

EMERGENCE OF THE LOCAL IN INTERCULTURAL SCIENCE TEACHING: PRE-SERVICE TEACHERS BUILDING BRIDGES BETWEEN CULTURES

J. C. TOVAR-GÁLVEZ*, C. FERNÁNDEZ-ARAGÓN

Master's Degree in Secondary School Teacher Education, Madrid Open University

ORCID ID: <https://orcid.org/0000-0001-7008-5140>*

joule_tg@yahoo.com*

Submitted 11/08/2025 - Accepted 24/10/2025

DOI: 10.15628/holos.2025.18952

ABSTRACT

The curriculum is a decision about what to include or exclude from society to build citizen profiles. The same happens in science education and teacher education. As a step forward in cultural inclusion, a group of pre-service teachers participated in a module on intercultural science teaching. The main framework is the epistemological bridge that describes the didactic process from

epistemological pluralism and interculturality. The qualitative methodology describes the participants' planning proposals. As a result, eight participants brought school science into dialogue with local-rural knowledge. A case analysis illustrates how the epistemological bridge manifests itself in planning.

KEYWORDS: epistemological pluralism, interculturality, local knowledge, science education, teacher education.

EMERGÊNCIA DO LOCAL NO ENSINO INTERCULTURAL DE CIÊNCIAS: PROFESSORES EM FORMAÇÃO CONSTRUINDO PONTES ENTRE CULTURAS

RESUMO

O currículo é uma decisão sobre o que incluir ou excluir da sociedade para construir perfis de cidadãos. O mesmo acontece na educação científica e na formação de professores. Como um passo à frente na inclusão cultural, um grupo de professores em formação participou de um módulo sobre ensino intercultural de ciências. A estrutura principal é a ponte epistemológica que descreve o processo didático do pluralismo

epistemológico e da interculturalidade. A metodologia qualitativa descreve as propostas de planejamento dos participantes. Como resultado, oito participantes trouxeram a ciência escolar para o diálogo com o conhecimento local-rural. Uma análise de caso ilustra como a ponte epistemológica se manifesta no planejamento.

PALAVRAS-CHAVE: pluralismo epistemológico, interculturalidade, conhecimento local, educação científica, formação de professores.

1 INTRODUCTION

The curriculum is the cornerstone of an educational system as it is a set of decisions on what socio-cultural aspects count or not to build citizen profiles for a nation's project (Barraza, 2018; Osorio, 2017; Wigdorovitz, 2016). In this way, the curriculum can be an instrument to institutionalize exclusions (Baronnet & Morales-González, 2018; Martínez et al., 2021; Ocoró, 2021). The same happens with science education and science teacher education (Canizález et al., 2023; Marzuca, 2021; Meinardi, 2017; Muñoz, 2021; Westermeyer & Quilaqueo, 2023). Thus, the curricular contents and the contents that pre-service teachers learn to teach in the future are institutionalized decisions. Such decisions favor the teaching of science that represents modern Western culture, marginalizing non-hegemonic communities' knowledge systems. As an advance in the inclusion of other knowledge systems in science teaching, a group of pre-service teachers participated in a module on intercultural science teaching. This article aims to describe the local-rural emerging in intercultural science teaching plans proposed by pre-service science teachers.

In this regard, the most common is finding research results that focus on using the rural, local, traditional agricultural, farmers or countryside context for teaching science (Avery, 2013; Zapata & Vlasic, 2023). Other researches focus on identifying teaching strategies more in line with science teaching in the rural context (Avella et al., 2024; Souza, 2021; Ribadeneira, 2020; Silva & Bizerril, 2020; Zinger et al., 2020). And others in the scientific and didactic education of rural teachers (Ferrell & Tharpe, 2024; Souza et al., 2021). However, it is necessary to move towards the recognition of local or rural knowledge and practices and to teach them in dialogue with school scientific knowledge (Galván, 2020; González et al., 2022; Muñoz et al., 2022). A further step would be to recognize that rural knowledge also circulates in cities and is an intangible asset teachers might teach in urban science classes. This knowledge also circulates in urban classrooms due to the migratory processes from the countryside to the cities. Thus, students or their families can bring rural knowledge into their new urban settings.

