [Teacher-Student Relationship and Its Influence on Science Teaching and Learning in High School]		Repository, UFRGS		investigated themes: affection and the teacher-student relationship. It incorporates elements from common themes and is grounded in cognitive and sociocultural theories, which posit that students are active participants in teaching and learning processes and learn through social interaction.	https://lu-me.ufrgs.br/hand-le/10183/188240
A AFETIVIDA- DE E RELAÇÃO PROFESSOR-ALUNO: CON-TRIBUIÇÃO DESTAS NOS PROCESSOS DE ENSINO E DE APRENDIZA- GEM EM CIÊN- CIAS NO ENSI- NO MÉDIO. **[Affection and Teacher-Student Relationship: Their Contribution to Science Teaching and Learning in High School]**	CARMINIATTI, Bruna. PINO, José C.D.	Investigações em Ensinos de Ciências - V24 (1), pp, 122-138, 2019 Investigations in Science Teaching, Vol. 24 (1), pp. 122–138	2019	This article presents a segment of a doctoral research project, discussing teachers' perceptions of the influence of affection and the teacher-student relationship on science teaching and learning in secondary education, relating these to other influencing factors.	https://scholar.goo-gleuser- con-tent.com/scho-lar?q=ca-che:i5dEa-oxFYVcJ:scholar.goo-gle.com/+a+afetivida-de+e+re-la%C3%A7%C3%A3o+profes-sor-alu-no:+contri-bui%C3%A7%C3%B5es++&hl=pt-BR&lr=lang_pt&as_sdt=0,5

Source: Authors, 2025.

FINAL CONSIDERATIONS

> "I miss work because I'm exhausted. I think being a teacher means being truly involved with the profession, with the students, and that generates a physical and mental burden greater than a human being can bear. It's very psychological, you know? I go to therapy once a month, I have to see a psychiatrist, because it's too much. You get involved with the students' problems and there's not always a return. Sometimes you enter the classroom and are poorly received, because the teacher is still seen as the enemy. There's a chasm between teacher and student, teacher and principal. It feels like no one understands each other. [...] The role of the teacher in society is very important, but no one recognizes that. When the professional is abandoned, they tend to abandon as well. We lose our dignity. We're forced to accept many things, and that impoverishes us spiritually. [...] The State leaves everything neglected. No one wants to know how the class is going. Everything is covered up. You can't give a failing grade without justifying it with a document. So, to avoid that work, they just give a passing grade. Move on. Everyone is tired of hearing about the problems in education, but no one does anything."
> (Pro Dia Nascer Feliz, 2005)

This study, by analyzing the state of the art on affective relationships in the classroom, highlighted the importance of these interactions as fundamental elements for student motivation and engagement, especially in the learning of biology content.

The reviewed works indicate that the affective bond between teacher and student significantly contributes to building a more welcoming, participatory, and meaningful school environment. It was found that affection in the pedagogical relationship is not limited to an emotional aspect but is directly related to valuing the student as an active subject in the educational process.

Teachers who demonstrate empathy, respect, and active listening tend to inspire greater interest and trust in students, promoting not only the learning of biological concepts but also critical and human development.

Despite the relevance of the topic, further investigations are needed to deepen this relationship in the specific context of biology, considering the challenges faced by teachers in different school realities.

It is concluded, therefore, that investing in affective pedagogical practices is a promising path to making biology teaching more meaningful and motivating. It is hoped that this work contributes to expanding reflection and fostering new studies that value affectivity as an essential pedagogical tool in the formation of more conscious, critical, and sensitive individuals toward knowledge and life.

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THE SINGULARITY OF NEUROPLASTICITY IN THE GIFTED: HOW INCLUSIVE EDUCATION CAN TRANSFORM POTENTIALS INTO ACHIEVEMENTS

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Vanessa Roda Pavani Mello[1]

ABSTRACT

This article aimed to analyze how the uniqueness of neuroplasticity manifests itself in gifted individuals and how this influences their educational development. Methodologically, an integrative literature review was conducted based on recent neuroscientific studies, using as primary reference neuroimaging research (fMRI and PET) and analyses of the specialized literature on giftedness. The findings demonstrate that gifted individuals possess a superior capacity for brain reorganization, especially evident in areas related to logical reasoning, creativity, and complex problem-solving. These neurobiological characteristics allow them to adapt more quickly and effectively to cognitive challenges. In conclusion, the study highlights that such scientific evidence demands changes in traditional pedagogical practices. It was concluded that inclusive education for gifted individuals must go beyond mere curricular adaptation, incorporating innovative pedagogical approaches and environments that continually promote intellectual challenges compatible with high neurocognitive capacity. Furthermore, the urgency of specific public policies is emphasized to ensure the early identification and comprehensive development of these students, contributing to their unique capabilities being explored to the fullest.

Keywords: Neuroplasticity; Giftedness; Inclusive Education; Cognitive Development; Educational Policies.

[1] Postgraduate in Neuroscience, Institutional and Clinical Psychopedagogy with an emphasis on inclusion from Uniminas, certified in "Introduction to Family Engagement in Education" by Harvard University, Bachelor of Law from CESMAC/AL, registered with the OAB/AL no. 7.498, undergraduate student in Pedagogy at UNIBF, Master's student in Neuroscience at the University of Orlando, postgraduate student in Institutional and Clinical Neuropsychopedagogy and Institutional Neuropsychopedagogy and Special Education at Uniminas, postgraduate student in Special Education with an emphasis on giftedness at Faculdade São Luís.
ORCID: 0009-0002-1355-9607
E-mail: pavanimello@gmail.com

INTRODUCTION

Neuroplasticity, the remarkable ability of the brain to reorganize itself and create new neural connections throughout life, has been the focus of intense study in recent decades, especially regarding cognitive differences among individuals. This article proposes a detailed investigation into how neuroplasticity manifests uniquely in gifted individuals and how these brain characteristics directly influence their learning and development trajectories.

In this context, the article seeks to answer the following question: How can the singularity of neuroplasticity in gifted individuals influence inclusive pedagogical practices?

The importance of this study lies in the growing need to adapt educational practices to be truly inclusive, fully recognizing and supporting students whose exceptional cognitive abilities demand innovative pedagogical approaches. Historically, giftedness has been associated with brain functioning that deviates from the typical pattern, presenting a complexity that often challenges traditional educational systems. In this context, neuroscience offers a deep understanding of the brain mechanisms involved, providing essential support for creating learning environments that not only accommodate but also stimulate these individuals with unique potentials.

In Brazil, despite the legal framework provided in Article 59 of the Law of Guidelines and Bases of National Education, educational and institutional practices capable of fully meeting the specific needs of gifted students are still scarce, requiring more effective action from public educational policies.

This article, therefore, aims to explore the relationship between neuroplasticity and giftedness, with an emphasis on how inclusive educational practices can be fundamental in transforming the potential of these individuals into concrete achievements. The analysis is based on relevant neuroscientific studies that highlight the challenges and practical opportunities for implementing an education that celebrates and enhances cognitive differences.

The expectation is that this study will offer concrete support for educators, educational managers, and policymakers, aiming at effective improvements in the educational support for gifted students.

Furthermore, this work seeks to foster a dialogue between scientific evidence and educational policies, emphasizing the importance of a pedagogical approach that respects and values the unique abilities of the gifted. The organization of the article will proceed as follows: initially, the concepts of neuroplasticity and giftedness will be addressed; next, the application of these concepts in inclusive educational practice will be discussed, with examples of methodologies that can be adopted. Finally, the article will conclude with an analysis of the implications of these practices for the integral development of gifted individuals and for society as a whole.

LITERATURE REVIEW

NEUROPLASTICITY IN GENERAL

Neuroplasticity, also referred to as neural plasticity, is the brain's extraordinary ability to modify its structure and function throughout life in response to experiences, learning, or injuries. This phenomenon allows the brain to reorganize itself by forming new synaptic connections, adjusting existing neural networks, and, in some cases, reallocating functions to different areas to adapt to new demands or repair damage. This characteristic is essential for cognitive development, continuous learning, and recovery after brain injuries (Luders et al., 2009).

Among the mechanisms through which neuroplasticity manifests, the most notable are synaptogenesis, synaptic plasticity, and neurogenesis. Synaptogenesis refers to the creation of new synapses between neurons, a process that is highly active during childhood development but persists throughout life in response to new experiences and learning (Kievit et al., 2016). This process is fundamental for the formation of neural networks that support the storage of new information and skills.

Another relevant mechanism is synaptic plasticity, which involves the modification of the strength of existing synaptic connections. This modification can be either positive or negative, depending on the type and frequency of stimuli received. It is crucial for learning and memory, as it enables the retention of acquired information and skills (Luders et al., 2009).

Additionally, neurogenesis—the formation of new neurons—occurs in some regions of the adult brain, such as the hippocampus, an area essential for memory and learning. This process, once thought to be exclusive to embryonic development, is now recognized as a continuous part of the brain's adaptation throughout life (Kievit et al., 2016).

Scientific evidence suggests that neuroplasticity is mediated by significant changes in neural connectivity, which may include everything from the formation of new synapses to the complete reorganization of brain areas in response to different stimuli. Synaptic plasticity, for example, is a central feature in learning and memory processes, allowing synapses to strengthen or weaken according to the individual's experiences (Luders et al., 2009).

Neurogenesis, especially in the hippocampus, also plays an important role in lifelong neuroplasticity. Studies indicate that adult neurogenesis can be significantly stimulated by activities such as physical exercise and continuous learning, suggesting that both the environment and experiences play a crucial role in maintaining and enhancing brain plasticity (Kievit et al., 2016).

Brain plasticity is most pronounced during childhood and adolescence—critical developmental periods in which the brain is extremely receptive to new learning and experiences. During these stages, brain structure is significantly shaped by interactions with the environment, establishing the foundation for subsequent cognitive and emotional development (Kievit et al., 2016).

However, neuroplasticity is not limited to these early stages. The adult brain also retains a considerable capacity for adaptation, although generally less intense. For example, individuals who suffer brain injuries may experience neural reorganization, in which other parts of the brain take over functions previously performed by damaged areas, demonstrating the brain's continuous adaptive capacity throughout life (Luders et al., 2009).

The implications of neuroplasticity for education are vast, especially for gifted individuals, whose cognitive abilities often exceed the expectations of traditional educational practices. Since these individuals have a heightened potential for learning and development, an educational environment that constantly stimulates the formation of new neural connections can be especially beneficial (Carlsson et al., 2000).

Understanding how neuroplasticity operates can help educators develop teaching programs that maximize this capacity, promoting the formation of new synapses and the strengthening of existing neural networks. This may include the adoption of dynamic teaching methods that continuously challenge gifted students, stimulating their creativity and ability to solve problems in innovative ways (Luders et al., 2009).

Neuroplasticity is, therefore, a central phenomenon for brain development and adaptation throughout life. Studies such as those by Luders et al. (2009) and Kievit et al. (2016) underscore the importance of this capacity for cognitive development, especially during critical life stages such as childhood and adolescence.

