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A Formal Approach to Ontological Pluralism in Knowledge Representation through Framework-Mediated Classification

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Abstract. *Conceptual models often assume a hegemonic classificatory framework within which alternative ontological perspectives are interpreted as secondary or reduced to matters of belief, rather than recognized as legitimate ontological commitments. However, knowledge representation across different domains and traditions reveals that ontological disagreement may concern what counts as essential, affecting the very organization of categories and not merely different ways of description. This article explores the role of formal mechanisms of mediation between distinct ontologies in knowledge representation, inspired by the Indigenous Mi'kmaq principle of Two-Eyed Seeing, which advocates the coexistence of diverse knowledge systems. It aims to develop a formal mechanism for representing ontological pluralism, avoiding both the reduction of categorical differences and the unnecessary multiplication of entities. We argue that the referential identity of individuals can be preserved while different ontological architectures organize these entities according to their own principles. Through a case study contrasting a scientific botanical ontology of cassava with an Ashaninka cosmological ontology, the divergence is shown to be structural. As result, a Framework-mediated classification is*

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proposed as a formal mechanism for representing such pluralism without implying that each ontology refers to a distinct entity. Finally, implications for RDF, Linked Open Data, and Wikidata are discussed.

1. Introduction

Conceptual models have been used for various purposes, such as knowledge representation, information organization, information system development, and communication among experts. Today, a vast amount of data and documents are available on the web to people and software tools, constituting an invaluable source for research, information, and entertainment. However, for this data and information to be accessible more quickly, accurately, and in a contextualized manner, it must somehow be found by search engines: either on the web itself or within a computerized system, and it is in this context that the importance of models as inputs for representing knowledge and information becomes evident. With the intensive use of generative AI tools such as ChatGPT, new opportunities are emerging that go beyond simply searching for documents and data, extending to content generation and answering a wide range of questions based on the training data of these tools. In this context, knowledge representation models have taken on an increasingly important role in the quest to improve the accuracy and transparency of responses from AI tools based on large-scale language models (LLMs) (Confalonieri & Guizzardi, 2025).

Regardless of their use, conceptual models presuppose certain ontological and epistemological perspectives, which translate into assumptions that can reproduce biases or hegemonic viewpoints, causing epistemic erasures, whether intentionally or unintentionally (D'Almeida & Campos, 2025), which is reflected in information retrieval and, in the case of AI tools, in the accuracy of their responses.

Furthermore, among the different viewpoints on the representation of knowledge domains, there are divergences regarding the ontological structure attributed to the domain itself, not merely regarding its description, and these viewpoints must be represented in a way that respects each one as valid. For example, it is not merely a matter of disagreeing on how to classify cassava (describing it as food, an economic resource, or a plant species), but of disagreeing on its very essential nature. Thus, while the Western scientific tradition considers cassava essentially a plant organism (a plant of the species Manihot esculenta), certain indigenous Amazonian cosmologies may conceive of entities such as cassava essentially as non-human persons (who are kin) or beings endowed with agency (Luz, 1996, p. 21).

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It should be clarified that, in the context of this work, we consider: (i) ontological commitment to be what an ontology assumes to exist or to be ontologically admissible; (ii) ontological structure to be the architecture of categories and relations through which these entities are organized; (iii) essential nature to be what an entity is from an ontological standpoint.

That said, it should be noted that not every classificatory divergence implies structural ontological pluralism. Thus, certain divergences represent merely alternative ways of describing or categorizing the same entity under the same ontological commitment, without this implying divergences regarding its essential nature. However, in other cases, there is a structural ontological difference, which manifests itself in distinct modes of ontological organization within a domain.

For example, in the case of a car, defining it as a vehicle or as a machine may represent a difference in aspect within the same ontological framework (considering that both a vehicle and a machine are, essentially, artifacts). In the case of cassava, however, the divergence concerns the ontological structure itself, since the category "plant" (from the botanical perspective) and the category "non-human person" (from the Amerindian perspective) occupy distinct and incompatible ontological positions within their respective hierarchies, that is, the categories used to understand and represent the same referent are not the same. This is not a matter of different terminology or different interpretations of certain aspects, which would be characterized as conceptual pluralism, as in the example of the car, but rather of different structures that can be reflected in different hierarchies, distinct essential properties, and, therefore, distinct ontological commitments; in other words, structural pluralism is observed. In the case of the cassava example, there is a single entity in the world, but different ontological structures for defining what cassava is. Thus, a distinction is proposed between conceptual pluralism (different descriptions or interpretations within the same ontological commitment) and structural ontological pluralism (different perspectives regarding the ontological structure and essential nature of entities). This distinction is supported by analytic philosophy, specifically in Putnam (1988) and Turner (2010), as discussed in Section 3 of this paper.

In accordance with a pluralist worldview, this paper analyzes the role of formal mechanisms of mediation between different ontologies in the representation of knowledge. To this end, we draw inspiration from the Mi'kmaq Indigenous principle known as *Two-Eyed Seeing* (Bartlett; Marshall; Marshall, 2012), which advocates for the coexistence of diverse systems of knowledge organization, without one prevailing over the others and respecting existing viewpoints as equally valid.

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We start from the premise that distinct ontologies can share referents without sharing the same ontological structure. In other words, the referential identity of individuals can be preserved across different ontological frameworks, even when each organizes these individuals according to its own principles of essentiality and ontological structure. By "referential identity," we mean, in the context of this work, that we are referring to the same thing that is acknowledged to exist in the world, that is, the same referent. For example, the cassava studied in botany and the cassava of Ashaninka cosmology refer to the same referent, albeit within different ontological frameworks.