The relevance of the recognition, recovery, and inclusion of rural, local, agricultural, farmer, or popular knowledge in the natural sciences class lies in promoting the decolonization of the curriculum and social justice. Decolonization is identifying, critiquing, and transforming colonizer-colonized power relationships at the ideological, epistemological, economic, and political levels, favoring local positions (Cabrales et al., 2021). However, this process does not only occur in the territory of the colonized who claim their ideologies, epistemologies, and other local cultural and social aspects; it also occurs in the territory of the colonizers (Tamimi et al., 2024). Likewise, in a specific way, the decolonization process is materialized in university curricula (Tamimi et al., 2024), teacher education (Martin & Pirbhai-Illich, 2016), and the contents at school through intercultural teaching (Uribe-Pérez, 2017). Thus, it is the task of faculties of education to educate science teachers who, in rural or urban areas, recognize the existence of local, every day, popular, traditional agricultural, rural, farmer or countryside knowledge, practices and values that communities use to explain the world.

1.1 The local-rural and intercultural science education

Regarding the definition of local knowledge, Avery and Kassam (2011) identify two types: a) local knowledge that people have about the nature that surrounds them and b) empirical scientific and technological knowledge about the functioning of systems (the body, agriculture, animals, among others) and everyday machines or devices. In both cases, knowledge is contextual and historical of the community and emerges from observation, experience, and socialization outside educational institutions. On the other hand, Conte and Ribeiro (2017) define Campesino (landless farmers) local knowledge as knowledge accumulated by Campesino communities through life experiences and agricultural labor practices. Specifically, Figueroa-Iberico (2020) understands local knowledge from a constructivist stance and as students' prior knowledge, which consists of a) knowledge of self and nature and b) values and worldviews (including ways of living together). The above means recognizing students as active subjects of the society and culture of their community (Salgado et al., 2018).

The next are specific didactic (teaching, learning and assessment) proposals to include local knowledge of communities in the science class:

- Recognition and recovery of rural or Campesino knowledge: For example, Bascopé and Caniguan (2016) identify categories of local knowledge of rural communities and integrate them with the school science curriculum. On the other hand, Castillo et al. (2023) recover the knowledge that a rural community has about the nutritional and medicinal use of plants. Likewise, Grajales and Tascón (2023) involve pre-service teachers in recovering everyday knowledge of urban communities, including ancestral knowledge about medicinal plants, science popularization, and coffee.
- Culturally sensitive, situated, and critical teaching: Ferrell and Tharpe (2024) propose a science teaching model that recognizes and values the diverse backgrounds and cultural experiences of rural students, as well as the contextualization of learning. In the same direction, Silva and Bizerril (2020) and Souza (2021) discuss teaching from the perspective of Science, Technology, and Society from a Freirian approach, which promotes a science education that is coherent with the rural reality but critical and liberating.

However, neither group of proposals is specific regarding how to plan and teach science in a horizontal relationship with local knowledge beyond using the local as an example or context for science. Thus, the first group of proposals describes the identification and recovery of local knowledge that teachers might use as content in science classes. The second group of proposals is philosophical and pedagogical.

2 THEORETICAL FRAMEWORK

2.1 Local-rural knowledge

Considering the previous review, a definition of local knowledge is – the set of ideas, values, procedures, devices, and rules a community has constructed about nature (including being) and

daily life (including existing ways). Such knowledge can be traditional or ancestral but also heterogeneous, dynamic, or disappear. Scientific notions acquired in or outside educational institutions can also nourish local knowledge. Such knowledge emerges from observation, experience, or communication between generations. Rural local knowledge is associated with the natural context, the territory, and work in the countryside, but it can circulate in cities due to migratory processes.

2.2 The Epistemological Bridge for intercultural science education

The epistemological bridge is a reference for pre-service science teacher education and science education that Tovar-Gálvez (2021) develops from the work of Castaño (2009) regarding epistemological inclusion in the science lessons. For Tovar-Gálvez (2021), the epistemological bridge describes the epistemologically inclusive didactic process (planning, teaching, and learning assessment) using pluralism and interculturality. Thus, epistemological pluralism (Olivé, 2009) recognizes and validates the existence of other epistemologies (knowledge systems and ways of knowing) different from the epistemology of science. From this perspective, pre-service teachers recognize other knowledge systems belonging to culturally differentiated (CD) communities that the curriculum excludes. On the other hand, interculturality (Walsh, 2009) is a dialogue between cultures (epistemologies) that recognizes the asymmetric power relations between cultures and seeks to balance them. Thus, pre-service teachers will use the CD knowledge systems as valid content for the science class.

