Interdisciplinary teaching proposal: the life and legacy of Nikolai Vavilov as a tool against scientific denialism

Proposta didática interdisciplinar: a vida e o legado de Nikolai Vavilov como ferramenta contra o negacionismo científico

Heslley Machado Silva[1]

Anthony K Nairn[2]

ABSTRACT

This article aims to present and discuss the construction of an interdisciplinary teaching proposal based on the trajectory of Russian scientist Nikolai Vavilov, emphasizing his scientific legacy and its potential as a didactic-formative tool to counter scientific denialism. The proposal was developed through bibliographic review, narrative analysis of Vavilov's historical journey, selection of audiovisual materials, and the design of pedagogical activities articulated across the disciplines of Science, Biology, History, Philosophy, and Geography. As a result, a didactic sequence was structured in seven stages, including discussions on genetic diversity, the history of science, authoritarian contexts, sacrifice in the name of knowledge, and analogies with contemporary issues, particularly climate denialism and digital pseudoscience. The proposal culminates in critical student reflections, expressed through essays and presentations. It is concluded that the study of Vavilov's life and legacy can foster scientific, ethical, and historical thinking in students, promoting the development of critical awareness in the face of disinformation. The study meets the standards of methodological clarity and provides tools for educators to replicate or adapt the didactic sequence in diverse school contexts.

Keywords*:* Nikolai Vavilov; genetic diversity; seed bank; education; scientific denialism.

[1] Professor e pesquisador pelo Centro Universitário de Formiga/MG (UNIFORMG) e pela Universidade Estadual de Minas Gerais (UEMG), Ibirité/MG. Doutor em Educação pela Universidade Federal de Minas Gerais (UFMG), Belo Horizonte/MG. Email: heslley@uniformg.edu.br. ORCID: https://orcid.org/0000-0001-8126-8962.

[2] Doutorando no Departamento de Humanidades da Universidade de York (Toronto). Email: anairn@yorku.ca. ORCID: https://orcid.org/0009-0009-9583-8749.

RESUMO

Este artigo tem como objetivo apresentar e discutir a construção de uma proposta didática interdisciplinar baseada na trajetória do cientista russo Nikolai Vavilov, com ênfase em seu legado científico e em seu potencial como instrumento didático-formativo para o enfrentamento do negacionismo científico. A proposta foi elaborada a partir de revisão bibliográfica, análise narrativa da trajetória histórica de Vavilov, seleção de materiais audiovisuais e elaboração de atividades pedagógicas articuladas entre as disciplinas de Ciências, Biologia, História, Filosofia e Geografia. Como resultado, estruturou-se uma sequência didática em sete etapas, contemplando discussões sobre diversidade genética, história da ciência, contextos autoritários, sacrifício em nome do conhecimento e analogias com questões contemporâneas, em especial o negacionismo climático e as pseudociências digitais. A proposta culmina em reflexões críticas dos estudantes, expressas por meio de redações e apresentações orais. Conclui-se que o estudo da vida e do legado de Vavilov pode estimular o pensamento científico, ético e histórico dos alunos, promovendo o desenvolvimento da consciência crítica frente à desinformação. O estudo atende aos critérios de clareza metodológica e oferece subsídios para que educadores repliquem ou adaptem a sequência didática em diferentes contextos escolares.

Palavras-chave: Nikolai Vavilov; diversidade genética; banco de sementes; educação; negacionismo científico.

1 INTRODUCTION

Nikolai Ivanovich Vavilov, a name that unfortunately remains in the shadows of public recognition, is a remarkable, if little-known, figure in the annals of the history of science (Vavilov; Dorofeev, 1992). It's a name that rarely echoes in the halls of education or in academic conversations, but his life and legacy transcend the anonymity that time and neglect have imposed on him (Cohen; Loskutov, 2016). Its role in cataloging, studying and storing seeds, including those from the tropical region, is undeniable. His contributions echo to this day for those who study botany in different parts of the world.

