

Proposal and evaluation of a theoretical framework for intercultural teaching of Astronomy through the Juruá Astronomy outreach project

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Abstract. This work explores an analytical proposal for teaching astronomy in an intercultural context, grounded in Masakata Ogawa's ideas of presenting science as a "foreign culture" to communities that do not have Western culture as their primary culture. Through a dialogue between the cultural traditions of an Mbyá-Guarani community and Western astronomical culture, the study discusses how conflicts between traditional and scientific cultural elements can be identified and addressed in educational settings. Our evaluation of these teaching activities is based on three principles of the theoretical framework: i) science must be seen in a cultural context and relativized; ii) characteristics of science as a culture (especially the view of humanity and nature and the scientific way of thinking) should be compared with those of traditional culture; iii) science as a culture should be situated within the context of the students' traditional culture. As a result, it is possible to affirm that the relativization of science during the teaching sequence was fully achieved by valuing Guarani stories and constellations. Future perspectives include promoting a deeper evaluation of science in the context of indigenous culture and explicitly comparing the views of humanity and nature and the different modes of thinking between the cultures.

Resumo. Este trabalho explora uma proposta analítica para o ensino de astronomia em um contexto intercultural, fundamentada nas ideias de Masakata Ogawa sobre apresentar a ciência como "cultura estrangeira" para comunidades que não possuem a cultura ocidental como a sua primeira cultura. A partir de um diálogo entre as tradições culturais de uma comunidade Mbyá-Guarani e a cultura astronômica ocidental, o estudo discute como conflitos entre elementos culturais tradicionais e científicos podem ser identificados e trabalhados em contextos educativos. Nossa avaliação dessas atividades de ensino é baseada em três princípios do referencial teórico: i) a ciência deve ser vista em um contexto cultural e deve ser relativizada; ii) características da ciência enquanto uma cultura (especialmente a visão de ser humano e natureza e o modo científico de pensar) devem ser comparadas com aquelas da cultura tradicional; iii) a ciência enquanto cultura deve ser vista dentro do contexto da cultura tradicional dos estudantes. Como resultado, é possível afirmar que a relativização da ciência durante a sequência de ensino foi plenamente alcançada a partir da valorização das histórias e constelações Guarani. Como perspectivas futuras, pretende-se promover uma avaliação mais profunda da ciência no contexto da cultura indígena e comparar de forma mais explícita a visão de ser humano e natureza e os diferentes modos de pensar entre as culturas.

Keywords. Teaching of Astronomy

1. Introduction

Educational initiatives targeting indigenous communities have been established as spaces for dialogue between scientific knowledge and traditional wisdom (Lovison; Pereira; Pavani, 2024). In this context, astronomy emerges as a unique tool capable of connecting science, culture, and identity, fostering enriching interactions between academic and indigenous knowledge. University outreach programs have explored this educational potential, developing actions that value ethnic, cultural, and social diversity, especially in schools located in indigenous territories. A significant example is the "Juruá Astronomy" outreach program of the IF/UFRGS, created in 2017 in response to a demand from the Mbyá-Guarani community of Tekoá Pindó Mirim. In partnership with the Itinerant Educational Observatory (OEI), activities were conducted at the Nhamandu Nhemopuã Indigenous State School, focusing on continuous teacher training and the recovery of celestial knowledge as a means of cultural and identity reinforcement for new generations. Since then, the program has promoted actions both in indigenous territories and in university spaces such as the Planetarium, the Museum, and the UFRGS Astronomical Observatory, consolidating an educational and cultural exchange. At the same time, initiatives aimed at the initial and continuous training of indigenous teachers, particularly in the Natural Sciences, have highlighted the importance of integrating elements of indigenous worldviews

into school curricula (Candau, 2008). This approach enables dialogue between ancestral knowledge and modern science, contributing to the strengthening of cultural identities and more meaningful science teaching. However, such processes require trust-based relationships between educators, indigenous leaders, and institutions, a key factor for successful actions. In indigenous territory schools, Resolution No. 5 of 2012, which establishes the national curriculum guidelines for indigenous school education, emphasizes complementary and challenging objectives: "I - the recovery of their historical memories; the reaffirmation of their ethnic identities; the appreciation of their languages and sciences; II - access to information, technical, scientific, and cultural knowledge of the national society"¹. These objectives reflect a fundamental tension: how to promote science education for indigenous students without turning it into a process of cultural assimilation (Aikenhead, 1996)? This paper analyzes the experiences accumulated in the program integrating astronomy, indigenous culture, and science teaching, reflecting on their contributions to the appreciation of ethno-cultural identities and the construction of more inclusive educational practices. The proposal aims to offer theoretical and practical subsidies for the development of initiatives that respect the plurality of perspectives and promote dialogue between scientific knowledge and

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traditional wisdom, contributing to a richer and transformative education.