Recognizing brain plasticity as a vital mechanism for learning and recovery suggests that educational approaches that stimulate this plasticity may be particularly effective, especially for gifted individuals. Education should, therefore, be adapted not only to meet but also to enhance cognitive and emotional development through the continuous stimulation of neural plasticity (Carlsson et al., 2000).

STUDIES ON GIFTEDNESS AND NEUROPLASTICITY

Giftedness is often understood as a condition that goes beyond exceptional cognitive and creative abilities, being deeply associated with a distinct form of neuroplasticity. This differentiated neuroplasticity enables gifted individuals not only to absorb and process information more quickly but also to adapt more effectively to new cognitive challenges.

Research indicates that this unique brain plasticity is fundamental to the gifted individual's ability to handle cognitive complexities in ways that most people cannot. Studies related to Dabrowski's Theory of Positive Disintegration suggest that the intense emotional reactivity and overexcitability observed in gifted individuals may be linked to a greater capacity for neural reorganization, facilitating adaptation and innovation in response to new stimuli (MENDAGLIO; TILLIER, 2006).

Although Daniel Goleman (1995) does not specifically address gifted individuals, he argues that the way emotions are processed can profoundly impact anyone's cognitive abilities. Goleman proposes that emotional reactivity—a trait that may be intensely present in gifted individuals—has the potential to stimulate creativity and, more broadly, influence neuroplasticity. This intense emotional reactivity may allow for more efficient neural reorganization, resulting in greater cognitive flexibility and the ability to find innovative solutions to complex problems. Applying these ideas to the context of giftedness, one can infer that the way these individuals process emotions may, in fact, amplify their cognitive and creative abilities, partly due to the role of neuroplasticity in adapting and innovating in response to new challenges.

Carlsson et al. (2000) observed that highly creative individuals demonstrate greater activity in the frontal cortex, a brain region associated with abstract thinking and problem-solving. This heightened activity reflects an enhanced capacity for adaptation and cognitive flexibility in these individuals—central characteristics of neuroplasticity. This flexibility allows the brain to reorganize its connections more efficiently in response to new stimuli, facilitating the processing of complex information and the creation of innovative solutions.

Davidson and McEwen (2019), in their study on neuroplasticity and social influences, point out that the brain's adaptive capacity can be significantly enhanced in environments that promote well-being. This is especially relevant for gifted individuals, whose brains appear to be "tuned" to respond more dynamically and effectively to cognitive challenges, facilitating the creation of innovative solutions.

These studies suggest that the brain plasticity of gifted individuals is not merely a passive trait but an active mechanism that enables efficient reorganization in response to new information and challenges. This capacity not only facilitates rapid learning and the resolution of complex problems but is also closely linked to how these individuals experience and process their intense emotions, promoting a more holistic and integrated cognitive and emotional development.

Vygotsky emphasized the importance of the social and educational environment in cognitive development, suggesting that individuals—including the gifted—can achieve higher levels of development through pedagogical practices that foster curiosity and creativity. Although Vygotsky did not directly discuss the concept of neuroplasticity, his developmental theory emphasizes that when exposed to environments rich in stimuli and challenges, individuals have the potential to develop cognitive and creative skills at higher levels, particularly through social interaction and cultural mediation (VYGOTSKY, 2007).

The relationship between giftedness and neuroplasticity is widely supported by research indicating how exposure to enriched environments can strengthen neural connections and promote the development of new synapses. Gifted individuals, whose brains are predisposed to greater plasticity, tend to respond exceptionally well to such stimuli. This interaction between biological predisposition and educational environment is, therefore, fundamental to the full development of these exceptional abilities (DAVIDSON; McEWEN, 2019; MENDAGLIO; TILLIER, 2006).

Pedagogical practices that recognize and stimulate neuroplasticity are essential to maximizing the potential of gifted individuals. By creating environments that encourage exploration, innovation, and problem-solving, educators can help these individuals fully develop their abilities. This is because neuroplasticity, more active and adaptive in the gifted, responds especially well to challenging stimuli, facilitating the reorganization of neural connections and the acquisition of new skills. In this way, neuroplasticity not only supports but also amplifies the cognitive and creative abilities of these students, becoming a crucial element in their education (GOLEMAN, 1995; MENDAGLIO; TILLIER, 2006).

COMPARISON OF NEUROPLASTICITY IN GIFTED AND NEUROTYPICAL INDIVIDUALS

The comparison between gifted and neurotypical individuals reveals significant differences in how neuroplasticity manifests in the brains of these two groups. Neuroplasticity, defined as the brain's ability to adapt and reorganize its neural connections, plays a crucial role in cognitive and emotional development and is particularly distinct in gifted individuals. Research by Luders et al. (2009) indicates that the density of gray matter in brain areas associated with intelligence is greater in gifted individuals, suggesting more pronounced plasticity in these regions. This increased density may be related to an enhanced ability to form new synaptic connections and reorganize neural networks, allowing these individuals to process information more efficiently and develop superior cognitive skills.

Carlsson et al. (2000) observed that brain activity during creative tasks is significantly more intense in gifted individuals. This suggests that these brains are more effective at adapting to new challenges and reorganizing neural networks in response to creative and complex stimuli. This heightened capacity for cognitive flexibility and neural adaptation is a central feature of neuroplasticity and may explain the gifted individual's ability to handle complex problems and innovate in ways that neurotypical individuals cannot as easily.

In addition to these findings, other studies corroborate that neuroplasticity in gifted individuals may be modulated in a distinct manner. For example, Shaw et al. (2006) demonstrated that the cerebral cortex in gifted children matures differently compared to neurotypical children. The cortical thickness in gifted individuals peaks later, but the subsequent thinning occurs more rapidly, possibly associated with greater efficiency in synaptic pruning and, consequently, more refined plasticity.

These significant differences in brain structure and function have profound implications for education. Neurotypical individuals may benefit from standardized pedagogical approaches that are effective for most students, but gifted individuals often require more dynamic and flexible teaching methods. The greater neuroplasticity in gifted individuals suggests that these students develop better in environments that offer continuous challenges and opportunities for innovation and problem-solving, rather than following a linear and uniform curriculum.

Inclusive education must, therefore, not only recognize but also celebrate and enhance these differences. The brains of gifted individuals are particularly sensitive to intellectual stimuli that promote neural reorganization (LUDERS et al., 2009; Carlsson et al., 2000; Shaw et al., 2006). For these individuals, a learning environment that constantly stimulates neuroplasticity can provide more complete and meaningful cognitive development, enhancing their creative and intellectual capacities.

Thus, the educational proposal for gifted individuals should be built around pedagogical practices that foster creativity, complex problem-solving, and critical thinking. These practices need to be adapted to capitalize on the superior brain plasticity observed in these individuals. In conclusion, while neurotypical individuals may follow more predictable learning paths, gifted individuals require an approach that acknowledges their heightened brain plasticity and offers an educational environment that fully explores their capabilities.

The difference in the manifestation of neuroplasticity between these two groups demands an education that goes beyond simple accommodation, requiring an approach that respects, understands, and values the unique characteristics of giftedness, stemming from atypical brain functioning and structure. This approach must be capable of continuously adapting, providing challenges that encourage the integral development of the gifted individual and allow them to fully realize their potential, transforming their cognitive singularities into meaningful contributions to society.

METHODOLOGY USED IN NEUROSCIENTIFIC STUDIES

Studies on neuroplasticity in gifted individuals, as well as in other populations, employ advanced neuroimaging methodologies to explore changes in brain structure and function in response to different stimuli and conditions. Techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) are essential for observing brain activity in real time, allowing for a detailed understanding of how the brain reorganizes and adapts its neural connections.

For example, a study using fMRI investigated neuroplasticity in blind individuals, demonstrating that areas of the brain traditionally associated with visual processing can be recruited for other functions, such as hearing and touch, in response to visual deprivation (Bedny et al., 2011). Although this study did not focus directly on gifted individuals, it illustrates a fundamental principle of neuroplasticity: the brain's ability to reconfigure its functions to optimize information processing under different environmental conditions. This principle can be extrapolated to understand how gifted brains reorganize to process information more efficiently, especially in contexts that demand high creativity and complex problem-solving.

Moreover, studies employing techniques such as fMRI and other forms of neuroimaging have revealed that the density of gray matter in specific brain areas—such as those related to intelligence and creativity—is generally higher in gifted individuals. This increased density can be observed and measured through these techniques, offering objective evidence of brain plasticity in individuals with high cognitive abilities. fMRI, in particular, allows for mapping changes in brain activity while individuals perform complex cognitive tasks, enabling the identification of the most active brain areas and how they communicate with each other during these processes (Luders et al., 2009).

Positron emission tomography (PET), in turn, complements this view by measuring cerebral blood flow and metabolism, offering a deeper understanding of how the brains of gifted individuals operate differently compared to neurotypical brains. Studies using PET can demonstrate how different brain regions consume energy during specific tasks, revealing activation patterns that correspond to the high cognitive capacity observed in these individuals.

These methodologies are essential for understanding neuroplasticity in gifted individuals, allowing not only the visualization of changes in brain structure and function but also the quantification of these changes in response to educational and environmental stimuli. These findings are fundamental for developing educational strategies that maximize the neuroplastic capacity of these individuals, ensuring that their cognitive abilities are fully realized.

The application of these techniques highlights the importance of educational environments that promote continuous stimulation and intellectual challenges—elements essential for fostering neural plasticity in gifted individuals. Understanding how these changes occur at the neurobiological level is crucial for formulating pedagogical practices that can enhance the cognitive and creative development of these individuals, promoting an education that not only adapts individually but also maximizes the extraordinary potential of gifted brains.

APPLICATION OF NEUROPLASTICITY IN GIFTED EDUCATION

Understanding neuroplasticity in gifted individuals has profound implications for education, particularly regarding the adaptation of pedagogical practices that can maximize the cognitive potential of these individuals. Neuroscientific studies, as previously mentioned, offer valuable insights into how the gifted brain reorganizes and adapts in response to different stimuli. This suggests that a differentiated educational approach—one that recognizes and enhances the increased capacity for neuroplasticity—is essential for the integral development of these students.

Research indicates that the density of gray matter in areas associated with intelligence and creativity is greater in gifted individuals, pointing to superior neuroplasticity in these individuals. In educational terms, this means that standardized curricula may not be sufficient to meet their needs. Instead, it is necessary to adopt differentiated curricula that offer constant cognitive challenges and encourage creative exploration. Such curricula could include, for example, complex problem-solving and interdisciplinary activities that promote critical thinking and innovation (Luders et al., 2009).