The objective of this work is to develop a formal mechanism for representing ontological pluralism, avoiding the reduction of categorical differences and the unnecessary multiplication of entities.

That said, this paper is structured as follows: Section 2 presents the methodological procedures; Section 3 presents the theoretical foundation underpinning the proposal; Section 4 presents the proposed formal mechanism and its application to the case study of cassava, contrasting a scientific botanical ontology with an Ashaninka cosmological ontology; Section 5 discusses the implications of the proposal for Semantic Web technologies; and, finally, Section 6 presents the concluding remarks.

2. Methodological Procedures

This research adopts a qualitative approach with regard to the established problem; in terms of its objectives, it is exploratory in nature; and in terms of the technical procedures employed, it relies on a literature review, using narrative literature review as the specific method. This approach is not systematic and often involves a degree of subjectivity in the selection of literature; however, "[...] it proves appropriate for addressing demands related to describing the configuration and state of the scientific literature at a specific socio-historical moment, allowing for the contextualization of the findings" (Ogassavara et al., 2025, p. 313). To minimize subjectivity in our selections, we established the following criteria: (i) reliable sources; (ii) search terms aligned with the study's objectives; (iii) analysis of the material based on a review of the title and abstract; (iv) exclusion of duplicate items or those not aligned with the work's objectives.

The literature search was conducted in the Information Science Database (BRAPCI) and on Google Scholar. Regarding the interpretation of the material, it is worth noting that in a narrative review, the analysis of the collected content is also "[...] permeated by the researchers' subjectivity, which is influenced by the experiences accumulated and the knowledge acquired throughout their academic and professional careers." (Ogassavara et al., 2025, p. 313).

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To illustrate the relevance of the proposal, a brief case study was used for illustrative purposes, contrasting a scientific botanical ontology of cassava with an Ashaninka cosmological ontology, a topic addressed in our previous works (D'Almeida & Campos, 2025).

Regarding the ontological model presented, we utilized the formalism and theoretical contributions of the Unified Foundational Ontology (UFO) (Guizzardi, 2005) and the associated modeling language, OntoUML (Guizzardi et al., 2018), whose theoretical assumptions are used to underpin well-founded conceptual models.

3. Knowledge Representation and Ontological Pluralism

The concept of knowledge representation (KR) can be defined, according to Davis et al. (1993), as a mechanism used to reason about the world rather than act directly upon it. Fundamentally, KR acts as a substitute for what it represents, establishing a semantic correspondence between the substitute and its referent in the world. However, perfect fidelity in this representation is impossible, as any model inevitably contains simplifications and inaccuracies relative to the semantic richness of the human mind (Campos, 2004). Ontological pluralism arises from this impossibility of a single, absolute representation; from this perspective, it is possible to recognize that there are various possible ways of agreeing on a worldview, depending on the purposes and viewpoints of different communities.

In the field of Information Science, as early as 1986, B. C. Vickery, in his article "Knowledge Representation: a brief review," already highlighted the relevance of knowledge representation both for computational systems and for fields that have historically addressed this issue, such as Information Science, Artificial Intelligence, Psychology, and Linguistics. His goal was not to discuss the technological possibilities available at the time, but to examine structural issues related to the semantic organization of sentences and utterances, the categories and relations employed in domain analysis, and the representation of knowledge through arguments and axioms. These themes remain central to contemporary studies on information representation and retrieval within the context of the Semantic Web and intelligent systems. The concern with knowledge representation has been a part of Information Science since its inception. With the advent of the Semantic Web, new topics — many of which are not exactly new — have become part of this field of research. One of the issues that has been a concern in Information Science, and is now raised by questions involving Knowledge Organization, is that such representation must adequately describe the reality of the domain to which it is dedicated, with clear and precise information, avoiding ambiguities in the aspects to be modeled.

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The success of this representation depends on what is known as ontological commitment, which can be defined as an agreement reached by a community regarding the meaning it establishes and is expressed, in this context, in the representations of concepts, both from the perspective of human understanding and from the perspective of machine processing through software agents. This involves defining the vocabulary in a way that minimizes ambiguities, so that its use can be shared to represent and retrieve knowledge among related communities that are committed to the adopted agreement (Nodine & Fowler, 2002). These representations take the form of models. In the development of these models, methodological procedures are used for domain modeling, that is, those related to conceptual modeling and those related to ontological modeling.

In this sense, conceptual modeling focuses on identifying and describing the elements and constraints of a real-world domain for their incorporation into information systems, being predominantly epistemological in nature. Ontological modeling, on the other hand, is grounded in formal ontologies that seek to systematize the expression of knowledge, functioning as an "explicit specification of a conceptualization." While conceptual modeling seeks to establish relationships between abstracted concepts, ontological modeling aims to identify objects and understand their nature, describing their basic properties to provide a clear and unambiguous foundation for the modeler (Villela, 2004).

Finally, it must be considered that conceptual models and ontologies are never neutral, as they carry intrinsic assumptions about the domains they represent. When determining a representation, the modeler takes a stance regarding the objects they recognize as fundamental, which reflects a shared choice of conceptualizations about a given, delimited reality.