The use of historical narratives in science education has long been recognized as a powerful strategy to foster conceptual understanding, critical thinking, and epistemological reflection among students. By contextualizing scientific ideas within their socio-political and philosophical backgrounds, the history of science (HOS) enables learners to grasp the dynamic, human, and sometimes controversial nature of scientific development (Matthews, 1994). This becomes particularly urgent in a context where misinformation spreads rapidly through digital media, and even educators may become vulnerable to false or manipulated scientific narratives (Silva et al., 2024). This approach also helps to demystify science and resist simplistic views of scientific knowledge as purely objective or linear (Rudge, 2000). Despite the recognized potential of HOS in science teaching, there is a notable lack of pedagogical materials based on figures such as Vavilov, which highlights the originality and relevance of the present proposal (Allchin, 2004).

Born in 1887 in Tsarist Russia, Vavilov emerged as a visionary pioneer in understanding the importance of the genetic diversity of seeds for the survival of humanity (Baranski, 2014). However, his innovative vision of collecting, preserving and studying seeds from all over the world to mitigate the threat of famine faced a trajectory full of adversity and tragedy (Levina; Yesakov; Kisselev, 2005). His work constituted considerable advances in relation to how the genetic characteristics of plants are transmitted, exalting Mendel's findings and indicating ways in which these findings could be applied to modern agriculture (Vavilov, 1922).

Vavilov was the first to realize the need to create a global seed bank, a storehouse of genetic diversity of cultivable plants, intended to serve as a vital resource for

humanity's food security (Vavilov, 1951). His vision extended beyond mere preservation, embracing the idea that a seed bank could also be a source of food and study in times of scarcity, a reality that many were already facing, especially in his native Russia and later in the Soviet Union (Glants; Toomre, 1997).

Vavilov's relentless pursuit of knowledge led him to undertake global expeditions, collecting precious seeds and identifying areas of critical importance for the preservation of genetic diversity (Vavilov, 1997). However, he faced not only scientific challenges, but also political and ideological obstacles, which came from his disciples, interested in gaining social, ideological and academic status in a society marked by political authoritarianism and competition for academic space and influence (Kolchinsky, 2014).

In a scientific environment marked by the competing (pseudo) scientific claims of Trofim Lysenko, a former pupil and academic rival, and by the first hints of scientific fake news (Dejong-Lambert; Krementsov, 2017), Vavilov fought politics and rivalries to protect his vision and his work. His opponents, led by Lysenko, not only slandered his research, but also drove millions of Russians to starvation by promoting disastrous agricultural practices based on faulty scientific research and reasoning (Roll-Hansen, 2005).

Vavilov’s vision of a seed bank became a reality in the 1920s as Vavilov travelled to 64 countries on 115 expeditions, collecting seeds under the ideals of the Bureau of Applied Botany. Under Vavilov’s vision and leadership, the Bureau was led with the ideal of protecting the world’s food supply, and Vavilov was active in pursuing that goal. Establishing the seed bank in the Bureau’s headquarters in Leningrad (St. Petersburg), the Bureau, a magnificent three-story building that looked more like a luxury hotel than a scientific organization, was the center of Vavilov’s vision. But Vavilov's story faced its darkest chapter with World War Two.

Once the alliance with Nazi Germany broke after the surprise invasion of Nazi forces in the summer of 1941, the Soviets underwent a grueling and harsh resistance, especially in Leningrad where the Siege of Leningrad would become one of the longest sieges in history at 872 days. The Bureau of Applied Botany, in the heart of Leningrad was precariously located, and moreover, had nutrients in the source of the seeds collected. Having worked with Vavilov for what became an important mission not only for the people of Russia and the Soviet Union, but for science and the world, some of the

scientists stayed to protect what they believed to be work of the utmost importance (Levina; Yesakov; Kisselev, 2005).