Furthermore, advanced educational technology plays a crucial role in applying neuroplasticity findings to gifted education. Technological tools that personalize learning, such as adaptive educational software, are particularly effective for these students. These technologies adjust the difficulty level of tasks based on student performance, providing continuous challenges that promote neural reorganization and the formation of new synaptic connections (Kadosh; Dowker, 2018). Virtual learning environments and simulators, which offer immersive and interactive learning scenarios, are also extremely beneficial for fostering brain plasticity (Sampedro-Piquero; Begega, 2017).

Michael Piechowski and Kazimierz Dabrowski, for example, emphasize that emotional development is as crucial as cognitive development in the holistic formation of gifted individuals. They suggest that giftedness involves intense emotional experiences, which implies that education must support both cognitive and emotional development. This creates an environment where gifted individuals can fully explore their neuroplastic capacities in a context that values both their abilities and emotional experiences (Piechowski, 1991; Dabrowski, 1964).

Miraca Gross advocates for the importance of academic acceleration for gifted students, arguing that when these students are appropriately challenged, their cognitive and creative capacities develop more effectively. Acceleration can be seen as a direct application of knowledge about neuroplasticity, as it provides the necessary stimuli for the gifted brain to continue adapting and growing in response to appropriate challenges (Gross, 1994).

Early identification and proper monitoring of gifted children are essential for them to develop their full potential. Gagné (2004) suggests that creating an appropriate educational environment is crucial to capitalize on these individuals' innate abilities, ensuring that their exceptional skills are fully developed and that they can contribute meaningfully and innovatively to society.

Inclusive education, in this context, must go beyond merely accommodating these students; it must also respect, value, and enhance their cognitive differences. Inclusion should not only guarantee access but ensure that this access results in educational experiences that challenge and develop the unique capacities of these students. This can be achieved through pedagogical practices that continuously stimulate neuroplasticity, promoting the formation of new synapses and the cognitive flexibility needed to tackle complex problems and create innovative solutions (Davidson; McEwen, 2019).

Thus, applying findings on neuroplasticity to gifted education suggests an approach that is simultaneously personalized and challenging, incorporating differentiated curricula, advanced technologies, and learning environments rich in stimuli. By adapting the educational system to capitalize on the neuroplastic capacities of gifted individuals, we can ensure their full development.

RECENT ADVANCES IN RESEARCH ON NEUROPLASTICITY IN THE GIFTED

In recent years, advances in research on neuroplasticity have revealed new perspectives on how this brain capacity manifests in gifted individuals. Researchers are investigating not only the relationship between neural plasticity and high cognitive ability but also how this plasticity may contribute to greater resilience in the face of cognitive and emotional challenges. Recent studies highlight that stress and social interventions can influence neuroplasticity, and that environments promoting well-being have the potential to enhance the brain's adaptive capacity. These findings are especially relevant for understanding plasticity in gifted brains, which tend to benefit from enriched educational environments to maximize their potential (Davidson; McEwen, 2019).

Similarly, research shows that environmental enrichment throughout life is crucial for maintaining and developing neural plasticity. Applied to the context of gifted individuals, it becomes evident that diverse and complex educational curricula are especially effective in stimulating their cognitive development (Sampedro-Piquero; Begega, 2017).

Studies indicate that logical-mathematical reasoning plays an important role in how gifted individuals identify patterns, analyze complex situations, and develop creative solutions. Gagné (2004) reinforces the importance of educational environments that challenge these abilities, allowing gifted individuals to make quick connections and recognize underlying structures in distinct problems, facilitating the generation of innovative and effective solutions. Thus, creating a learning environment that challenges and stimulates these capacities is fundamental to the full development of these individuals.

Moreover, understanding neuroplasticity in numerical cognitive development is particularly relevant for these students, as their exceptional abilities are closely linked to the capacity to solve problems efficiently and innovatively. Pedagogical practices that adapt to the needs of these students and continuously challenge their neural plasticity can promote more balanced development, maximizing their cognitive potential (Kadosh; Dowker, 2018).

Research has also examined how the brains of children who suffered perinatal brain injuries reorganize to maintain cognitive functions even under adverse conditions. These results suggest parallels with gifted brains, where neural plasticity enables more efficient and creative responses to environmental stimuli (Stiles et al., 2012).

A systematic review of the neuropsychological profile of gifted children revealed that neuroplasticity plays a crucial role in their superior cognitive abilities, highlighting the unique capacity for neural reorganization that grants these children exceptional performance across various knowledge domains (Cassidy et al., 2018).

The exploration of executive functions and their variations among gifted individuals reveals a deeper understanding of how neuroplasticity may manifest differently in these highly adaptable brains. Executive functions such as inhibitory control, working memory, and cognitive flexibility are essential for planning, decision-making, and solving complex problems. In gifted individuals, these functions tend to be more developed, allowing them to process information more efficiently and adapt quickly to new challenges (Friedman; Miyake, 2017).

These executive functions are mediated by neural networks that continuously reorganize in response to varied stimuli, suggesting heightened brain plasticity. This adaptive capacity not only facilitates superior academic performance but also contributes to creativity and innovation—traits frequently associated with gifted individuals. Understanding these variations in the manifestation of executive functions reinforces the importance of educational practices that recognize and continuously stimulate these differences.

To ensure the integral development of these individuals, it is essential that the educational environment offers challenges that activate and develop these executive functions. This may include tasks that require critical thinking, complex problem-solving, and the application of concepts in new contexts. By promoting an environment that continuously challenges the neural plasticity of gifted individuals, education can maximize their cognitive and creative potential, allowing their abilities to be fully explored and meaningfully applied in society.

This educational approach, which integrates knowledge about neuroplasticity and executive functions, is essential to ensure that gifted individuals not only reach their academic potential but also develop the skills necessary to face life's challenges in innovative and effective ways. The most recent scientific findings make it clear that, to promote true inclusion, educational practices must be adapted to recognize and nurture the differences of these individuals. Only then can we ensure that each gifted person has the opportunity to fully develop their unique potential, contributing significantly to society.

METHODOLOGY

TYPE OF RESEARCH

The present study is characterized as qualitative research, of an exploratory nature and integrative bibliographic approach. Qualitative research allows for the evaluation of complex phenomena through the interpretative analysis of non-numerical data, while the exploratory nature is justified by addressing a topic that is still insufficiently systematized: the interface between neuroplasticity and giftedness within the framework of inclusive education.

The integrative review was chosen for its ability to provide a critical synthesis of theoretical and empirical results, benefiting the articulation between neuroscientific foundations and educational applications.

SEARCH TECHNIQUES AND SELECTION CRITERIA

Data collection was carried out through a systematic survey of relevant scientific publications in the databases Scielo, PubMed, Google Scholar, and CAPES Journals. The searches were conducted between February and April 2024, using the following descriptors combined in Portuguese and English: "neuroplasticidade" / "neuroplasticity", "superdotação" / "giftedness", "educação inclusiva" / "inclusive education", "desenvolvimento cognitivo" / "cognitive development", and "políticas educacionais" / "educational policy".

The following inclusion criteria were established: i) publications with a theoretical or empirical approach relevant to the topic; ii) peer-reviewed articles, scientific books, or systematic reviews; iii) studies that directly addressed neuroplasticity in gifted individuals or the educational impacts resulting from this interaction; iv) publications from the year 2000 onward, with emphasis on the last 15 years.

Conversely, the following were excluded: works with an exclusively biomedical or neurological focus without connection to learning; opinion pieces or texts lacking scientific grounding; reductionist approaches that limit giftedness to high academic performance or IQ as an absolute criterion.

ANALYSIS PROCEDURES

After the initial filtering, the selected materials were read in full and categorized into five thematic axes: (i) foundations of neuroplasticity, (2) brain manifestations associated with giftedness. (3) comparison with neurotypical individuals, (4) educational implications, and (5) public policy proposals. The analysis followed a qualitative interpretative approach, seeking convergences, divergences, and gaps in the literature.

The interpretation of the data aimed to integrate empirical findings with the theoretical approaches of authors such as Linda Silverman, Kazimierz Dąbrowski, Michael Piechowski, Daniel Goleman, and Lev Vygotsky, as well as recent neuroscientific studies by Abraham (2018), Luders et al. (2009), Cassidy et al. (2018), and Davidson and McEwen (2019), among others.

DISCUSSION ON METHODOLOGICAL CHOICE

The choice of an integrative review is based on the need to understand giftedness from a broad and contemporary perspective that integrates neuroscience, developmental psychology, and inclusive education. This approach makes it possible not only to scan the current state of research but also to propose practical paths for the pedagogical implementation of findings, considering the neurobiological and emotional specificities of gifted individuals.

In addition to encompassing different areas of knowledge, the adopted methodology enables the formulation—based on scientific evidence—of proposals for educational policies that respect the neurodiverse functioning of gifted individuals. Thus, this article aims to contribute theoretical and practical support to the construction of a more responsive, inclusive, and neuro-compatible education.

RESULTS AND DISCUSSION

The results obtained from the literature analysis demonstrate that neuroplasticity in gifted individuals manifests in a unique manner, characterized by greater gray matter density, intensified brain activity in regions associated with creativity and intelligence, and a more efficient pattern of neural reorganization (LUDERS et al., 2009; SHAW et al., 2006). These particularities enable faster cognitive adaptation and a heightened capacity for solving complex problems and fostering innovation (CARLSSON et al., 2010; DAVIDSON; McEWEN, 2019).

The analyzed studies also show that the environment directly influences the expression of this neuroplasticity, especially when it offers challenging and emotionally positive stimuli (SAMPEDRO-PIQUERO; BEGEGA, 2017; PIECHOWSKI, 1991).

In this context, standardized and linear pedagogical practices tend to limit potential, whereas differentiated approaches tailored to the special needs of each gifted individual—such as flexible curricula, adaptations in learning and assessment methods, academic acceleration, and curricular deepening—not only favor the full development of their neurobiological capacities but also promote well-being and holistic health.

Dialogue with authors such as Vygotsky (2007) and Dąbrowski (MENDAGLIO; TILLIER, 2006) reinforces the importance of responsive educational environments that value not only cognition but also the affective and social dimensions of development. These results point to the need for public policies that not only understand giftedness as a form of neurodivergence but also ensure concrete practices of school and institutional support—from early identification to the implementation of compatible teaching strategies.

CONCLUSION

This article aimed to analyze how neuroplasticity manifests in gifted individuals and what the implications of this cerebral singularity are for inclusive education. Based on an integrative literature review, it was possible to gather neuroscientific evidence that confirms the high capacity for brain reorganization in gifted individuals, especially in regions associated with intelligence, creativity, and problem-solving.

The main findings reveal that this heightened neuroplasticity depends not only on biological predispositions but also on the quality of educational and emotional stimuli received. The analyzed literature indicates that differentiated and specific pedagogical practices, combined with the recognition of giftedness as an expression of neurodiversity, are essential for the integral development of these individuals.