The epistemological bridge metaphor describes a bridge as composed of at least two distant and independent endpoints and a common walkway connecting these endpoints. Thus, the epistemology of the sciences and the epistemology of CD communities represent two endpoints. Each epistemology possesses a domain that differs from others, composed of ideas, practices, artifacts, materials, values, and norms. However, the bridge will be complete when communities identify the commonalities between epistemologies, which promotes individuals' transit between epistemologies. For example, the scientific and rural communities have procedures for obtaining products from the land and positive values about the land. Although the procedures and values may differ, they have similar functions within each epistemological domain. These commonalities allow for dialogues between the communities. Moreover, anyone crosses the bridge in any direction at any time.

On the other hand, Tovar-Gálvez (2021) expresses the epistemological bridge in two practical principles to facilitate its use by teachers, teacher educators, the research community, and the policy and program design experts:

- *Principle of epistemological independence:* There are innumerable epistemologies other than the epistemology of school science. These other epistemologies belong to non-hegemonic communities that the curriculum do not represent and have intrinsic validity in their context. When teachers put this principle into practice, they recognize the existence of systems of ideas, practices, artifacts, materials, values, and norms that differ from school science. Moreover, teachers validate the contribution of such knowledge systems to

understanding and interpreting reality. Likewise, teachers use such knowledge systems as content in the science classroom without mixing, evaluating, or subordinating them to science.

- *Principle of epistemological similarity:* Different epistemologies have common elements that are a way to cross epistemological boundaries, transit between epistemologies, and dialogue-collaborate. The similar or alike elements between epistemologies can be ideas, practices, artifacts, materials, values, and norms. Teachers put this principle into practice when they identify similar elements between school science and the knowledge systems of CD communities. Students transit between epistemologies in any direction and at any time, and each subject decides where to stay.

2.3 Intercultural Teaching Practice for Science Education (ITPSE) of Planning

The ITPSE of planning concretizes the epistemological bridge and its development consisted of three design-test-design cycles with in-service science teachers in Colombia (Tovar-Gálvez & Acher, 2021; Tovar-Gálvez, 2023a and 2023b). The ITPSE of planning defines an expected teaching performance, which describes how teachers should plan within the framework of the epistemological bridge. Subsequently, teachers find three planning tasks that guide them to the expected performance.

Expected teaching performance: Build the epistemological bridge by organizing the contents you will teach from each epistemology, establishing relationships between them, and articulating them to the students' learning output. The students' learning output is the explanation of the same situation from each epistemology, the scientific one, and others from CD communities.

2.3.1 Planning Task 1

Propose an everyday situation that students will explain from each epistemology, the scientific, and other CD communities.

- Prompt 1: A situation is an occurrence, event, incidence, or happening in the context close to the students, which includes a phenomenon or artifact that students might explain from both epistemologies. A question is a good guide for students to explain the situation.
- Prompt 2: An epistemology is a set of ideas, practices, artifacts, norms, and values a community uses to interpret and intervene in reality. For example, School science and indigenous peoples' wisdom are independent epistemologies.
- Prompt 3: An explanation is a conclusion about an unknown problem or situation supported by evidence gathered through experience and reasoning. Reasonings arise from interpreting the data or evidence from the ideas of each epistemology.

2.3.2 Planning Task 2

Organize each culture's knowledge and experiences as independent content in the form of ideas, production practices, and legitimization practices. Using these contents, students will pose explanations for the situation.

- Prompt 4: An idea is a connection between concepts, values, and practices that has the power to describe or account for phenomena.
- Prompt 5: Production practices are all the experiences communities carry out based on knowledge to produce information, goods, products, services, or new knowledge. For example, medicinal plants or traditional agricultural techniques are production practices in a rural setting. In science, laboratory procedures are some production practices.
- Prompt 6: Legitimization practices are all the experiences that communities carry out based on norms to support, endorse, regulate, standardize, recognize, and disseminate their knowledge and products. These norms delimit the domain of each epistemology. For example, in a rural environment, communities legitimize (incorporate) knowledge when the new generations learn from the elders in fairs, visits, dialogues, practices, observation, or direct work. In science, communities legitimize (validate) knowledge by using standardized protocols to regulate procedures. Students put into practice the epistemological independence when everyone uses ideas and practices without mixing them, explaining one from the other and evaluating one from the other.
- Prompt 7: The students must use the ideas to interpret the situation. Likewise, each culture's production and legitimization practices must focus on students studying, analyzing, or understanding the situation they will explain.