Facing starvation as Nazi troops laid siege to the city (Gerhard, 2015), twelve of Vavilov's fellow scientists, despite having access to the stored seeds, refused to consume the nutrients contained within the over 380,000 seeds of the bank, choosing instead to defend the seed bank. They ultimately all died of starvation. They protected the seeds because of they believed it to be right (Loskutov, 2021). The drama of Vavilov's legacy is too important to be hidden from view.

Vavilov himself ended up imprisoned as a traitor, a victim of Lysenko's intrigues (as well as many others) and Stalin's authoritarianism, probably dying of starvation due to malnutrition (Pringle, 2008). A tragic irony befell the scientist who dedicated his life to fighting hunger, for he himself was a victim of it (Kolchinsky, 2014).

Nikolai Ivanovich Vavilov's story is both moving and fascinating. It teaches us much about the value of science, perseverance in the face of adversity and the dangers of denying science (Corinto, 2019). It also suggests the value of science beyond its epistemic claims, offering a place for reflection upon the metaphysical dimensions of value and purpose more broadly. Vavilov's legacy lives on in the formidable "Svalbard Seed Bank," built in 2008 in the Norwegian Arctic, a "seed" that could one day sustain humanity in times of calamity (Hopkin, 2007). Vavilov's life reminds us of the importance of protecting and nurturing scientific knowledge, refuting conspiracy theories, even in the darkest circumstances, for the sake of the well-being of all humanity (Harris, 1988).

While Vavilov's trajectory is undeniably remarkable, it is crucial to avoid constructing a narrative that idealizes his life as a heroic saga, since such distortions risk falling into what can be defined as "pseudohistory": an idealized or inaccurate portrayal of scientific episodes that may compromise students' understanding of how science actually operates (Allchin, 2004). In this sense, this article seeks to preserve a critical and historiographically balanced perspective, recognizing both the scientific contributions and the socio-political contingencies that shaped his work (Allchin, 2004), and adopting a historiographical posture supported by academic literature that warns against the dangers of romanticization and oversimplification in educational contexts (Tavares; Prestes, 2012).

In this context, the present article aims to analyze the potential of Vavilov's life story as an interdisciplinary pedagogical tool to promote critical thinking and counteract scientific denialism in high school education. Specifically, the study intends to: (1) examine the historical and scientific significance of Vavilov's contributions; (2) discuss their didactic potential through an interdisciplinary lens; and (3) present a structured teaching proposal that enables educators to explore themes such as the history of science, authoritarianism, ethical choices in scientific practice, and contemporary issues related to misinformation and denialism. By doing so, the article seeks to demonstrate how historical narratives can foster scientific literacy and critical awareness among students.
It is important to highlight that the didactic sequence proposed in this article has not yet been empirically applied. Rather, this work constitutes a theoretical and exploratory contribution, aimed at enriching the field of science education by offering an interdisciplinary framework centered on a historically underexplored figure. Future studies are encouraged to implement and evaluate the pedagogical effectiveness of this proposal in classroom contexts, using qualitative or mixed-method approaches.

2 METHODOLOGICAL FRAMING OF THE PROPOSAL

Although this article does not present an empirical intervention with data collection and statistical analysis, it is grounded in a theoretical-methodological approach consistent with the field of research in science education. Pedagogical proposals must be based on structured planning and theoretical assumptions that articulate content, methodology, and objectives (Zabala, 2015). This study is better characterized as a theoretical and exploratory contribution, structured upon design principles and grounded in science education literature, but without empirical implementation at this stage (Barab; Squire, 2016). The stages of the proposed sequence follow the logic of interdisciplinary articulation, inspired by historical-critical pedagogy and socio-scientific issues, which have shown promising results in promoting critical scientific literacy (Aikenhead, 2006).