A knowledge organization tool can thus reflect specific biases, favoring certain aspects and underrepresenting others, thereby causing harm or benefit to specific user communities (Milani & Guimarães, 2014). Among the forms these biases can take is the risk of reproducing prejudices, and exclusionary worldviews that, in a context of ontological pluralism, render invisible the ontological commitments of the very communities these tools are meant to represent, thereby obscuring forms of knowledge that do not fit into the categories of the dominant system.

The constant erasure of specific knowledge systems, such as those originating from indigenous communities, can be understood as part of broader processes of epistemic hierarchization. The coloniality of knowledge (Quijano, 2005; Oliveira & Osman, 2017) refers to the persistence of colonial structures in the production, validation, and circulation of knowledge, even after the end of formal political colonialism. Within

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the context of the coloniality of knowledge, epistemicide, according to Carneiro (2005), operates by discrediting forms of knowledge that do not conform to the parameters of the modern Western scientific paradigm, primarily targeting the ontological and epistemological systems of indigenous communities.

In this sense, systems of knowledge organization can actively contribute to the maintenance of asymmetries by reproducing the parameters established by the coloniality of knowledge, universalizing categories based on Eurocentric ontologies, and functioning as instruments of epistemicide. On the other hand, they can act as instruments that open space for visibility, dialogue, and cooperation among different knowledge systems and their respective ontological and epistemological assumptions (Gonçalves & Mucheroni, 2021; D'Almeida, Silva, & Campos, 2023). In line with the perspective of ontological plurality, the ecology of knowledge is coined by Santos (2014) as an alternative to the monoculture of knowledge, recognizing that no form of knowledge is complete and that epistemological diversity is necessary for the advancement of knowledge.

However, recognizing ontological pluralism in the face of new technological challenges highlights the need for a theoretical framework that underpins the coexistence of different knowledge systems in terms of knowledge representation, without reducing one to the other, thereby avoiding reductionism in the categories and relationships of the perspectives involved, as well as the unnecessary multiplication of entities in the elaborated representation.

3.1. The Principle of Two-Eyed Seeing

As a means of underpinning the coexistence of Indigenous and Western knowledge, Bartlett, Marshall, and Marshall (2012) proposed *Two-Eyed Seeing* as a guiding principle that fosters complementarity among different worldviews for the production of knowledge. Originally developed in the context of educational and research projects in the natural sciences that sought to integrate Mi'kmaw indigenous knowledge and Western science (Bartlett; Marshall; Marshall, 2012; Bartlett et al., 2015), *Two-Eyed Seeing* has been applied in various fields, such as health, environmental education, and participatory research. The approach is based on the principle that proposes "seeing with one eye from the strengths of indigenous ways of knowing and with the other eye from the strengths of Western ways of knowing—and using both eyes together, for the benefit of all" (Bartlett; Marshall; Marshall, 2012, p. 335). This principle serves as a central element of the framework proposed in this study.

By evoking "two eyes" the principle emphasizes that each knowledge system, indigenous and Western, possesses specific potentials and strengths, and that a more

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complete understanding of reality is only possible when both function simultaneously, without one being subordinated or reduced to the other. This productive coexistence proposed by the *Two-Eyed Seeing* principle highlights that each knowledge system must be represented based on its own assumptions and criteria of validity, maintaining its internal integrity; at the same time, keeping both eyes open simultaneously demonstrates that both contribute jointly to a more diverse and complete understanding of reality.

Although the principle does not specify solutions for implementing a pluralist framework, it functions in this project as a guide that informs design and development decisions for systems intended to encompass ontological pluralism. *Two-Eyed Seeing* offers important operational principles for this context: the coexistence of different points of view (where each eye perceives reality from a specific ontologically situated perspective) and the absence of a hierarchy among different epistemologies and ontologies (seeing with both eyes open at the same time). Based on this principle, it becomes evident that different knowledge systems can coexist equally legitimately within the same representational system, as distinct ontological commitments regarding how to view and understand the same referents in the world. This underpins the construction of plural systems, affirming the validity of each of the perspectives involved.

3.2. Perspectivism e Ontological Pluralism

For Viveiro de Castro, in the context of anthropology, Amerindian perspectivism is an idea based on a "perspectival quality," according to which: "the world is inhabited by different kinds of subjects or people, human and non-human, who perceive it from distinct points of view" (Castro, 1996, p. 115). Ontological pluralism, in turn, complements this view by providing philosophical insights to understand that such points of view are not merely subjective beliefs, but rather distinct commitments regarding the very structure and essence of entities in the world. Thus, the pluralism advocated here necessitates a diversified approach that encompasses both the epistemological and ontological dimensions in the representation of knowledge.

That said, the theoretical framework underpinning this work is based on five basic principles (pillars) to ground the organization of knowledge from a pluralistic perspective: (i) knowledge is always situated, relational, and produced within social, political, and technological contexts (Haraway, 1988; Harding, 1991); (ii) a non-reductive epistemic pluralism is adopted, which recognizes the coexistence of multiple equally legitimate systems of knowledge, each operating according to its own

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logic, without one being able to be completely reduced or translated into the terms of another (Dupré, 1993; Longino, 2002; Kellert; Longino; Waters, 2006; Chang, 2012); (iii) a decolonial dimension is adopted, which implies recognizing that hierarchies among systems of knowledge are historically constructed through colonial processes that privileged Western knowledge and marginalized other epistemologies (Santos, 2014; Smith, 2021); (iv) epistemic pluralism, while necessary, is not sufficient to underpin a plural organization of knowledge. Ontological pluralism is also required, which involves not only different ways of describing entities but also distinct structural commitments regarding their essence (Putnam, 1981, 1988; Turner, 2010); (v) the proposed pluralism is not limited to the theoretical recognition of diversity but requires the reconfiguration of the mechanisms through which knowledge is organized and technologically mediated (Bowker & Star, 1999; Olson, 2001; Duarte & Belarde-Lewis, 2015).