The primary contribution of this research is to offer scientific foundations to support the urgency of educational practices and policies that respect and enhance the capacities of gifted individuals. This includes the effective implementation of strategies such as academic acceleration, personalized curricula, reduction of content repetition already mastered, horizontal expansion of content with the inclusion of topics of interest to the student, projects based on themes chosen by the student integrating areas of knowledge, inquiry-based learning and complex problem-solving, project-based learning (PBL), academic mentoring or tutoring, emotional self-regulation and metacognition techniques, debates, seminars, and the production of original content, use of adaptive technologies, sensory-adjusted environments, flexible schedules and workloads, as well as continuous teacher training.

In summary, ensuring the full development of these individuals requires more than mere access to school: it demands policies and practices that effectively provide them with the conditions to transform potential into contribution, respecting their singularities and guaranteeing them a dignified and productive place in society.

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THE IMPORTANCE OF ENVIRONMENTAL EDUCATION IN THE SCHOOL CONTEXT: AN INTEGRATIVE REVIEW

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Eliene de Carvalho Vieira[1], Marilane de Moura Santos Meneses[2] and Maria Gardênia Sousa Batista[3]

ABSTRACT

Environmental education, integrated into the school environment, is an essential tool for developing conscious, critical citizens committed to environmental preservation. This study aims to analyze, through an integrative literature review, how environmental education has been implemented in Brazilian schools and the main challenges and strategies reported in recent years. Articles published between 2013 and 2023 were selected from the SciELO, BVS, and Google Scholar databases, using previously defined inclusion criteria. The results highlight the relevance of environmental education as a cross-curricular component, revealing innovative and participatory pedagogical practices. However, limitations are observed regarding teacher training, project continuity, and coordination with public policies. The conclusion is that, for environmental education to be effective, institutional commitment, ongoing teacher training, and the involvement of the school community are necessary.

Keywords: Environmental education; Schools; Sustainability; Pedagogical practices; Teacher training.

[1] Graduate student of Biological Sciences
through the Institutional Program for the Promotion and
Induction of Innovation in Initial and Continuing Training of
Teachers and School Principals – PRIL - UESPI- Simões - Piauí - Brazil.
[2] Graduate student of Biological Sciences
through the Institutional Program for the Promotion and
Induction of Innovation in Initial and Continuing Training of
Teachers and School Principals – PRIL - UESPI- Simões - Piauí - Brazil.
[3] Professor, PhD in the Biological Sciences Program
Universidade Estadual do Piauí (State University of Piauí) - UESPI
LATTES: http://lattes.cnpq.br/118410980618896
ORCID: https://orcid.org/0000-0001-8281-1277

INTRODUCTION

The environmental crisis afflicting the planet has intensified in recent decades due to an economic development model based on the excessive exploitation of natural resources and the logic of unrestrained consumption. Issues such as global warming, water scarcity, ecosystem pollution, and biodiversity loss directly affect the quality of life of populations and underscore the urgency of educational actions that promote a new relationship between society and nature (Reis et al., 2021).

In this context, environmental education (EE) emerges as an essential tool for addressing contemporary socio-environmental issues by encouraging critical reflection, behavioral change, and the development of an ethical and sustainable consciousness. EE goes beyond the transmission of ecological knowledge, proposing a continuous, transformative, and interdisciplinary educational process capable of mobilizing individuals to care for the environment and to engage in civic participation (Costa; Costa, 2024).

In Brazil, environmental education is supported by Law No. 9.795/1999, which establishes the National Environmental Education Policy and mandates its inclusion at all levels and modalities of education. This legislation represents a significant milestone in consolidating EE as a right for all and a duty of the State, recognizing the central role of educational institutions in shaping an environmentally responsible society (Brasil, 1999).

Therefore, schools are configured as privileged spaces for the development of environmental education. It is within this environment that children, adolescents, and young people can be sensitized to the importance of environmental preservation and encouraged to become transformative agents of reality. The school has the potential to integrate scientific knowledge, ethical values, and social practices, promoting integrative and contextualized pedagogical projects (Müller; Silva, 2023).

Recent studies indicate that the presence of environmental education in schools has increased, especially through initiatives such as school gardens, recycling projects, climate education, and interdisciplinary actions (Almeida, 2022). However, significant challenges are also highlighted, such as the lack of ongoing teacher training, the absence of public incentive policies, and the difficulty in articulating theory and practice in everyday school life. Many teachers still feel unprepared to address environmental topics critically and integratively, limiting themselves to isolated content disconnected from the pedagogical project (Santos et al., 2020).

Despite these difficulties, various experiences have shown that when well-planned and executed, environmental education in the school environment contributes to strengthening student protagonism, developing socio-emotional skills, and building values based on empathy, solidarity, and respect for life (Leite et al., 2025). Furthermore, EE practices in the school context have been associated with

improvements in institutional climate, community mobilization, and the encouragement of collective actions in favor of sustainability (Muniz et al., 2025).

Given this, it becomes essential to analyze how environmental education has been effectively implemented in Brazilian schools, which pedagogical strategies have proven effective, and what the main challenges and advances in this field are. Based on these questions, the present study aims to conduct an integrative literature review on the importance of environmental education in the school environment, in order to contribute to the strengthening of educational practices that promote ecological awareness and the construction of more sustainable and just societies.

METHODOLOGY

This study is an integrative literature review, a methodology that allows for the synthesis of results from previously published research, enabling broader conclusions about a given phenomenon or problem (Souza et al., 2020). The integrative review consists of several stages, including: identifying the topic and formulating the research question, establishing inclusion and exclusion criteria, defining the information to be extracted, evaluating the included studies, interpreting the results, and presenting the review.

The guiding question of this review was: “What is the importance of environmental education in the school environment, according to recent scientific literature?” To answer this, searches were conducted in the following databases: Scientific Electronic Library Online (SciELO), Virtual Health Library (BVS), and Google Scholar, as they are widely used in the educational and multidisciplinary fields.

Data collection was carried out in May and June 2025, using the following descriptors combined with the Boolean operator “AND”: “educação ambiental” AND “escola” (environmental education AND school), “educação ambiental” AND “ensino” (environmental education AND teaching), and “educação ambiental” AND “educação básica” (environmental education AND basic education). The inclusion criteria were: articles published between 2019 and 2025, available in full, in Portuguese, that directly addressed environmental education in the Brazilian school context, with a focus on pedagogical, curricular, or training aspects. The exclusion criteria included: duplicate articles, works that did not directly address the theme of EE in schools, and non-scientific productions such as monographs and dissertations.

The selection of studies occurred in three stages: reading the titles, reading the abstracts, and finally, reading the full texts of the selected articles. The data extracted from each study were organized in a spreadsheet containing information such as: author, year of publication, study objective, methodology used, main results, and conclusions.

This methodological approach enabled the systematization of the available knowledge on the practice of environmental education in Brazilian schools, contributing to the identification of advances, challenges, and gaps in the recent scientific literature.

RESULTS AND DISCUSSION

The search conducted in the SciELO, BVS, and Google Scholar databases between 2019 and 2024 initially yielded 75 articles, of which 8 were selected for critical analysis (Table 01). These studies cover a variety of Brazilian educational contexts, especially at the elementary and secondary levels, and discuss pedagogical practices, teacher training, social impacts, institutional challenges, and public policies related to environmental education (EE).

Table 01: Articles selected for critical analysis

Authors	Year	Study Title	Objetivo	Main Findings
Carvalho et al.	2020	Educação ambiental na escola: uma análise da percepção discente [Environmental education at school: an analysis of student perception]	Analyze elementary students' perception of EE	Most students understand the importance of environmental preservation, but pedagogical practice remains superficial.
Ferreira e Santos	2020	O papel da educação ambiental nas escolas públicas [The role of environmental education in public schools]	Examine how EE is being implemented in public schools	EE is still treated in a fragmented and occasional manner, without effective integration into the curriculum.
Lima et al.	2021	Educação ambiental crítica e cidadania ecológica: um estudo em escolas do semiárido [Critical environmental education and ecological citizenship: a study in semi-arid schools]	Investigate the presence of critical EE in student formation	Critical EE promotes more conscious and active citizenship but faces institutional challenges.
Oliveira e Almeida	2021	Percepção ambiental e educação: experiências com alunos do ensino médio [Environmental perception and education: experiences with high school students]	Analyze EE experiences with high school students	Student interest was observed, but there is a lack of pedagogical support and appropriate participatory methodologies.
Pereira et al.	2022	Educação ambiental no contexto escolar: práticas e desafios [Environmental education in the school context: practices and challenges]	Investigate pedagogical practices and challenges faced by teachers	Many teachers are willing, but lack ongoing training and institutional support.
Rodrigues et al.	2023	A transversalidade da educação ambiental no currículo escolar [The cross-curricular nature of environmental education in the school curriculum]	Evaluate how EE is addressed cross-curricularly in the curriculum	Despite legal requirements, cross-curricular integration is still weak in practice, requiring more teacher training.
Silva e Rocha	2023	Sustentabilidade e práticas pedagógicas: um estudo de caso em escolas públicas [Sustainability and pedagogical practices: a case study in public schools]	Analyze sustainability practices developed by teachers in public schools	Teacher leadership stands out, but the lack of systematic school policies hinders continuity of actions.
Souza et al.	2024	Environmental education and social transformation: a qualitative study in communities	Investigate EE's contribution to socio-environmental transformation in schools	Well-conducted EE projects contribute to collective engagement and changes in environmental perception among students and families.

Source: authors, 2025.

ACTIVE AND INNOVATIVE METHODOLOGIES FOR ENVIRONMENTAL EDUCATION

The studies demonstrate that the implementation of active methodologies in environmental education (EE), such as practical and interdisciplinary projects, is crucial for engaging students and facilitating the understanding of socio-environmental topics. Activities such as school gardens, recycling workshops, the creation of educational materials, and field trips to green areas are widely used to bring students closer to environmental realities and to encourage socio-environmental responsibility (Gomes; Pereira, 2021; Oliveira et al., 2022; Santos et al., 2023).

Additionally, the growing use of digital technologies—such as educational apps, interactive platforms, and environmental games—is noteworthy. These tools expand access to information and promote collaborative learning. They also support the contextualization of content and stimulate youth protagonism by allowing students to explore local and global environmental issues with autonomy (Lima; Fernandes, 2023).

Practical examples, such as the school composting project reported by Silva and Souza (2023), demonstrate benefits not only for learning but also for the environmental sustainability of the school itself, by reducing waste and promoting conscious consumption. In this way, linking curricular content to concrete actions helps consolidate meaningful learning and develop socio-emotional skills.

TEACHER TRAINING: CAPACITATION, CHALLENGES, AND DEMANDS

Teacher training is identified as one of the pillars for the success of environmental education. Several articles highlight the lack of continuous and specific training, which limits teachers' ability to integrate environmental concepts into the curriculum and apply innovative methodologies. This gap often results in fragmented and superficial approaches, where EE is addressed sporadically and without interdisciplinary articulation. Martins and Almeida (2020) point out that the absence of adequate training can generate insecurity among teachers and limit the effectiveness of environmental practices. In turn, Lima and Fernandes (2023) emphasize the need for training that fosters dialogue between scientific, pedagogical, and cultural knowledge, enabling a critical and contextualized approach (Martins; Almeida, 2020; Lima; Fernandes, 2023; Pereira; Souza, 2024).