2.3.3 Planning Task 3

Identify similarities between the scientific epistemology and those belonging to CD communities. Students will use those similarities to consciously transiting between domains, learn from each, and construct explanations.

- Prompt 8: The different communities have points in common in the knowledge production processes. Some similar or common elements are observation and communication practices, regulatory norms, values, goals, desires, specific languages, experts, production practices, and legitimization practices. For example, observation is a practice employed by rural and scientific communities. Although such practice differs for each culture (independent in its procedure and norms), it has a similar objective – people use observation to collect information about a phenomenon. Students put into practice the principle of similarity when they identify similarities, commonalities, or close goals among epistemologies and use them to explain situations. Likewise, students continue to preserve the independence of epistemologies.
- Prompt 9: Some of the most frequent errors are that students use the language of science to talk about the CD contexts and vice versa. Equally, it can happen that students use science

lab apparel and tools to carry out CD practices. It is, therefore, vital to remember that although some aspects are similar, they are also independent.

3 METHODOLOGY

This study is qualitative because it takes as data the words through which the participants express their ideas about science education. Likewise, this study interprets what the participants express by analyzing the content of their proposals from previous categories coming from the theoretical framework (Cisterna, 2005; Hsieh & Shannon, 2005).

3.1 Population and context

The study was conducted with pre-service teachers enrolled in the subject "Teaching and Learning of Biology and Geology II" of the Master's Degree in Secondary School Teacher Education of the Universidad a Distancia de Madrid (Madrid Open University). The researchers offered an online module on intercultural science teaching with virtual media as part of the course. The participants' product is a proposal for planning science teaching from the epistemological bridge through the tasks of the ITPSE.

3.2 Data collection tool

A planning guide is the data collection tool. The tool has a previous design process through three design-test-design cycles with in-service teachers in Colombia (Tovar-Gálvez & Acher, 2021; Tovar-Gálvez, 2023a and 2023b). The tool provides a series of conceptual, epistemological, and metacognitive prompts (Sandoval, 2003) to guide teachers in developing the ITPSE of planning tasks. Participants provided informed consent for using the data collected for research purposes.

3.3 Analysis criteria

The analysis has two parts. First, a general report describes the local-rural contents that pre-service teachers chose to include in planning intercultural science education. Second, a case analysis illustrates the epistemological bridge between school science and local-rural knowledge. The analysis criteria are four previous categories from the theoretical framework: a) the potential of the situation for students to explain it from both epistemologies, b) the epistemological independence of the contents, c) epistemological similarity between the contents, and d) the potential contribution of the contents to the explanations. The proposal's content is analyzed to identify how the planning reflects the mentioned criteria.

4 RESULTS

4.1 Type of local-rural knowledge chosen by pre-service science teachers

Among the 32 participants in the module, 29 handed in the completed planning tool, and 8 of them proposed to relate school science with local-rural knowledge, as follows:

- a) Traditional use of medicinal plants (4):
 - *Use of the plant "cat's claw" to treat infections.*
 - *Traditional knowledge on the use of medicinal plants: oral transmission and community practice.*
 - *Ritual and traditional use of medicinal herbs: ancestral knowledge about medicinal plants and their application in rituals and treatments.*
 - *The traditional beliefs and practices of the grandfather's culture (...) on using medicinal plants (...).*
- b) Traditional agricultural knowledge (2):
 - *The transmission of agricultural knowledge and techniques from generation to generation.*
 - *Traditional knowledge about planting and harvesting cycles and local agricultural practices specific to the region.*
- c) Traditional river and fish farming knowledge (1)
 - *Knowledge of river and fish phenomena obtained from observation and fishing for generations.*
- d) Knowledge of traditional cheese production (1)
 - *Artisanal practices passed down from generation to generation: use of freshly milked milk to make cheese and use of natural vegetable rennet in the Canary Islands.*

4.2 Planning case including school science and local-rural knowledge

Table 1 presents the contents planned by a pre-service teacher who participated in the module and used the planning tool designed.