Regarding principles (i) through (iii), it is considered that: (a) there is no neutral or single way to organize knowledge. Every organization of knowledge has underlying epistemological assumptions (Hjørland, 2008; Mai, 2011; Bowker & Star, 1999); (b) epistemic pluralism is desirable, insofar as different epistemologies can coexist side by side, and the inclusion of diverse perspectives strengthens the of knowledge organization systems (Longino, 2002; Santos, 2009; Bartlett *et al.*, 2015).

With specific regard to the fact that knowledge must be non-reductive, we draw on Boaventura de Sousa Santos (2007, 2014), whose concept of the ecology of knowledge proposes the coexistence of different knowledge systems, rejecting both their hierarchization and their fusion into a single system. Furthermore, it is recognized that different knowledge systems address different problems in different contexts, and that none of them is complete or self-sufficient on its own. This viewpoint aligns with the concept of *"Two-Eyed Seeing"* (Bartlett; Marshal; Marshall, 2012), which proposes that different knowledge systems maintain their own integrity and logic, jointly contributing to a broader understanding of reality without one being reduced to the terms of the other.

To support the idea that different beings perceive the world from different perspectives, and that these are not mere subjective beliefs but actual realities for each

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category of being, we cite Viveiros de Castro (1996, p. 127), who notes, regarding the Amerindian perspective, that all beings perceive the world in the same way, yet the world each one perceives is different:

> [...] being people in their own right, non-humans see things as "we" do. But the things they see are different: what is blood to us is cauim to the jaguar; what is a rotting corpse to the souls of the dead is fermenting cassava to us.

In other words, according to Viveiros de Castro, in Amerindian perspectivism, all beings (humans, animals, plants, inanimate objects, such as the Moon, etc.) see themselves as "people" from their own perspective, but the world that each type of being sees is different. Thus, there is no single, pre-structured reality, even though it is described in different ways (highlighting multiple cultures, or multiculturalism), but rather multiple natures experienced by different types of beings, which the author calls multinaturalism. For the author, while multiculturalism is based on the assumption of a single static nature, the objective world, which can be interpreted according to multiple cultures, multinaturalism presupposes multiple natures, which are experienced by a single form of culture (which would be the "people's" perspective). This "people" varies according to the type of body (understood as a set of affections and dispositions) of those who experience this nature. Thus, what our framework identifies as the referent in the world functions as the point of convergence where these multiple natures meet, allowing the same entity to be experienced as ontologically distinct realities.

With regard to pillar (iii), we must acknowledge the issue of the coloniality of knowledge. According to Mitova (2021), a South African philosopher specializing in epistemology and the decolonization of knowledge, for the decolonization of knowledge to be possible, it is necessary to recognize that colonialism imposed a single perspective as epistemically legitimate, erasing other forms of knowledge and producing what is considered "epistemicide." Based on this recognition, the path to decoloniality involves restoring epistemic authority to different perspectives, especially those that have been historically marginalized, and guaranteeing the right to think and produce knowledge legitimately from within their own contexts:

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"Therefore, decolonization requires, at a minimum, treating all epistemic perspectives as equal" (Mitova, 2021, p. 4).

In light of this, two problems arise that must be avoided in systems of knowledge representation. One is that one perspective cannot be reduced to another, for example, treating the Ashaninka perspective as a mere "belief" in contrast to the scientific perspective, as this would erase legitimate categorical differences. Another is that these perspectives cannot be treated as if they referred to distinct entities, creating, for example, categories such as "botanical cassava" and "Ashaninka cassava" as ontologically separate objects, as this would unnecessarily multiply entities and compromise the referential identity of the concrete plant, cassava, to which both perspectives refer.

That said, for the epistemic pluralism and the decolonial dimension advocated here to be realized in the practice of organizing knowledge, it is necessary to delve into ontological questions, as discussed in pillar (iv). In this sense, this work proposes that the epistemological pluralism presented here be accompanied by ontological pluralism.

We propose a distinction between conceptual ontological pluralism (different descriptions within the same ontological commitment) and structural ontological pluralism (different commitments regarding the essential nature of entities). This distinction finds support in analytic philosophy, in Putnam (1981, 1988) regarding the relativity of conceptual schemes, and in Turner (2010), who defends ontological pluralism, arguing that entities have different modes of existence.

Putnam (1981) defends conceptual relativism (the concept that inspires our definition of conceptual pluralism in the context of this work), according to which different conceptual schemes can organize reality in distinct ways, without there being a single dominant ontological perspective, and without implying the denial of an objective reality. In Putnam's words:

> Our conceptions of coherence and acceptability are, on the view I shall develop, deeply interwoven with our psychology. They depend upon our biology and our culture; they are by no means 'value free'.

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> But they are our conceptions, and they are conceptions of something real (Putnam, 1981, p. 55).

Mitova (2021, p. 12), a South African philosopher specializing in epistemology, corroborates this idea:

> The conceptual relativist I have in mind here accepts the idea that there can be competing descriptions. But she would maintain that such descriptions don't constitute different realities; rather, they carve out in competing ways a preexisting objective reality.
>
> […] different cultures have different conceptual frameworks through which they process this reality. Some concepts, then, would not be shared across cultures, and statements featuring them will turn out to be true in one culture and false in another.