Moreover, the lack of didactic resources, materials, and institutional support are frequently cited challenges in the analyzed studies, revealing a significant barrier to the consolidation of consistent pedagogical practices in environmental education. The shortage of appropriate materials—such as books, booklets, laboratories, and green spaces—limits the development of interactive and contextualized activities. Added to this is the overload of teachers' work and the absence of institutional incentives, which demotivate educators from systematically incorporating environmental themes into the curriculum (Santos et al., 2020; Silva & Andrade, 2021).

Several studies indicate that without concrete support from educational institutions and managing bodies, EE tends to remain a sporadic and peripheral approach. In this context, the role of public policies is emphasized as fundamental to ensure resources, adequate infrastructure, partnerships with universities and environmental organizations, as well as continuing education programs that value and strengthen EE in schools. When such policies are effectively implemented, greater teacher engagement, interdisciplinarity, and transformative actions in the school routine are observed (Gonçalves & Melo, 2022; Rodrigues et al., 2023; Almeida et al., 2023).

IMPACTS OF ENVIRONMENTAL EDUCATION ON CITIZENSHIP AND THE COMMUNITY

It is also important to emphasize that environmental education has a strong impact on the civic formation of students, promoting values such as solidarity, empathy, critical thinking, and social responsibility. Ferreira et al. (2022) show that active participation in environmental projects strengthens students' bonds with the school community and broadens social mobilization, encouraging collective actions for environmental preservation and conservation. The extension of these actions beyond the school, involving family members and neighbors, is a distinguishing factor that enhances the reach of environmental education (Mendes et al., 2023).

Awareness of local environmental problems—such as inadequate waste management and the preservation of natural resources—generates critical consciousness that can translate into more sustainable daily practices. Furthermore, EE contributes to the construction of a culture of peace and respect for socio-environmental diversity, which are fundamental for coexistence in complex and multicultural societies (Leite et al., 2025).

PUBLIC POLICIES AND THE INSTITUTIONAL ROLE

Law No. 9.795/1999 remains the main legal reference for environmental education in Brazil; however, its practical implementation still faces barriers. Studies indicate that the commitment of education departments, school management, and state governments is crucial for the legislation to be translated into concrete and structured actions (Souza et al., 2021; Gonçalves; Melo, 2022).

Furthermore, the lack of coordination between public policies, school programs, and teacher training hinders the continuity of EE projects and their systematic integration into the curriculum. Rodrigues et al. (2023) highlight the importance of collaborative networks among schools, universities, and civil society organizations to strengthen environmental education and facilitate the exchange of successful experiences.

STRUCTURAL CHALLENGES AND IMPROVEMENT PROPOSALS

The structural challenges range from the lack of adequate infrastructure and pedagogical materials to teacher overload and the low prioritization of environmental education (EE) in schools (Pereira; Souza, 2024; Rodrigues et al., 2023). To overcome these obstacles, the literature suggests the need for integrated policies that ensure specific funding for EE, high-quality continuing education, and the development of contextualized and innovative methodologies.

Another relevant point is the strengthening of engagement from the school community and families, which can enhance the effects of EE and ensure its long-term sustainability (Mendes et al., 2023). The integration between formal education and community practices can be an effective path to broaden students' understanding of the importance of sustainability. Furthermore, the incorporation of new digital technologies, combined with participatory methodologies and interdisciplinary projects, represents a promising perspective for modernizing EE, making it more attractive, dynamic, and effective (Oliveira et al., 2022; Lima; Fernandes, 2023).

CONCLUSION

Based on the integrative review conducted, it was possible to observe that environmental education plays a fundamental role in the school context, not only as a curricular component but as a transformative instrument of students' socio-environmental awareness. Active pedagogical practices involving concrete experiences—such as school gardens, recycling projects, and the use of digital technologies—prove to be effective strategies for promoting engagement and civic formation.

However, the effectiveness of these practices is closely linked to teacher training, which is shown to be insufficient and fragmented in many contexts, reflecting the need for more robust public policies and investments in the continuous professional development of educators. The lack of adequate infrastructure and appropriate pedagogical resources constitutes a challenge that must be addressed to consolidate environmental education as a cross-cutting axis in schools.

The socio-environmental impacts of environmental education go beyond the school environment, reaching the community and contributing to the formation of critical, responsible citizens committed to sustainability. The active participation of students in environmental projects fosters the development of ethical values, critical awareness, and a sense of belonging—essential elements for building more just and sustainable societies.

Therefore, for environmental education to reach its transformative potential, it is essential to establish effective articulation among public policies, school management, teacher training, and the engagement of the school community. Strengthening these dimensions can ensure the continuity, depth,

and reach of environmental practices, promoting sustainability as a central value of Brazilian basic education.

Finally, the importance of future research is highlighted—research that evaluates the long-term impact of environmental education interventions, expands the investigation of innovative methodologies, and explores the integration of schools with the community and territory, consolidating environmental education as an indispensable tool for addressing the socio-environmental challenges of the 21st century.

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Aurum EDITORA

CHAPTER 9

THE MEME GENRE AS DIDACTIC MATERIAL IN PORTUGUESE LANGUAGE CLASSES

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Wemerson Simões[1]

ABSTRACT

This article is an excerpt from one of our studies, developed as part of our specialization in Informatics in Education at the Federal Institute of Espírito Santo. It focused on the use of the meme genre in a second-year high school classroom. The objective was to examine how this genre, part of students' everyday technological experiences, can be used in Portuguese language classes to encourage reading, comprehension, and, most importantly, text production. The activity's theme was "pesticides and their problems in society," a topic closely related to the rural realities of the Escola Família Agrícola de Olivânia and most of its students. The activity revealed that the meme genre, a result of technology, attracts significant attention from students and can be usefully used in native language classes, since it is present in their reality and is capable of constructing and conveying meaning. At the end of the activity, we found that textual genres arising from new technologies cannot be left aside, as they are capable of strengthening students' connections with what is offered to them.

Keywords: Portuguese Language; Genres; Meme; Pesticides.

[1] Master in Linguistic Studies
Federal University of Espírito Santo
E-mail: wemersonsimoes@gmail.com

INTRODUCTION

Sírio Possenti (2000) states that it is not uncommon for Portuguese language teachers to encounter students struggling in their classes, nor is it unusual to hear that some students find the content boring or even unnecessary. This perception is shaped by various factors, one of which is the use of normative grammar and texts disconnected from the learners' everyday lives, treating our language as unique and immutable. Furthermore, the offering of disconnected and decontextualized texts, detached from lived experiences, further complicates their application in the classroom.

Another contributing factor to student disengagement is the resources used. According to Caiado (2011), society is undergoing significant technological evolution, leading to new means of communication. Often, teachers do not take advantage of these changes, whether due to lack of resources in schools, insufficient training, or lack of pedagogical support, leaving them reliant on outdated methods. Therefore, using resources and content aligned with technological changes can be a way to encourage student participation.

Within this context, the meme is a discursive genre produced with digital technology resources and constantly disseminated through them. Its widespread circulation makes it popular and routine, easily recognized by social media users. Typically, it arises from a socially relevant event and is constructed as humorous texts, sometimes with critical reflections. The semiosis of this type of production is based on a relationship between context, writing, and image, making it a way to construct meaning and express opinions.

The widespread circulation of memes is fueled by social media users, where adolescents spend much of their time. Thus, they are democratic texts that address various themes and issues, always through succinct texts and representative images. They are often how young people (and people in general) access societal issues in the given context, and this, combined with their broad dissemination potential, makes them important tools for constructing meaning and conveying ideas. The fact that this genre is an integral part of society's daily life makes it pedagogically significant.

In this sense, we first provide a brief conceptualization of what a genre is and how it functions in society. Bakhtin (2003) already proposed in his theory of discursive genres that language reflects the environment and, for this reason, adapts to it. Marcuschi (2003, 2008, 2010) built upon this to conceptualize his theory of textual genres. Therefore, our conceptualization is based on these two authors.

Another factor that cannot be overlooked when discussing the meme genre is the interactive construction between image, writing, and other textual resources, studied in multimodality theories. This relationship is important because elements such as color, font size, margin positioning, and other factors also carry significant semantic weight for the genre to achieve its purpose. To analyze these factors, we

will use the Grammar of Visual Design by Kress and van Leeuwen (2006). Additionally, we will examine how the genre can be validly and importantly used in the classroom.

Based on these conceptualizations, we will demonstrate examples of the meme development and production process carried out by students.

DISCURSIVE AND TEXTUAL GENRES: SOME CONCEPTUALIZATIONS

Mikhail Bakhtin, in his book Estética da criação verbal (2003), considered one of the most important studies on discourse genres, asserts that human activities differ according to the social spheres to which they belong, and that language and its use are tied to these spheres. Thus, discourse reflects the purposes and conditions of its producer, and every form of communication is subject to numerous variations. These variations are implicitly related to those involved in the discourse and the environment in which it is situated.

To the numerous varieties of produced discourse, Bakhtin assigns the term "genres of discourse." According to him, all our utterances follow a standard form, a relatively stable structure. This may occur intentionally or through implicit relationships between the produced discourse and its producer. It is important to note that a discourse is a sequence of one or more utterances, and according to Bakhtin, the concept of discourse genre refers not only to oral discourse but also to written discourse. According to Bakhtin, the use of language:

> [...] takes place in the form of utterances (oral and written), concrete and unique, which emanate from participants in one or another sphere of human activity. The utterance reflects the specific conditions and purposes of each of these spheres, not only through its thematic content and verbal style—that is, through the selection made from the resources of the language: lexical, phraseological, and grammatical resources—but also, and above all, through its compositional construction. These three elements (thematic content, style, and compositional construction) merge inseparably in the whole of the utterance, and all are marked by the specificity of a communication sphere. (BAKHTIN, 2003, p. 179)

For the philosopher, the social environment is extremely important in determining the structure of the genre, since each sphere in which discourse is produced elaborates a relatively stable sequence.

Thus, socio-communicative interaction enables the speaker to easily determine which discourse genre to use and how it should be structured at the moment of communication. This occurs because genres are:

> [...] constituted in a certain way, with a specific function, in given spheres of human activity, which makes it possible to (re)cognize and produce them whenever necessary. If this were not the case, there would be a predominance of individual and individualizing production devoid of the traits of socially constructed work, which would greatly hinder the process of reading and comprehension [...]. (KOCH & ELIAS, 2013, p. 106)

Koch and Elias (2013) agree with Bakhtin, stating that the composition of discourse genres follows a structure that varies according to the function for which the discourse is produced. Thus, the discourse genre "is constituted under different formats, contents, and styles, inseparable at the moment of constitution" (p. 106). The social sphere in which the discourse is produced guides this construction.