Table 1: Teacher-in-education planning.

The situation that students will explain	
During the town's festivities, the main tourist attraction is the Celtic fair, where, among other things, medicinal herbs are exhibited and sold. The students, mostly of Galician origin, comment in class about the fair and share that many of the medicinal herbs seen at the fair are used by their grandmothers and grandfathers in their homes. From this, the following question arises: How can using herbs to treat ailments and/or health problems be explained?	
International scientific community	Galician community
Scientific Idea	Culturally Differentiated Idea
Identifying active principles and medicinal properties of herbs: study of chemical compounds and their effects on the human body.	Ritual and traditional use of medicinal herbs: ancestral knowledge on medicinal plants and their application in rituals and treatments
Scientific Production Practice	CD Production Practice

• Perform extractions of active principles from herbs and analyze their chemical composition. • Prepare a detailed report on the identified chemical compounds and their medicinal effects relating them to the system in which they would act (reproductive, digestive system, etc.).	• Preparation of infusions and ointments following traditional recipes. • Performance of the ritual "Herbas de san Xoán" as an example of a ritual practice using traditional medicinal herbs from the Celtic culture.
Scientific Legitimation (Validation) Practice	CD Legitimation Practice (Incorporation)
Class presentation where students will share their findings about the medicinal plants of Galicia. They can use slide presentations, posters or short talks to share the information they have collected.	• Students will organize a school event at which they present their learning about the ritual use of medicinal herbs, inviting members of their families and/or communities to participate and share their experiences. • In addition, they should document the practices in a book or poster to preserve and disseminate ancestral knowledge. Students can collaborate in creating a written resource that compiles information about medicinal herbs, rituals, and traditions of Celtic origin.
Similarities	
• The similarities between the practices of knowledge production about medicinal herbs in the scientific and culturally differentiated communities lie in the fact that both aim to obtain and apply knowledge about herbs' medicinal properties. Although the practices may differ in each context, the scientific and culturally differentiated communities share the common purpose of seeking ways to improve health and well-being using natural resources such as medicinal herbs. • In both cases, the community carries out systematic and structured processes to obtain information about herbs through laboratory experiments and clinical studies in the scientific community or through observation, empirical experimentation, and oral transmission of knowledge in the culturally differentiated community. Moreover, specific norms and values in both contexts guide knowledge production practices and legitimize such knowledge within the community.	

4.2.1 *Potential of the situation for students to explain it from both epistemologies.*

The situation has the potential for students to explain it from science and local-rural knowledge. Part of the potential is that the situation relates to the ancestral context of the local Galician community and its knowledge, which the curriculum does not include. The other part of the potential is that biological and chemical science can explain aspects related to medicinal plants. Also, the situation is adequately structured because it poses a context (Celtic fair), a phenomenon (grandfathers and grandmothers use some of the plants of the fair), and a motivating question (explain the medicinal use of herbs).

4.2.2 *Epistemological independence of the contents:*

The teacher embodied the principle of epistemological independence in the planning. This goal is evident by the fact that the teacher clearly and coherently proposed ideas, production practices, and legitimization practices delimited for each epistemology. Likewise, the contents are

coherent within their epistemological domain. In addition, the teacher does not mix or subordinate epistemologies.

4.2.3 *Epistemological similarity between contents:*

The teacher embodied the principle of epistemological similarity in the planning. This fact is evident in Table 1, in which the teacher describes two similarities: practices of knowledge production and the rules and values of regulation. In addition, the teacher consistently argues why such aspects of the epistemology of science and the local-rural epistemology are similar.

4.2.4 *Potential contribution of content to the explanations:*

The contents of each epistemological domain potentially help students explain the situation. The ideas and practices planned for the scientific part, as well as those corresponding to the local-rural part, are directly focused on analyzing the situation and answering the question.