Turner (2010), in turn, complements this by advocating an ontological pluralism according to which reality should not be reduced to a single ontological structure, but may encompass multiple legitimate structures: "But as an ontological pluralist, I hold that thinking of reality as having a single ontological structure — a single pegboard — is a mistake, as is thinking of ontological categories as divisions within this single structure" (Turner, 2010, p. 7).

In the case of the cassava example, it is understood that this is a structural ontological divergence, since the cosmologies in question attribute distinct essential natures to the same entity in the world, aligning with the multinaturalism proposed by Viveiros de Castro (1996), where the divergence occurs in the very ontological constitution of the entity in the world. Thus, the ontological pluralism advocated by Turner (2010) becomes fundamental to grounding this difference as something that goes beyond mere conceptual description. In other words, the divergence over what cassava is should not be understood as a different interpretation of an object, but the result of distinct ontological structures that shape reality.

Furthermore, as argued by Blaser (2013), a renowned Argentine anthropologist, divergences regarding entities in the world do not occur because people have different interpretations of them, but because their practices bring them into existence as different entities. Thus, starting from the existence of the same entity

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in the world (the referent), there may be divergences regarding its ontological structure and its essential nature. As Blaser (2018, p. 16–17, emphasis added) illustrates:

> Returning to our example, a so-called cosmopolitan approach to resolving the disagreements between the Innu and the provincial government would call on the participants to set aside their respective parochial *perspectives* and focus on what is common to both: the "thing" that concerns them, a thing that some call caribu, others call *atîku*.
>
> (...)
>
> In this sense, caribu and *atîku* would not refer to different perspectives on the same "thing," but to completely different (albeit related) things.

It should be noted that the intention here is not to delve into the philosophical issues linked to the perspectives of Putnam, Turner, or Blaser; rather, it is simply to use them as a conceptual foundation for the distinction between the types of pluralism proposed here. It should also be noted that the aim of this work is not to establish correspondences and interoperability between distinct ontologies, but rather to propose a mechanism that allows for the respectful coexistence of different ontologies within the same representational system, without requiring their mutual reduction or unification.

However, we argue that it is possible to conceive of interoperability even when ontological structures are distinct, since it is understood that the common referent functions as a boundary object (Star & Griesemer, 1989), enabling the articulation between distinct ontologies without requiring structural equivalence, which can be advantageous in initiatives such as those involving linked open data.

Boundary objects can be physical or abstract objects, shared among distinct communities, functioning as a link for interactions (Star & Griesemer, 1989; Campos, 2018; D'Almeida, 2026). They do not require absolute consensus regarding their nature, allowing each community to interact with them based on its own assumptions, without this hindering coordination among the parties involved. This is possible because boundary objects are sufficiently flexible to adapt to the needs and

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specificities of each community that uses them, while remaining robust enough to maintain a recognizable identity across these communities (Star & Griesemer, 1989).

It is worth noting that interoperability in our work is not centered on the homogenization of ontological categories, but on the possibility of recognizing that different structures refer to the same entity in the world. Since both groups (botanists and indigenous people) are referring to the same cassava (the referent), they share a common link that prevents them from becoming completely disconnected, even if their conceptions of what cassava is diverge.

Finally, regarding pillar (v), the aim is to bring the proposal to fruition by illustrating its application in an expressive model using OntoUML, as well as its limitations when transposed into the context of RDF initiatives such as those involving open linked data, particularly Wikidata. Given the importance of this initiative as a unifying framework for data on the web, it is essential to improve the way it represents this data, so that traditional knowledge, such as that of the Ashaninka, is not treated merely as beliefs, but rather has its cosmology preserved within such technological mediation mechanisms. Thus, respect for diversity of thought ceases to be merely a theoretical principle and is embodied in the tools of the Semantic Web itself.

4. Framework-Mediated Classification: Principles and a Brief Experiment

The proposed model is represented in a way that reflects a pluralistic ontological architecture in which different frameworks can define their own types to classify the same individuals in the world, without this implying a multiplication of entities or categorical reduction. The model is structured into three levels: (i) the level of referentes (called “World”), (ii) the level of types internal to the frameworks, and (iii) the metalevel, which represents the structural dependence of these types on a specific ontological framework. Figure 1 illustrates the model, expressed in OntoUML (Guizzardi et al., 2018). The model focuses on the representation of enduring entities of the type <<Kind>> (BiologicalPlant and SpiritualPlantBeing), as this is the case with cassava, which illustrates the example cited throughout this work, although it can be adapted to represent other types of endurant or even perdurant entities, provided

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there is an associated referent in the world, since the principles of pluralism are the same.