Textual genres thus emerge from discursive domains (journalistic, religious, legal, etc.), since:

> all human activities are related to the use of language, which is realized through utterances [...] that emanate from participants in one or another sphere of human activity [...]. And with this theoretical position, we arrive at the union of genre with its social involvement and its relation to human activities. (KOCH & ELIAS, 2008, p. 155)

Koch and Elias affirm that textual genres are interconnected with social practices and sociocultural knowledge, although they may undergo thematic, compositional, and stylistic changes. All genres possess styles, which are not fixed or rigid instruments. The authors explain that the sociocultural life of authors is important in their productions; therefore, the textual genre is not defined by its format, but by its function (2013, p. 113). To claim otherwise contradicts the sociocultural competencies proposed by Bakhtin.

Still within this context, Marcuschi (2008) emphasizes that textual genres arise from demands, from diverse and different purposes in the social spheres in which they are produced. This justifies their diversification. Thus, those who produce a text structure it according to their objective. According to Marcuschi (2008), discourse production is considered relatively stable, as it often follows the same parameters; therefore, social relations and contact with these modalities enable recognition of the structure to be used.

Since language is a form of social interaction, constructed by the social sphere of its user, the choice of textual genre occurs at the moment of its production. For this reason, often during the process of constructing the utterance, this structuring is not perceived by the producer, as it occurs intuitively. As discourses are created and formed from relatively stable sequences, as explained by Bakhtin (2003), it is up to the producer to discover which one is most appropriate for the textual genre to fulfill its purpose. This search is one of the reasons for variations in genre structures.

Within these considerations, we cannot overlook the fact that the meme is a product of the emergence of new technologies and their constant use in society. This genre, when disseminated through media detached from new communication channels, loses its semantic load. Therefore, its medium is extremely important in constructing meaning. Separating the meme from its medium—the digital environment—is akin to issuing a medical certificate in the form of a song, or producing a sales contract through a drawing.

According to Barreto (2015), the concept of meme was introduced by Richard Dawkins in 1976. For its conceptualization, a comparison was made between cultural evolution and genetic evolution to

assert that a meme would be a cultural gene replicated through interaction. Thus, the meme would be a unit of information diffusion and cultural transmission. Meme construction, therefore, arises from the replicability of social interactions and behaviors.

Dawkins (apud BARRETO, 2015) bases the meme evolution process on three fundamental elements: mutation, natural selection, and heredity. The first considers the meme's ability to undergo small changes each time it is passed on, with more changes occurring over time; the second element arises from the idea that some memes attract more attention and are therefore replicated longer; the third element posits that the meme undergoes variation and recombination from an original idea, which remains present throughout its mutations. From these elements, the author asserts that memes compete for survival.

Relating Dawkins' concept to Bakhtin's (2003) considerations on language, it is possible to understand the traits that characterize the meme, the focus of our study. Barreto (2015, p. 31) states:

> [...] memes are understood as ideas, jokes, games, or behaviors that spread through viral replication, characterized by the repetition of a basic formal model from which people can produce different versions of the same meme. Thus, memes differ from viral videos because they presume that, as the meme spreads through the network, altered versions of the original idea emerge.

The author also notes that the meme is strengthened by technological resources, as they offer ease of production and dissemination—factors conducive to its use in the classroom. She also notes that memes are often part of jokes, games, and humor, another excellent pedagogical attraction.

Although the meme genre is new, it resembles others already in existence, such as infographics, flowcharts, or even billboards. This proximity reveals the presence of Dawkins' concept of heredity and Bakhtin's (2003) concept of secondary genre. A defining feature of these genres is the meaning produced through the interaction of present modalities.

MULTIMODAL GENRES

Many genres associated with new technologies incorporate various resources in the construction of meaning. Just as with other textual genres, these structures draw upon different modalities of language, such as images, sounds, gestures, etc. These are known as multimodal genres.

The texts used in everyday society are models: products of interactions and relationships among diverse social groups and contexts. As Bakhtin (2003) stated, if a completely new genre were used at every moment, communication would become practically impossible. From this perspective, we cannot ignore the emergence of numerous textual genres arising from a society in constant transformation of its communication media.

It is common for genres to emerge from new technologies. Considering textual genre as something concrete, recurrent, and socially rooted (MARCUSCHI, 2008), this issue becomes even more evident. New genres are communicative instruments with specific purposes, developed to fulfill particular functions; they are mediated by digital communication and, as such, evolve alongside it.

Marcuschi (2004) emphasizes that the many emerging genres share similarities and often spark debate regarding their impact on language and social life. Viewing textual genres as historical and social phenomena, we can observe that new communication proposals influence language use while also being the result of its evolving usage. These genres "radically transform existing genres and develop some truly new ones. However, [...] the internet and all genres linked to it are fundamentally based on writing. On the internet, writing remains essential." (MARCUSCHI, 2008, p. 198).

Language is considered a living entity that evolves with a constantly changing society. That is why we no longer speak or write as people did thirty years ago. This social dynamism leads to the emergence of new words, while those no longer in use fade from recognition among younger generations. These are ongoing changes in language since its inception. Alongside these variations, new genres and modalities also emerge (MARCUSCHI, 2008). In today's context, filled with technological advancements, these linguistic variations accompany such developments. An example of this is the social media platform Twitter. There, each message can contain a maximum of 143 characters, which encourages the use of abbreviations to shorten words—an accepted norm within that platform. This creates a new modality. Additionally, Twitter messages include other features such as profile pictures, usernames, timestamps, etc.; these elements also constitute a new textual genre. This example supports Marcuschi's (2008) assertion, as the essential component of the genre remains writing, albeit in a different modality. What must not be overlooked is the need for reflection on language, its genres, and its modalities, since these numerous changes and variations also produce new types of readers. Schools must not remain bound to disciplinary approaches from decades past, as they often do, but must instead adapt to this new reality (DOMINGOS et al., n.d.).

In its use alongside new technologies, Portuguese language emerges with different modalities, no longer confined to formal standard language. In digital communication, resources that were not available in face-to-face, telephone, or letter-based communication become common: sound, image, layout, typography, and other forms of meaning-making. Dionísio comments on these issues:

> "[...] it is very easy to create [...] and disseminate such creations to a wide audience. All the resources used in constructing textual genres contribute rhetorically to the construction of meaning. Increasingly, we observe the combination of visual material with writing; we undoubtedly live in an increasingly visual society." (DIONÍSIO, 2008, p. 131)

Dionísio's observations are, in a way, supported by Bazerman (2011), who states that each text and each genre involves a set of relationships, positions, and social roles recognized by those involved. Thus, he explains that each textual genre is produced through a dialectical interaction among members of a specific social group—what Bakhtin (2003) calls a sphere.

Bakhtin (2003) argues that genres vary according to the social spheres to which they belong. Each group produces texts according to its specific needs. This notion aligns with Marcuschi (2002), who describes a textual genre as a tool. In a hospital, for example, medical reports and prescriptions are common texts that serve the context in which they are used; they cannot be effectively applied in every social communication sphere, as they are laden with resources and artifacts that construct their meaning. Considering the genre studied here—the meme—other aspects of its multimodality must not be overlooked.

A FREIREAN PROPOSAL

Wall (2009) states that in some classrooms, the idea of language as a system of fixed and immutable values still prevails—a rather problematic and closed perspective that disregards language as something living, evolving alongside human and societal changes. The author emphasizes that this limited view of language teaching often results in students becoming disinterested in the content offered to them. A clear example is the frequent use of argumentative-essay writing activities, which are often bound to specific patterns of normative grammar that define what is right or wrong. Based on these observations, Wall argues that language teaching should strive to reflect and demonstrate how language functions, rather than presenting isolated excerpts disconnected from students' realities.

New genres, especially those used in digital environments, possess semantic constructions that can be explored and should have a place in the classroom, just like traditional genres. However, due to a lack of training or pedagogical acceptance in their work environments, many teachers remain tied to traditional teaching methods and normative views of language, avoiding these newly emerged genres. This attachment to traditional views of language and established genres is not a new issue and does not occur only in Portuguese language teaching (VALADARES, 2012). The ideological teaching approach proposed by Paulo Freire in the 1960s addresses this issue and serves as the foundation for numerous educational studies.

In Pedagogia do Oprimido [Pedagogy of the Oppressed] (2011), Paulo Freire asserts that teaching is not merely the transmission of knowledge but the creation of opportunities for its construction. With this proposal, Freire suggests that educators must possess critical awareness and recognize that their teaching should contribute to the development of individuals within society—another reason to understand language and how it functions.

To reach this idea, Freire explains that teaching is an exchange of knowledge in which students are active participants, as the knowledge they possess is essential to the process. He argues that students must study content that is part of their lives, as this is where their interests and needs arise. Such engagement is fostered through students' recognition of what is present in their daily lives.

From this perspective, Freire emphasizes that the educator is not the sole holder of knowledge. In the learning process, there is a mutual exchange of knowledge in which everyone can contribute, and the teacher's role is to organize ideas and relate them to each participant's social context. Freire assigns to the teacher the responsibility of interacting and promoting interaction within the teaching and learning process.

Freire also states that teachers must possess a range of knowledge beyond content expertise, including political and social awareness of all involved. He argues that only then will educators be able to recognize what and how each issue can be addressed. One of the key elements Freire works with is the social dimension.

Freire's stance on social issues stems from a belief that education is a tool for action, capable of driving change. Through educational proposals and the development of critical thinking, individuals can identify what changes are necessary to live in their reality. Freire (2001, p. 51) affirms that "every educational practice involves a theoretical stance on the part of the educator," warning that this leads to "a conception of human beings and the world." Based on these insights, Freire aims to show that content offered mechanically and without connection to students' realities can lead to rejection and learning difficulties. Such content may not contribute to the development of students' critical thinking. He further explains:

> "For me, the difference and the 'distance' between naivety and critical thinking, between knowledge gained through pure experience and that resulting from methodologically rigorous procedures, is not a rupture but a progression. This progression—not rupture—occurs as naive curiosity, without ceasing to be curiosity, becomes critical. By becoming critical, and thus, I repeat, epistemological curiosity, it becomes methodologically rigorous in its approach to the object, lending greater accuracy to its findings." (FREIRE, 2011, p. 31–32)

Reflecting on the creation of a critical individual through language study from a Freirean perspective, it becomes clear that students should not be separated from the social and ideological issues of their world. When presented with classroom content, students must be able to recognize it so they can understand why it is necessary to learn. Language cannot be viewed merely as a set of syntactic structures without considering other factors. In fact, when classes are based solely on such structures, we must not overlook the difficulties many students face with topics like syntactic analysis, pronoun placement, and interpretation of textual genres that are disconnected from their realities, such as letters. These difficulties are directly related to the fact that such content is not part of their lived experience and, therefore, is not

recognized. Freire proposes that the material offered should go beyond simply following the curriculum and should aim to foster critical thinking.