In line with the Brazilian National Common Curricular Base, interdisciplinarity is understood as a pedagogical orientation that fosters integration between knowledge fields in order to build critical and contextualized learning (Branco et al., 2018; Nogueira; Dias, 2018). It transcends the mere juxtaposition of subjects, aiming for a dialogical and

integrative construction of knowledge (Lund, 2016; Mengis; Nicolini; Swan, 2018). It should be seen not only as a methodological option but also as a cultural stance (Fazenda, 1994). Its emancipatory role lies in connecting knowledge to lived reality (Freire, 2014). It also requires collaborative work to strengthen coherence in curriculum and practice (Lück, 2017). In this proposal, History contributes with contextual elements of authoritarianism; Science and Biology offer the genetic and ecological content; Philosophy provides ethical and epistemological reflection; and Geography links Vavilov's expeditions to spatial and environmental dynamics. Conversely, all these fields benefit from interdisciplinary dialogue by strengthening critical and civic education against denialism.

2.1 Interdisciplinary teaching proposal: the life and legacy of Nikolai Vavilov as a tool against scientific denialism

While the objectives of the article relate to the analysis and presentation of an interdisciplinary educational model, the following section outlines the specific pedagogical objectives of the proposed didactic sequence to be implemented in the classroom context.

General Objective: To promote a comprehensive understanding of the life and legacy of Nikolai Vavilov, exploring his importance in the history of science and reflecting on the lessons his career offers for the disciplines of Science, Biology, History, Philosophy, and Geography, as well as for the phenomenon of scientific denialism in today's society.

Target audience: High school students.

Estimated duration: The proposal can be developed over several lessons, or however the teacher chooses to develop the activities, depending on the depth of the discussions and how the teacher intends to approach the stages. It is up to the teacher to assess the possibilities of using this didactic proposal in its entirety or not, how long it will take in each of the stages and how they will conduct these discussions.

Conceptual justification of the didactic proposal

The teaching proposal presented here is based on pedagogical strategies grounded in the literature on science education that values the role of narrative, interdisciplinarity,

and the history of science as didactic tools. Introducing historical episodes into science education fosters students' understanding of the nature of science and its epistemological foundations (Matthews, 1994). Additionally, the proposal is aligned with the concept of *contextualized teaching*, which seeks to relate scientific content to contemporary socio-political challenges (Sasseron; de Carvalho, 2011). The life of Vavilov, in this context, functions not only as historical content but as a trigger for discussions on ethics, scientific rigor, denialism, and civic responsibility.

In addition to the international literature mobilized, the proposal also aligns with Brazilian discussions in Science Education, particularly within the CTSA perspective. It emphasizes the importance of socio-scientific issues as an axis for science education (Fernandes; Gouvêa, 2020; Melo; Conrado; Neto, 2024). It highlights the role of contextualized teaching for scientific literacy (Santos; Mortimer, 2001). It stresses the importance of problematization and interdisciplinarity for meaningful learning (Pierson; Neves, 2001; Vieira et al., 2017). This dialogue reinforces the proposal's relevance for the Brazilian educational reality, where critical engagement with denialism is directly linked to democratic citizenship.

3 PROPOSED STAGES

3.1 Introduction

- The teacher begins the lesson by asking the students about the importance of learning about the history of scientists, their contributions to humanity, and the philosophical implications therein.
- The teacher introduces the Russian scientist Nikolai Vavilov as an important but relatively unknown figure in the history of science, highlighting his pioneering views on seeds and genetic diversity.
- The teacher uses an excerpt from the video series *Cosmos: Possible Worlds*, starting with the opening minutes of episode four "Seeds of the World", which is focused entirely on Vavilov and his life and research saga, as both introduction and starting point for the discussion.

3.2 Vavilov and his scientific contribution

- The teacher details Nikolai Vavilov's life story, emphasizing his views on the importance of the genetic diversity of seeds and the creation of a seed bank. Using clips from episode four of *Cosmos* to connect ideas and introduce achievements.
- Discussion about Vavilov's travels around the world to collect seeds and his choice of "centers of origin" for plants.
- Activity: Students research and present the geographical regions of the "centers of origin" of plants and how these regions relate historically, biologically and geographically to the rest of the world.