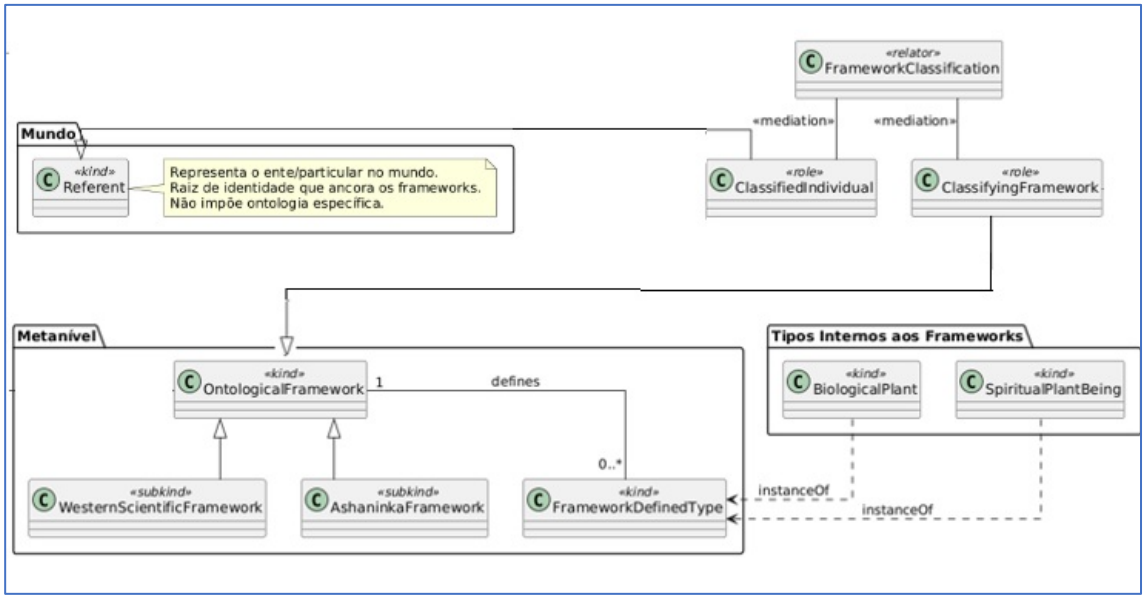

Figure 1. Ontological model of the proposed pluralist framework

At the level of referents (World), "Referent" is defined as <<kind>>. This element does not impose any specific ontology (biological, social, indigenous, etc.), serving solely as a minimal ontological commitment, which is to provide a principle of numerical identity to particulars, that is, to ensure that we are dealing with the same element. The model does not specify the essential nature of these individuals but assumes that they possess their own criteria for individuation (Lowe, 2006), can be either endurants or perdurants, and can be classified into instances of different types depending on the ontological framework adopted.

At the level of Types Internal to Frameworks, we have BiologicalPlant and SpiritualPlantBeing, both modeled as <<kind>>. It is important to note that they represent the conceptual types defined by each framework regarding the referent. Thus, within the WesternScientificFramework, the type BiologicalPlant is the category that classifies the referent from a botanical perspective. In the AshaninkaFramework, however, the type SpiritualPlantBeing classifies the same

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referent as a being endowed with agency and a soul, from the perspective of Ashaninka cosmology.

The model explicitly distinguishes between what is a framework (OntologicalFramework), what is a framework-defined type (FrameworkDefinedType), and which framework defines which type (WesternScientificFramework or AshaninkaFramework). For this reason, SpiritualPlantBeing is not an instance of AshaninkaFramework, but rather a type defined by that framework.

The FrameworkDefinedType element thus acts as a general category, indicating that each type (whether biological or spiritual) is a definition dependent on a specific framework, rather than an absolute and isolated truth.

It is worth noting that our model expresses aspects that relate to the idea of multilevel modeling (Fonseca et al., 2018), where an entity can function at different levels of abstraction, both as a specific type and as an instance of a more general type. This approach allows for the representation of its dependencies in relation to its respective frameworks.

The multilevel instantiation relationship (instanceOf) makes explicit that categories such as BiologicalPlant or SpiritualPlantBeing have their validity and definition anchored in their respective contexts, thus depending on the framework to be structured as such. This means that the divergence between them is ontological and structural, and not merely a different interpretation of the referent. Although the referent exists in the world independently of the frameworks, the way it is structured and defined is linked to the framework that gives it meaning, which is consistent with the assumptions underlying our proposal.

In turn, the relationship between individuals and frameworks is expressed through the FrameworkClassification relator. According to the Unified Foundational Ontology (UFO), relators can be used to mediate roles (<<role>>). Thus, the model presents ClassifiedIndividual as a role played by Referent, and ClassifyingFramework as a role played by OntologicalFramework. The FrameworkClassification relator mediates between these roles, representing the situation in which an individual is classified according to a given framework.

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In ontological terms, the relator embodies the relationship of mutual dependence between the referent and the framework. Thus, without a referent to be classified, the framework does not perform its classificatory function, and without a framework, the referent remains ontologically indeterminate. This mediation enables structural pluralism in the model, as it allows the same referent to participate in multiple simultaneous classifications, each linked to a different framework, without creating a contradiction. Thus, cassava can be classified simultaneously as a BiologicalPlant by the Botany framework (WesternScientificFramework) and as a SpiritualPlantBeing by the Ashaninka framework (AshaninkaFramework), while maintaining its unique referential identity, that is, it is the same individual.

Thus, in the model shown in Figure 1, `Referent` ensures that we are dealing with the same individual (numerical identity), while `FrameworkDefinedType` specifies what it is (essential identity). Without this distinction, structural pluralism would be unfeasible, as each culture would be referring to a different entity.

This structure allows us to formalize the idea that different communities can discuss the same referents in the world from distinct perspectives, without this leading to ambiguities about what is being discussed or contradictions between ontologies, and without unnecessary multiplication of entities.