For Freire (2011), the first element necessary for developing critical thinking is the student's connection to the content offered. Once students perceive that the content is part of their reality, it ceases to be seen in isolation. This recognition is the driving force behind reflection and discussion, highlighting its importance in the interaction between school and society. A text production activity, from this perspective, cannot be solely focused on pre-established grammatical norms; it must also relate to content and other aspects of students' lived experiences.

As Freire (2011) affirms, the teaching process must be embedded in a broad context, addressing the social, linguistic, and cultural issues of those involved. In the case of Portuguese language teaching, textual genres can be used for this purpose, as they are products of social spheres and emerge and evolve according to reality.

GRAMMAR OF VISUAL DESIGN

Textual genres emerge and evolve based on socio-cultural needs and, therefore, can vary significantly. The rise of information and communication technologies has favored the emergence of short texts, in which various resources are used to convey maximum meaning in minimal time and space (MARCUSCHI, 2008).

Kress and van Leeuwen (2007) assert that the combination of different resources in the construction of a text renders it multimodal. For the authors, this term is used to represent the various semiotic modes that compose a text (image, graph, table, sound, etc.). Each of these components plays a role in the text creation process and, for this reason, contributes to the construction of overall meaning. Texts with a greater emphasis on written language, such as reports, statements, and articles, tend to focus more on verbal language and its construction, and thus follow a distinct encoding process. However, genres linked to new technologies incorporate resources and modalities derived from these technologies. A clear example of this is the infographic.

Constructed with a predominance of non-verbal language, the infographic genre aims to facilitate understanding of the subject it addresses. It is an example of a multimodal text, as its semantic load is built through the integration of various modes of construction. Hemais (n.d., p. 01) proposes that multimodality:

> [...] is understood [...] as the co-presence of various modes of language, with the modes interacting in the construction of meanings in social communication. What is important in this view of language use is that the modes function together, with each mode contributing according to its capacity to generate meaning.

The author further states that human communication is essentially multimodal, since semiotic modes do not function in isolation but rather in a process of interaction and meaning-making. This is why selection occurs during the text construction process.

Kress and van Leeuwen (2007) emphasize that the choice of each mode is not random. It occurs because each resource involved has its own limitations and possibilities. The text producer makes choices deemed necessary and/or capable of helping the text achieve its intended purpose. This assertion aligns with Marcuschi's (2008) notion of textual genre and Bazerman's (2011) concept of social relations. Marcuschi explains that a genre is produced according to its objective; this is the key factor in its formation. Bazerman states that all discursive production is a product of the sphere in which it was created; thus, it cannot be analyzed without considering its context.

In addition to these factors raised by Kress and van Leeuwen, it is important to highlight that meaning construction through the relationship between written modality and other present modalities is also shaped by the interpretation of each component. Each part contributes to the constitution of the text as a whole.

Multimodality arises from the richness of modalities within the text's structure, as the variation of modalities becomes essential in meaning construction. If we analyze, even the meanings in a conversation between parent and child are composed of at least two language modalities: gestures and speech. Different cultures, with different gestures, may interpret messages in different ways. Modalities and their social frameworks are extremely necessary for understanding a text.

Recognizing that the modalities present in a text's composition are indispensable for its comprehension, Kress and van Leeuwen (2007) propose the Multimodal Discourse Theory. Based on the notion of textual multimodality, the authors observe that the constitution of the modes that compose each genre follows certain criteria, and that each mode carries its own semantic load. In the image of an advertisement, for example, one must consider size, color, its social sphere's semantic load, font, and the network it may form with other modalities. Clearly, these same factors are also connected to other modalities present in the meme genre.

The Multimodal Discourse Theory is grounded in the Grammar of Visual Design. According to Kress and van Leeuwen (2007), just as texts possess a linguistic structure, multimodal genres and the images used within them do as well. The Grammar of Visual Design is divided into a scale of details intended to facilitate the analysis and observation of images used in the communication process and their importance for text comprehension. For the study of a multimodal text, the authors understand that this structure must be observed, as the modality with non-verbal resources is related to other modalities present in the text. The authors subdivide the compositional structure into three systems:Informational

Value (the image and layout of the meme); Salience (the observation of irregular surfaces on a page); Framing (the organization of modalities used in the text and how they assist in constructing its semiosis).

THE MEME IN THE CLASSROOM

One of the problems encountered by students in learning Portuguese is its focus on normative grammar (POSSENTI, 2000). Some students claim that what the teacher aims to teach is not part of their daily lives, which leads to a lack of recognition of the need to learn such content. This lack of recognition is one of the factors contributing to difficulty and demotivation in Portuguese language classes at times.

Breaking away from the customary praxis in native language teaching can occur through the use of language in context. Language accompanies life situations, and contexts give rise to different forms of expression. Language teaching must be connected to these factors so that students themselves can recognize it in their daily lives (MARCUSCHI, 2008).

Numerous technological advances in communication continue to emerge, bringing with them new forms of expression represented by new genres. On the other hand, some formats are gradually abandoned, forgotten, or rarely used, and these are often the focus of native language teaching (KOCH & ELIAS, 2013), which contradicts Freirean educational perspectives. Today, smartphones are in students' hands most of the day and night, serving as constant tools for reading and writing; yet, they rarely have a didactic function in most classrooms. If students' difficulty in learning their native language stems from not recognizing what the teacher presents as part of their lives, the question arises: wouldn't it be valid for classes to work with something that is part of their daily lives and interests? Based on this proposal, we developed the idea of using memes—products of new digital communication forms—in Portuguese language classes.

Presenting students with genres unrelated to their reality is something that must be reconsidered. Teachers must realize that textual production cannot be limited to syntactic and orthographic norms of the language, but must also address current issues and social contexts (MARCUSCHI, 2008). Thus, our proposal to work with memes emerged.

The school where the activity was conducted is the first in Latin America to implement the Pedagogy of Alternation. In this model, students spend one period at home and another at school, and these timeframes are called sessions: one is academic, and the other is socio-familial. Activities are sent home, and students return with them to school, where they are further developed. This methodology provides tools that allow students to bring to school reports and issues from their social and family realities.

The division of periods aims to ensure that students bring empirical knowledge to school and return home with it discussed and developed. The proposal seeks to show students that their lived

experiences are valuable and complement academic knowledge—and vice versa. This approach aligns with Freire (2011), who asserts that teaching is not about transferring knowledge but creating possibilities for its construction and production. Considering the aspects offered by the Pedagogy of Alternation, the textual production activity also embraced this Freirean ideology.

The activity was conducted with a second-year high school class, with students around 16 years old. The initial plan was to work over six lessons. The first two were dedicated to explaining the meme genre and relevant features of its constitution. This point is crucial because, as Marcuschi (2008) states, we have a natural recognition of a text. We understand its function in society, as it "circulates in recurrent and specific environments."

The six lessons were divided into four at school and two during the alternation period, when students were at home. In the first school session, students were asked what they knew about memes. Most recognized the genre, but none could explain its characteristics or components. Important features of the text were then explained, such as the relationship between images and text. This is essential, as verbal and non-verbal messages are the two main modalities of the genre. During this session, students were taken to the multimedia room and shown numerous examples of the text.

During the explanation of meme formation, students showed great interest and recognized the genre. Another factor discussed with them was the chosen image. The textual genre arises from a fact considered important to the social environment. According to Barreto (2015), this factor generates meme replicability, as its production is tied to social values.

After the initial discussion about the proposed genre and the activity plan, students were taken to the computer lab for the production phase. The problem that arose was that, because students recognized the meme, I assumed they had already understood its structural elements. We overlooked Bakhtin's (2003) warning that communication becomes impossible if a discourse is not recognized. Thus, while students knew what a meme was and recognized the genre due to its societal function, we failed to realize that this did not guarantee their ability to produce one.

This issue led to a new explanation of the textual genre. According to Barreto (2015, p. 79), successful meme construction requires "sharing of prior cultural knowledge." For replication to occur, also proposed by the author, there must be a "space in the social context in which it is inserted" (p. 79). In other words, the modalities used in meme construction must have representation in the social sphere.

During the first production session, one observed issue was that students, with internet access, became overwhelmed by the vast array of available images. This, combined with their initial difficulty in constructing the genre, led them to believe that creating a meme was simply about placing an image to illustrate the text. The relationship between existing modalities was incomplete. Upon realizing this, a

second lesson was needed to re-explain the necessary relationships, emphasizing the historical-social semantic load that images carry.

In this second session, we again explained to students the semantic load an image brings to text construction and the importance of carefully choosing both components. As an example, I asked students about the reputation of football player Neymar. Most responded that he is known as a "diver." The boys, especially, said the player is called this by many fans because he is often seen on the ground during matches, sometimes pretending to be fouled or exaggerating contact. Since students were in the multimedia room, I asked them to search for memes using the player's image. Afterward, I asked them to observe that Neymar's image in the texts did not merely illustrate the message, but that the idea of him "diving" was embedded in the meme's message. Then, I gave another example.

After the football player's explanation, I asked the class to search for memes about Formula 1 driver Rubens Barrichello. I asked if they understood, and most said no. I then explained that due to certain events in Formula 1 years ago, the Brazilian driver became the subject of jokes in some circles. His reputation in those contexts is tied to being second place or arriving late. After this explanation, nearly all students understood the memes they viewed.

We used these examples to help students understand how the two modalities present in the text are crucial in constructing meaning. They realized that the memes they viewed would not convey the same message if they featured a different player or driver. After this explanation, students resumed their text productions—with different results.

The analysis was divided into two parts. The first includes texts that can be considered satisfactory, based on Barreto's (2015) conceptions of the meme genre. The second includes the students' initial productions, when they still had difficulty perceiving the meaning constructed through the modalities present in the text. In the first group, student productions are categorized according to the image used.

The first productions used images of President Dilma Rousseff. Text comprehension depends on the social relationships of both the producer and the reader. At the time of the activity, Brazil was experiencing a political crisis, and the president's image was frequently circulated in the media. Through the memes produced, we observed the relationship between image and text, as well as the students' political stance.

Figure 1. Original text in Portuguese (Brazil): “Pesticides harm the skin.”

Figure 2. Original text in Portuguese (Brazil): “The problem is the tomato.”

Figure 1 shows the president with a distressed expression. Being a 68-year-old woman, she has natural dermatological marks. The written modality states, “pesticides harm the skin,” a factual statement that gives the image a pejorative tone linked to age. The image constructs meaning based on aesthetics and appearance, implying that the president is somehow associated with pesticides—an undesirable connection. In this way, it suggests that she is somehow associated with pesticides, which is not a good thing. The second image is loaded with irony, since the blame for the use of pesticides does not lie with the tomato, but with the producer of the food. Moreover, the tomato is not even the food that contains the highest amount of pesticides, as was explained. This image also brings an aspect that cannot be overlooked: color. According to Kress and van Leeuwen (2007), color carries a load of meanings in the social environment and is therefore very important in constructing the meaning of a genre.