2. Science as Cultural Representation

Ogawa (1986, 1995) presents an innovative and critical perspective on science education in non-Western societies by framing science as a culture that must be contextualized and relativized within educational settings. His approach emphasizes fostering scientific education that promotes cultural awareness and a critical dialogue between traditional and scientific knowledge, particularly in preparing future citizens. Ogawa underscores the importance of students developing an awareness of their traditional culture, particularly its views on humanity, nature, and associated modes of thought. To achieve this, he advocates for incorporating findings from cultural anthropology and ethnography on local traditions into science education. This foundational step aims to value students' cultural identities and create a basis for constructive interaction between different epistemologies. Moreover, Ogawa highlights the necessity for students to understand the characteristics of science as a culture by exploring its perspective on humanity and nature, as well as the specific mode of reasoning it fosters. To this end, knowledge derived from the history, philosophy, and sociology of science should be integrated into curricula. This approach helps students perceive science as a cultural and historical construct rather than a universal truth detached from sociocultural contexts. Another significant contribution by Ogawa is his emphasis on educating for decision-making in science-related matters, a focus increasingly emphasized in Western science education and equally essential in non-Western contexts. This method aims to develop critical and informed citizens capable of navigating contemporary scientific and technological issues while remaining mindful of their social and cultural impacts. For Ogawa, practices developed in multicultural or intercultural education contexts also hold substantial relevance for enriching science education in non-Western societies. He concludes by proposing three main principles: (1) science should be understood in a cultural context and relativized; (2) the characteristics of science as a culture (e.g., views on humanity and nature) should be compared with those of students' traditional culture; and (3) science as a culture should be embedded within the context of students' traditional culture. This perspective challenges us to rethink science education as a field where multiple cultures and ways of knowing can coexist.

3. Methodology

To evaluate the pedagogical approach based on Ogawa's (1986) three key principles—(1) understanding science as a cultural concept that must be relativized, (2) comparing the characteristics of science with students' traditional culture, and (3) embedding science within the context of traditional culture—we analyzed two activities developed by the Astronomia Juruá project: the activity on the phases of the Moon and the activity on constellations. The activities were carried out with students from the Escola Indígena Nhamandu Nhemopu'ã in the Pindó Mirim village. In the activity on the phases of the Moon, mythical narratives from different cultures were explored—including Mbyá-Guarani myths and stories from the Greco-Roman tradition—alongside scientific concepts presented through the construction of a Moon phase simulator and a constellation projector. In the activity on constellations, the focus was on the Tudja'í (Old Man) and Maino'i (Hummingbird) constellations,



FIGURE 1. Photo showing the constellation simulator, featuring the Old Man constellation.

which hold significant meanings for timekeeping within the Guarani worldview. These stories were complemented by hands-on workshops where students built constellation projectors, connecting traditional knowledge with an understanding of celestial motion. These activities exemplify the potential of astronomy as a tool for strengthening cultural identity while introducing scientific concepts in an inclusive and meaningful way.

4. Conclusion

The activities carried out by the Astronomia Juruá project represent a significant effort to foster dialogue between Western scientific knowledge and the traditional knowledge of the Mbyá-Guarani peoples, aligning with Ogawa's first point, which proposes that science should be understood in a cultural context and relativized. The inclusion of mythical narratives and cultural practices in the teaching of Astronomy highlights a recognition of the plurality of worldviews and an attempt to contextualize scientific knowledge in relation to the indigenous worldview. However, a more critical analysis points out that, while the appreciation of cultural stories and symbols is an important step, the deepening of intercultural dialogue could be greater. In some activities, such as the scientific explanation of the Moon's phases, Western content predominated, suggesting that the relativization of science as a culture could still be expanded, allowing indigenous perspectives to take a more prominent role. Regarding Ogawa's second and third points, which emphasize the need to compare the characteristics of science as culture with those of students' traditional culture and to embed science within the cultural context of students, there are significant ad-

vancements but also gaps. The activity on constellations demonstrated success in symbolically integrating the Mbyá-Guarani and Western astronomical worldviews, especially by highlighting the constellations “Tudja’i” and “Maino’i” and connecting them to indigenous calendars and cycles of time. However, the use of pedagogical materials, such as Moon phase simulators and constellation projectors, still reflects, in essence, a Western scientific perspective, which may be perceived as predominant. Therefore, there is an opportunity to explore tools and methods more rooted in the material culture and oral traditions of the Mbyá-Guarani peoples. Such methods could better reflect their ways of producing knowledge and contribute to truly multicultural and collaborative education. The activities developed by the Astronomia Juruá project demonstrate significant progress in promoting intercultural science education, contributing to the appreciation of the traditional knowledge of the Mbyá-Guarani peoples and fostering dialogue with Western scientific knowledge. However, the analysis of the practices carried out highlights the need for a greater balance between cultural and scientific perspectives to prevent Western science from becoming predominant in the educational process. This ongoing effort to integrate and value indigenous knowledge, combined with constant reflection on the methodologies adopted, is essential for building education that is genuinely inclusive and sensitive to cultural diversity.

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