3.3 The historical-scientific context

- Analysis of the historical context in which Vavilov was situated, including the Second World War, technological and scientific pressures on the Allies and the Axis, the Nazi siege of Leningrad and Stalin's authoritarianism. The teacher will continue to use clips from *Cosmos* to bring visual detail into the learning.
- Discussion of Vavilov's competition with Trofim Lysenko's pseudoscience and how this affected his work and his life.

3.4 Philosophical reflections

- Teacher will foster an environment that opens the class to discussion on what students identify as themes from what they have learned so far about Vavilov, the context of his environment, and the implications for science generally. The teacher will ask students to expand their thinking, requiring flexibility and guidance.
Activity: Discuss specifically the death of the scientists and their choice to protect the seeds while starving, drawing out what and how the students think about such an act. Important to direct students' attention to the affect of the sacrifice, and get them to consider it against idea of science as objective, rationale, and "disenchanting".

3.5 Reflections on the current world and scientific denialism

- Discussion about scientific challenges and denialism in the 21st century, such as the COVID-19 pandemic and the anti-vaccine movement, climate change denial and the spread of scientific fake news (Silva, 2021).
- Activity: Students reflect on the reasons that lead a society to follow pseudoscience and how the internet and social networks may enable and enhance this phenomenon.

3.6 Parallels with history

- Comparison between the pseudoscience promoted by Lysenko and current science denialism.
- Discuss how pseudo-scientific ideologies can damage societies, countries and regions. Reflect on the consequences of scientific denialism in the political field, and how unsubstantiated decisions can lead to disasters, using the issue of global warming as an example of this risk. Also reflect on the difference between substantiated claims being applied via unsubstantiated means. Important here to stress the role of informed citizenry to avoid “good” technologies and science being adopted with “bad” public policies.
- Analysis of climate catastrophes in various parts of the world, relating them to the scientific evidence on climate change and the scientific denialism that persists on the internet and social networks.

3.7 Lessons learned

- Students share their perceptions of the historical events in Nikolai Vavilov's life and the lessons learned in science, biology, history, philosophy, geography and other subjects.
- Discussion on the value of evidence-based science and the risks of scientific denialism.
- Closing with a reflection on how Vavilov's story can inspire an appreciation of science and its role today. Also reflect on the perception of science as presented in *Cosmos*, drawing out the meaning-making role that science had for the scientists of the Bureau of Applied Botany, ultimately leading to their deaths.

4 EVALUATION

Assessment can be carried out through class discussions, student presentations, participation in the proposed activities and a reflective essay on the lessons learned from Nikolai Vavilov's life and legacy. In addition, the ability to establish interdisciplinary connections and critically reflect on contemporary scientific denialism should also be considered in the assessment.

5 FINAL CONSIDERATIONS

The aim of this article was not only to present an educational strategy but also to reflect critically on how historical-scientific narratives, such as that of Nikolai Vavilov, can be pedagogically mobilized to strengthen students' understanding of science, ethics, and civic responsibility in an era of widespread scientific denialism. This proposed activity is intended to enhance the teaching of various subjects and should lead students to reflect on the importance of knowing the events of the past, especially to avoid repeating mistakes in the present and in the future. A relatively simple activity is proposed, but one that can trigger knowledge related to various fields, while at the same time rescuing Vavilov's legacy, which is almost unknown, especially in education, even in science education. It is also intended that through this activity students, and even teachers, can realize the risks of scientific denialism, so much in vogue today, through the internet and social networks.

Finally, it is important to recognize that the proposal presented here should be understood as an initial contribution that requires empirical testing and evaluation. Future implementations of the sequence in diverse educational contexts will be essential to assess its real impact on students' scientific literacy and critical thinking, especially in relation to historical reasoning and resistance to pseudoscientific narratives. While the lack of statistical or empirical data precludes definitive claims about its efficacy, the theoretical foundation of this proposal and its alignment with current debates in science education indicate its relevance as an initial contribution that invites future empirical research and application in varied educational contexts (Barab; Squire, 2016).