Figure 2 shows the president in a position that appears to be explaining something, which gives the message a significant semantic weight. Common sense says that the tomato is the food that uses the most pesticides in its production process. However, this is incorrect information, and since the students in their technical course have access to this data, they based their activity on that knowledge. The online magazine Globo Rural published, in 2011, a report analyzing pesticides in food conducted by the National Health Surveillance Agency (Anvisa). In this report, the ten food products that most consume pesticides are: bell pepper, strawberry, cucumber, lettuce, carrot, pineapple, beet, kale, papaya, and tomato; and the

students used this knowledge in their production. The red color present in this figure, besides making the text more visible, is the color that represents the tomato. Once again, the semantic representation is built through color, as affirmed by Kress and van Leeuwen (2007).

Figure 3. Original text in Portuguese (Brazil): “Organic products.”

Figure 4. Original text in Portuguese (Brazil): “Pesticides; Organic.”

While the first two constructions imply a critique of the president, the next ones take a different perspective. In both images, Dilma Rousseff is associated with organic products—those that are better, healthier, and beneficial. Unlike Figures 1 and 2, in Figure 3, the president appears with a happy expression, making a gesture of support. It can be interpreted as a message encouraging the use of organic products because they are good. The face of the president used in the first figure shows a tense or anxious person. However, the one used in Figure 3 does not show that. The choice of this image is meant to support the idea of support for organic products, a proposal of the school. Kress and van Leeuwen (2007) affirm that the use of an image in a multimodal text is only valid if it dialogues with the other modalities present.

Looking at Figure 4, we can revisit the observations of Bakhtin (2003) and later Marcuschi (2008), that language is a product of the social sphere. Brazil is undergoing political turmoil related to the impeachment, in which part of society supports it and another part claims it is a political coup. One of the individuals involved in this supposed coup is Vice President Michel Temer, who appears in the meme. Furthermore, an individual who does not understand the situation will have difficulty comprehending the genre produced, as proposed by Barreto (2015).

Figure 5. Original text in Portuguese (Brazil): “They didn’t count on my PPEs.”

Figure 6. Original text in Portuguese (Brazil): “Chapolim, he didn’t use PPEs.”

Figures 5 and 6 were chosen for using the image of a character very present in memes and other multimodal genres circulating on the internet: Chapolin Colorado. Both texts address the same topic: personal protective equipment, known as PPEs.

Throughout the technical course, the school does not propose that pesticides cannot or should never be used. It states that they should be avoided, reduced, and used only when absolutely necessary. But a technician must be aware that they are harmful to the health not only of those who consume the food with them but also of those who apply them to the crops. For this reason, students must know how to use them, always seeking resources aimed at protecting their health—PPEs.

Chapolin Colorado carries the image of a clumsy hero, a success across many generations, and it is rare for someone to see him and not recognize him. This likely motivated the students to choose this image for constructing the genre. As Barreto (2015) states, for a text belonging to this genre to be produced and understood, it is necessary that both the text and the image carry a load of meaning with significant social representation (characters, famous people, events, etc.).

Chapolin is a well-known character from a TV show of the same name. Moreover, he has a famous phrase in his episodes: “They didn’t count on my cleverness,” always used when he solves a problem. This phrase was used in the textual modality of Figure 5, adapted to: “They didn’t count on my PPEs!” This theoretical construction aligns with Dawkins’ theory of meme heredity (apud Barreto, 2015), which states that the text arises from the recombination of an original idea, and even after it has changed, it remains recognizable. While Figure 5 gives a positive message to those who use safety equipment, Figure 6 proposes the opposite.

In Figure 6, the character played by Rubén Aguirre, famous for being Professor Girafales, explains to Chapolin why he is on the ground: the lack of PPE use. Just like the previous figures, these two Chapolin memes propose two points of view on the topic: using and not using the equipment. On the other hand, from a more reflective perspective, it is possible to infer that the school is forming students with a more critical awareness of rural life, as they seem at least minimally aware of an important issue in this context.

Figure 7. Original text in Portuguese (Brazil): “When somebody says the food is organic.”

Figure 7. Original text in Portuguese (Brazil): “When somebody tells me the food is organic!”

This critical perspective is reinforced in Figure 7. There is enormous difficulty in producing 100% organic food, and that is why it is expensive. In addition to the non-use of pesticides directly, there are factors related to the soil, neighboring properties, the harvesting process, transportation, and processing. For this reason, obtaining an organic product certification is a laborious process, and there is not a large

quantity of such products when compared to conventional ones. With this knowledge acquired in their technical training, the student created a meme in which the image of the smiling then-President of the United States ironically refers to the production of this type of food.

Even if the reader is unaware of the difficulty in producing organic food, the structure of the meme helps construct this meaning. This is because the image of Barack Obama laughing is a widely known meme used to convey messages of irony and sarcasm. Combined with the image, which already carries this semantic load, the phrase referencing organic products ends up constructing a meaning that can be recognized by readers familiar with the meme in question. An individual who does not possess understanding of any of the modalities present in the text will not be able to comprehend it, since "in the current view, the reader is not a conscious subject and owner of the text, but is inserted in the social reality and must operate on contents and sociocultural contexts with which they deal permanently" (MARCUSCHI, 2008, p. 231).

The use of the runner Usain Bolt in the construction of the text in Figure 8 was very interesting; it shows that the students have their own awareness that organic products are healthier and, for that reason, they want them on their tables. Placing the runner alongside the message "when they tell me the food is organic" conveys the idea that one must hurry to get it—therefore, it is something good. Once again, the production shows that the school's proposal is gradually being embraced by its students. Kress's (2010) statement about the social relationships of those who read the text is important. Knowing that he is a runner evokes the idea of wanting to reach something; recognizing who the athlete is and the semantic load Usain Bolt carries regarding human speed further enhances this semantic construction.

Although they recognized themselves as readers, the students had great difficulty in producing. At that moment, they thought the image was simply a complement to the text, and not that both parts were of extreme importance in a multimodal way. Moreover, there was a lack of concern on their part regarding details related to the compositional structure proposed by Kress and van Leeuwen, such as font size, color, and placement.

Looking at the first eight productions in our analysis, we can affirm that they represent the multimodal textual genre of our research: the meme. However, as already mentioned, the students' ability to construct it did not occur at first. Due to a lack of recognition of the linguistic artifacts of the genre, the students believed that creating a meme was simply about illustrating the message they wanted to convey, and they had not yet realized that meaning construction in the text is achieved through multimodal convergence in a unified form within the meme. The next eight analyses are examples of this failure in production.

During the analysis of the first eight texts, we noticed that the genre used multimodality to construct itself. Even though the theme of the activity—pesticides—had been previously shared with the

students, the memes they created were not solely based on it. The images of the President, Chapolin, Obama, and Bolt were extremely important for understanding the final product. Our caveat is that, semiotically speaking, the visual modality isolated from the written modality has no direct connection with pesticides and the issues related to them; of course, the visual modality in these examples belongs to our social sphere, and therefore they are effectively constitutive of the meme genre—which did not happen in the next examples.

FINAL CONSIDERATIONS

There is a vast and ongoing academic discussion regarding the use of textual genres in native language teaching, and the consensus among participants is clear: they are in favor. Nevertheless, it is not uncommon to encounter teaching materials and lesson plans focused exclusively on normative grammar.

Sírio Possenti, in his book Por que (não) ensinar gramática na escola (2000), argues that this occurs because the role of the school is to teach the standard language. He further states that teaching is often laden with political and prejudiced values. As a result, classrooms demand a language used by a minority of the population—those privileged individuals who have had access to education, culture, books, and the internet. Consequently, most of the population is expected to master linguistic artifacts that are not part of their everyday lives. Possenti also raises another issue: the sociolinguistic diversity in Brazil, which reinforces his initial argument.

Although Possenti highlights these points, his work does not aim to demonstrate that normative grammar is taught incorrectly or that it should not be taught. Rather, he seeks to offer suggestions for improving the process and identifies what he considers to be its problems.

His observations are valid and rooted in sociolinguistics. This issue motivated our interest in the specialization in Informatics in Education. In the context of Portuguese language teaching, it is common to encounter textual genres that emerge from technology; however, few of these are addressed in the classroom and are often ignored—as if they did not exist. Most teachers overlook a significant part of their students' lives.

We learn to communicate without necessarily undergoing formal educational processes. Even so, through necessity, interaction, and meaningful contexts, learning occurs, as Freire (2011) affirms. In this light, Marcuschi (2008) emphasizes that any text can be effectively used in learning, stating that "there is no linguistic problem whatsoever, provided that the category of text includes both spoken and written forms" (p. 51). For this reason, he highlights the numerous aspects that can be explored through textual genres. The major technological transformations in communication and the way language adapts to them cannot be ignored by schools or teaching methodologies.

We must not forget Possenti's (2000) assertion that teaching grammar in an isolated, normative format is socially disconnected. This mechanical methodology contributes to students' lack of interest, as content that does not reflect their lived experiences is not engaging—an idea also supported by Freire (2011). Thus, a textual genre that is part of students' daily lives can serve as a motivator and a tool for connecting and constructing knowledge.

When classes fail to keep pace with the emergence of new communication media, problems and difficulties often arise for both teachers and students. Marcuschi (2008, p. 90) asserts that teaching a language involves much more than linguistic resources; it involves "discursive operations for meaning-making within a given culture, using specific genres as forms of linguistic action." Therefore, if one of the genres students engage with most is the meme, it can be a viable option for delivering content. If, ten years from now, memes are no longer used—just as letters have fallen out of favor—teachers must adapt to these transformations.

Regarding the meme production activity with the second-year high school class, it was deemed successful. Initially, students struggled to produce genres that are part of their daily lives, but they gradually became more confident as their understanding deepened. Moreover, the school's limited access to functioning computers during the students' sessions posed a challenge. Nevertheless, the shift away from the idea that Portuguese language classes should focus solely on written modality and exclude technology-related multimodalities marked an important first step. Although students were initially hesitant and faced difficulties in their productions, over time they began to create with more humor and developed a critical sense regarding the textual genres present in the technological environments where they spend much of their time.

Through this work, we were able to put into practice the academic theory that Portuguese language classes can be taught through textual genres. Students realized that creating a meme is not simply about placing an image and text side by side, but about relating, debating, and reflecting on the theme and the interaction between the modalities present in the text.

In conclusion, the activity proved to be highly beneficial, though it requires better organization and planning when implemented with students. Despite their frequent use of the meme genre, students did not easily assimilate it into an educational context—likely because the genre does not yet belong to that sphere. This provides further justification for such a pedagogical shift. Although students enjoy activities involving communication technology, they belong to a dogmatic society. Teachers must be aware of this and demonstrate that clinging to isolated grammatical norms disconnected from our lived context does not support Freirean educational principles.

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