The model thus ensures the basic principles of our proposal: (i) each individual maintains their referential identity across ontologies, ensuring that both ontologies are dealing with the same entity; (ii) each ontology preserves its own categorical commitments; (iii) multiple categorizations coexist without any reduction or multiplication of entities; (iv) no ontology is considered hegemonic in relation to the others.

The Linked Open Data (LOD) approach makes it possible to implement this proposal (albeit with some limitations), as it offers mechanisms, such as unique identifiers (URIs), reification, and qualifiers (Campos; Campos; Barbosa, 2019), that allow ontologies with different structures and assumptions to be articulated around a common referent. These issues will be discussed in the following section.

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5. Implications for Semantic Web Technologies

As illustrated in Figure 1, the proposed model expresses, in a compartmentalized manner, the different perspectives on cassava (Ashaninka and Botanical), which point to the same referent, which functions as a boundary object, allowing for the articulation between the different ontological structures without categorical reduction. When representing this model in RDF, some semantic loss is observed due to the limitations of this language. Figure 2 illustrates how the model in Figure 1 might look, in simplified form, if we were to transpose it into RDF.

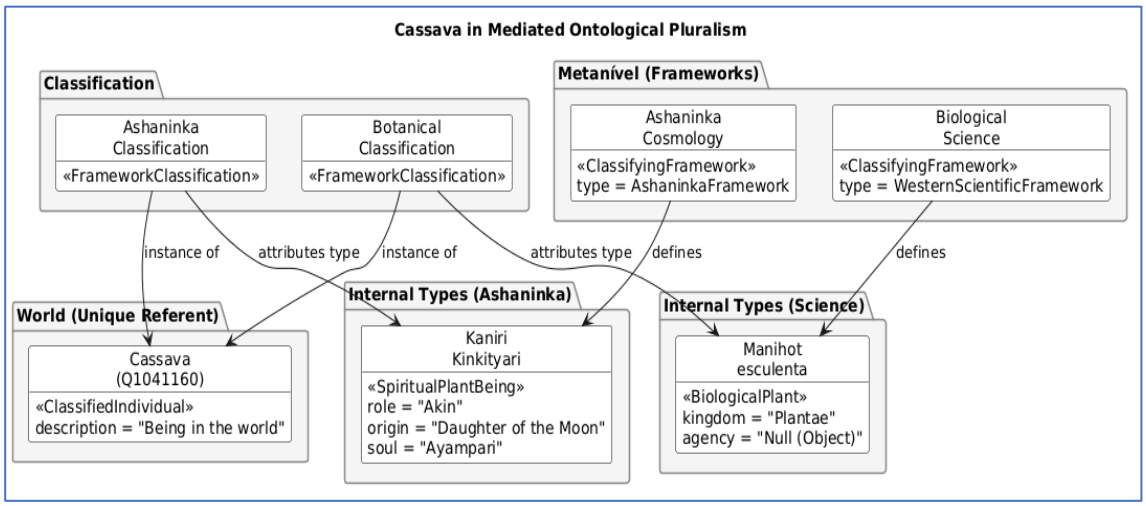

Figure 2. Representation of cassava in ontological pluralism mediated by RDF

When representing the model in RDF, we could enter the data on cassava into Wikidata from the perspectives of the frameworks exemplified here.

To represent the Ashaninka perspective on cassava using Wikidata's RDF data structure and adhering to the Ontological Pluralism framework, we need to distinguish the Referent (the entity in the world) from the classifications mediated by the Frameworks (AshaninkaFramework, WesternScientificFramework), and we can do this, to some extent, through the use of qualifiers. On Wikidata, qualifiers "allow statements to be expanded, annotated, or contextualized beyond what can be expressed in a single property-value pair" (Wikidata, 2026).

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We want to represent that, in the Ashaninka model, cassava is not merely a plant, as it is in the botanical perspective, but a being endowed with a soul and kinship ties. We must therefore employ qualifiers to reconfigure the technological mediation mechanism typically used in RDF, so that this representation is possible.

Since we do not actually enter the model's data into Wikidata, the properties illustrated below, which do not exist in Wikidata, are not numerical as they should be (e.g., P1234), but rather, for example, P_Type. Similarly, instead of being numerical like the cassava that already exists in Wikidata, items will be described as Q_Ashaninka_Ontology, for example. Those that appear with a number, however, do exist in Wikidata (Q1041160, P31).

That said, we could express something like the following in Wikidata using qualifiers:

Cassava (Q1041160) (item) instance of (P31) (property) Ashaninka Classification of Cassava (Q_Classif_Ashaninka) (property value)
assigned type (P_Type) (qualifier) → Relative (Q_Kinkityari) (qualifier value) Mediator Framework (P_FrameworkOntologico) (qualifier) → Ashaninka Cosmology (Q_Ashaninka_Ontology) (qualifier value)

These statements aim to express that there is a classification associated with cassava, and this classification characterizes it as a Relative within the Ashaninka Cosmology. It is important to note that this does not mean cassava should be understood absolutely as a Relative, but rather that cassava should only be understood as a Relative when associated with a classification that is mediated by the Ashaninka Cosmology. In other words, we are not asserting that cassava *is* a person (a relative) in the context of Western science, but rather that, through the mediation of the AshaninkaFramework, the referent should be regarded as a SpiritualPlantBeing, with all the attributes that define it as such.

By positioning the Ashaninka Classification as an instance of the Ashaninka Classification, we prevent the item "Cassava" from inheriting both botanical and mythical properties simultaneously at the same level.