REFERENCES

AIKENHEAD, Glen S. **Science education for everyday life: evidence-based practice**. New York: Teachers College Press, 2006.

ALLCHIN, Douglas. Pseudohistory and pseudoscience. **Science & Education**, v. 13, p. 179-195, 2004.

BARAB, Sasha; SQUIRE, Kurt. Design-based research: putting a stake in the ground. In: _____. **Design-based research**. New York: Psychology Press, 2016. p. 1-14.

BARANSKI, Marci. Nikolai Ivanovic Vavilov (1887–1943). **Embryo Project Encyclopedia**, 2014. Disponível em: https://embryo.asu.edu.

BRANCO, Emerson Pereira et al. Uma visão crítica sobre a implantação da Base Nacional Comum Curricular em consonância com a reforma do Ensino Médio. **Debates em Educação**, v. 10, n. 21, p. 47-70, 2018.

COHEN, Jeffrey I.; LOSKUTOV, Igor G. Exploring the nature of science through courage and purpose: a case study of Nikolai Vavilov and plant biodiversity. **SpringerPlus**, v. 5, n. 1, p. 1-9, 2016.

CORINTO, Giovanni. Cultivation as taking care of plant diversity and global commons: Nikolai Ivanovich Vavilov's legacy. **Human Evolution**, v. 33, p. 59-73, 2019.

DEJONG-LAMBERT, William; KREMENTSOV, Nikolai. **The Lysenko controversy as a global phenomenon: genetics and agriculture in the Soviet Union and beyond**. Cham: Springer, 2017.

FAZENDA, Ivani Catarina Arantes. **Interdisciplinaridade: história, teoria e pesquisa**. Campinas: Papirus, 1994.

FERNANDES, José Paulo; GOUVÊA, Guaracira. A perspectiva CTS e a abordagem de questões sociocientíficas no ensino de ciências: aproximações e distanciamentos. **# Tear: Revista de Educação, Ciência e Tecnologia**, v. 9, n. 2, 2020.

FREIRE, Paulo. **Pedagogia da autonomia: saberes necessários à prática educativa**. Rio de Janeiro: Paz e Terra, 2014.

GERHARD, Gesine. **Nazi hunger politics: a history of food in the Third Reich**. Lanham: Rowman & Littlefield, 2015.

GLANTS, Musya; TOOMRE, Joyce. **Food in Russian history and culture**. Bloomington: Indiana University Press, 1997.

HARRIS, Chauncy D. Nikolay Ivanovich Vavilov (1887-1943). **Soviet Geography**, v.

29, n. 7, p. 653-657, 1988.

HOPKIN, Michael. Norway unveils design of 'doomsday' seed bank. **Nature**, v. 445, n. 7129, p. 693-694, 2007.

KOLCHINSKY, Eduard I. Nikolai Vavilov in the years of Stalin's "Revolution from Above" (1929–1932). **Centaurus**, v. 56, n. 4, p. 330-358, 2014.

LEVINA, Elena S.; YESAKOV, Viktor D.; KISSELEV, Lev L. Nikolai Vavilov: life in the cause of science or science at a cost of life. **Comprehensive Biochemistry**, v. 44, p. 345-410, 2005.

LOSKUTOV, Igor G. Wartime activities of the Vavilov Institute. **Trudy po Prikladnoi Botanike, Genetike i Selektsii**, v. 182, n. 2, p. 151-162, 2021.

LÜCK, Heloísa. **Gestão educacional: uma questão paradigmática**. Petrópolis: Vozes, 2017.

LUND, Kristine. **Modeling the individual within the group: an interdisciplinary approach to collaborative knowledge construction**. Grenoble: Université Grenoble Alpes, 2016.

MATTHEWS, Michael R. **Science teaching: the role of history and philosophy of science**. New York: Routledge, 1994.

MELO, Paulo Nascimento; CONRADO, Dália Melissa; NETO, Nílson de Freitas Nascimento. Aproximando pedagogia libertadora, educação CTSA crítica e ensino por QSC para ações sociopolíticas e socioambientais. **Alexandria: Revista de Educação em Ciência e Tecnologia**, v. 17, n. 1, p. 7, 2024.

MENGIS, Jeanne; NICOLINI, Davide; SWAN, Jacky. Integrating knowledge in the face of epistemic uncertainty: dialogically drawing distinctions. **Management Learning**, v. 49, n. 5, p. 595-612, 2018.

NOGUEIRA, Lívia; DIAS, Juliana Pereira. Base Nacional Comum Curricular (BNCC): sentidos em disputa na lógica das competências. **Revista Investigações**, v. 31, n. 2, p. 26-48, 2018.

PIERSON, Alice; NEVES, Marcos Rogério. Interdisciplinaridade na formação de professores de ciências: conhecendo obstáculos. **Revista Brasileira de Pesquisa em Educação em Ciências**, v. 1, n. 2, 2001.

PRINGLE, Peter. **The murder of Nikolai Vavilov: the story of Stalin's persecution of one of the great scientists of the twentieth century**. New York: Simon & Schuster, 2008.

ROLL-HANSEN, Nils. The Lysenko effect: undermining the autonomy of science. **Endeavour**, v. 29, n. 4, p. 143-147, 2005.

RUDGE, David W. Does being wrong make Kettlewell wrong for science teaching? **Journal of Biological Education**, v. 35, n. 1, p. 5-11, 2000.

SANTOS, Wildson Luiz Pereira dos; MORTIMER, Eduardo Fleury. Tomada de decisão para ação social responsável no ensino de ciências. **Ciência & Educação**, v. 7, p. 95-111, 2001.

SASSERON, Lúcia Helena; DE CARVALHO, Anna Maria Pessoa. Alfabetização científica: uma revisão bibliográfica. **Investigações em Ensino de Ciências**, v. 16, n. 1, p. 59-77, 2011.

SILVA, Heslley M. The danger of denialism: lessons from the Brazilian pandemic. **Bulletin of the National Research Centre**, v. 45, n. 1, p. 55, 2021. Disponível em: https://doi.org/10.1186/s42269-021-00516-y.

SILVA, Heslley M. et al. Fake news about the environment: how Brazilian, Colombian, and Mexican science teachers react. **Revista Electrónica de Enseñanza de las Ciencias**, v. 23, n. 2, p. 325-342, 2024.

TAVARES, Thiago Ferreira; PRESTES, Maria Elice Brzezinski. Pseudo-história e ensino de ciências: o caso Robert Hooke (1635-1703). **Revista da Biologia**, v. 9, n. 2, p. 35-42, 2012.

VAVILOV, Nikolai I. **Five continents**. Rome: International Plant Genetic Resources Institute, 1997.

VAVILOV, Nikolai I. Phytogeographic basis of plant breeding. In: _____. **The origin, variation, immunity and breeding of cultivated plants**. Waltham: Chronica Botanica, 1951. p. 1-366.

VAVILOV, Nikolai I. The law of homologous series in variation. **Journal of Genetics**, v. 12, n. 1, p. 47-89, 1922.

VAVILOV, Nikolai I.; DOROFEEV, Viktor F. **Origin and geography of cultivated plants**. Cambridge: Cambridge University Press, 1992.

VIEIRA, Ana Alice Nunes et al. Metodologia científica no Brasil: ensino e interdisciplinaridade. **Educação & Realidade**, v. 42, n. 1, p. 237-260, 2017.

ZABALA, Antoni. **A prática educativa: como ensinar**. Porto Alegre: Penso, 2015.

Recebido em: **05/06/2025**

Aprovado em: **05/09/2025**