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The use of P_type and P_ontologicalFramework as qualifiers makes it clear that "Relative" is not what cassava *is*, but rather how it is characterized within the context of a given ontological framework.

The FrameworkClassification prevents ontological collapse, that is, it avoids stating that the plant "is" and "is not" human at the same time, since the truth of the statement is tied to the framework that defines it.

However, the proposed model has limitations when transposed to Wikidata. Although Wikidata allows the use of qualifiers to contextualize statements, its underlying RDF structure (subject-predicate-object) presents obstacles to representing genuine ontological pluralism, as it reduces complex mediating relationships to direct connections between entities, failing to adequately express the categorical separation between the referent and the different cosmologies that define the ways in which it is classified. In the framework proposed in Figure 1, we use <<Relator>> to isolate type assignment, ensuring that the physical entity (the cassava in the world) is merely a neutral point of reference, that is, one that does not commit to any particular point of view.

The transposition of the expressive model proposed in Figure 1 to RDF-based LOD environments is subject to limitations, because RDF treats its triples as globally valid, that is, it assumes that any statement inserted into the graph is universally valid regarding the object, without distinguishing from which perspective that information is considered. To represent perspective-based statements in RDF, it is necessary to resort to mechanisms such as reification or *named graphs* (Hernández; Hogan; Krötzsch, 2015; Rupp; Schnabel; Eckert, 2022), but these mechanisms often present obstacles. Regarding reification: "Most applications treat data as facts. However, with reification, statements are assertions rather than facts, and applications may be required to follow chains of assertions that might even contradict each other" (Maier; Hädrich; Peinl, 2005, p. 186). As for *named graphs*, although they allow triples to be grouped and associated with an identifier (URI), they also do not solve the problem of perspective-based representation, as this is merely a syntactic, rather than ontological, approach to addressing the issue (Carrol et al., 2005).

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Other limitations can be observed. In the original OntoUML model, ClassifiedIndividual is a <<role>>. This means (according to UFO theory) that it is an *anti-rigid* property with relational dependency; that is, cassava only assumes the role of "classified individual" when it participates in the classification relationship. In its essence (<<kind>>), cassava is merely the referent in the world.

RDF does not have a native concept of "Role." All that can be expressed is that a thing belongs to an rdf:type—and nothing more. There is no way for RDF to natively express that "being an element classified by science" is something contextual or contingent, whereas "being an entity in the world" is something essential.

Nevertheless, despite the limitations regarding native inferences, the model expressed in RDF allows us to answer the following question: "What possible classifications exist for the referent 'cassava,' under which cosmologies, and what are the natures associated with this referent, according to each classificatory framework?"

The ability to answer this question stems from the framework's mediation architecture: rather than linking conflicting attributes to the referent, the model isolates the properties within specific types defined by their respective frameworks. Thus, a structured query (such as a SPARQL one) allows filtering which aspects are attributed to the referent under a specific classification. This makes it possible, for example, to retrieve the agential nature of cassava only when the retrieved context is that of the Ashaninka cosmology, thereby preserving the internal coherence of each knowledge system.

Without this separation into Framework and Classification, that same query on Wikidata today would return a set of conflicting properties on the same item (Q1041160), with no way to distinguish between the cosmologies.

The proposed model ensures that the nature attributed to the referent (having a soul, or being an inanimate entity) does not belong to the referent itself (the plant, in and of itself, is not contradictory), but rather belongs to the specific type (Ashaninka or Science), which is attributed to it through a Classification (FrameworkClassification) defined by a specific Cosmology (OntologicalFramework). Therefore, the framework answers the example question in a consistent and pluralistic manner.

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6. Final Considerations

Conceptual models often adopt a hegemonic viewpoint, in which divergent ontological perspectives are typically interpreted as secondary or merely beliefs, rather than being recognized as legitimate ontological commitments. In this context, we examined the role of formal mechanisms for mediating between distinct ontologies in the representation of knowledge, inspired by the Mi'kmaq indigenous principle of *Two-Eyed Seeing*, which advocates for the coexistence of diverse knowledge systems. Through a brief illustrative case study contrasting a scientific botanical ontology of cassava with an Ashaninka cosmological ontology, we demonstrated that the divergence of viewpoints is structural, that is, a divergence regarding the essential nature of the referent, rather than merely concerning alternative conceptual descriptions. We present a framework mediated ontological classification model as a formal mechanism to represent such pluralism without each ontology referring to a distinct entity. The proposed framework allows for the separation of the referent in the world, the types defined by each framework, and the classification mediated by a specific ontological framework, thereby avoiding both categorical reduction and the unnecessary multiplication of entities.

Finally, we highlight the semantic limitations when transposing this ontological model into languages such as RDF, which are used in Semantic Web initiatives such as Linked Open Data, particularly in Wikidata.

It is hoped that our proposal will help prevent epistemic erasure and recognize the legitimacy of non-hegemonic knowledge systems on their own terms. It should be noted that the models presented are explored for illustrative purposes and do not claim to be an accurate reproduction of the knowledge of Indigenous peoples, which would require more in-depth bibliographic research, especially involving dialogue with Indigenous communities, a task that falls outside the scope of this study.

Future work could explore the application of the model in other domains where ontological conflict exists, as well as test its implementation in semantic infrastructures other than RDF and Wikidata.

We conclude that, in order to ensure epistemic justice, knowledge organization systems must allow for the coexistence of various legitimate ways of

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structuring the world, without one being imposed in a hegemonic manner over the others.

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