5 DISCUSSION

5.1 A bridge between the epistemology of school science and local epistemology.

The planning case study establishes a bridge between the epistemology of school science and the local epistemology of the community of Galicia. The situation that students will explain from both epistemologies and the contents defined from each epistemology comply with the principles of the epistemological bridge. Thus, the participant's proposal includes ideas and practices for students to explain the use of medicinal plants from science and local Galician knowledge. Each domain differs from the other, and there is no hierarchy or mixture between them. Those domains are the end and distant points of the bridge. On the other hand, what the pre-service teacher proposed makes the epistemological similarity explicit. Specifically, the production practices of both epistemologies converge in their objective of using plants to cure diseases. Likewise, information gathering is a common practice between both epistemologies. This similarity is the common path or footbridge that joins the end points of the bridge.

5.2 Contributions to the consolidation of intercultural teacher education

The present study contributes to consolidating the research field of science teacher education from an intercultural point of view, as it provides convergent data with other research reports. On the other hand, the divergences are an opportunity for dialogue and complementarity among the various studies.

For example, Tovar-Gálvez (2020) reports a study with in-service chemistry teachers in secondary public schools in Colombia. Participants also used the tool based on the ITPSE of planning. Comparing results from both studies, those are the findings:

- Situation: In the cases reported by Tovar-Gálvez (2020), the participants proposed everyday situations for the students, describing an unknown phenomenon and with a motivating

question. In contrast, in this study, the pre-service teacher is more specific in choosing an everyday situation, describing an unknown phenomenon, but in the context of the local community from which knowledge and forms of knowing emerge to relate to the school science.

- Epistemological independence: Participants in Tovar-Gálvez's study (2020) define content for both epistemologies with internal consistency. However, sometimes, the proposals do not respect the domains because the participants used the language of one epistemology in the other. The case of this article defines independent contents for each epistemology.
- Epistemological similarity: In both the previous study and the present case, the participants managed to capture the epistemological similarity by explicitly stating the objective of the practices proposed to explain the situation.
- The potential contribution of the contents to the explanations: The participants in both studies connected the ideas and practices to the situation students will explain. This goal is evident in how the teachers define the ideas and the specific information or results students can collect through the proposed practices.

On the other hand, Kavalek et al. (2022) also studied classroom planning by pre-service teachers in an undergraduate program in Campesino education in Brazil. The proposals begin by choosing a phenomenon that students will address from school science and local knowledge. Participants must also explain the relationship between this phenomenon and each epistemology. Finally, the plans include activities to approach the knowledge of each epistemology. The comparison of data elucidates:

- In both cases, teachers motivate students to approach a phenomenon from the contents of science and local knowledge.
- In both cases, the connection between local and scientific content and the situation that students will address must be explicit.
- Teachers' justifications of the relationship between each epistemology and the phenomenon students will address in the study of Kavalek et al. (2022) are consistent with the formulation of the ideas of each epistemology in the present research.
- Both forms of planning include activities within each epistemology. The difference is that the ITPSE of planning discriminates between production and legitimation practices.
- Each epistemology has a demarcated domain in both investigations, and teachers plan independent content from each epistemology.
- The most notable difference is that planning with the ITPSE of planning methodological framework guides teachers to make explicit the similarities between the epistemologies.

5.3 Contributions to the advancement of intercultural teacher education

The research reported here contributes to broadening the field of science teacher education from and intercultural point of view. A framework such as the epistemological bridge and ITPSE of planning and data such as those presented here contribute to resolving some of the limitations in

science teacher education and professional development that includes local epistemologies in the classroom.

For example, in Brazil, Conte and Ribeiro (2017) studied how teachers in a Campesino school relate curriculum content and the knowledge learned by communities in their agricultural work and daily life. The authors identify that the school involves students in maintaining a vegetable garden, chickens, and fruit trees, as well as in a local food kitchen. These activities belong to the work and traditions of the local Afro-descendant, indigenous, and Campesino communities. Another aspect related to the local culture that the studied school promotes is the religiosity of the community through saints' feasts. However, Conte and Ribeiro (2017) state that this knowledge only circulates outside the classroom. Thus, the relationship between curriculum and local knowledge in the classroom is unclear. Given this, the theoretical and methodological framework, as data presented in this study, contribute to realizing a culturally inclusive relationship between curriculum and local knowledge in the classroom.

Similarly, Uribe-Pérez (2019) studies nine science teacher education programs in Colombia. The researcher interviewed pre-service teachers from each program regarding whether they included local, ancestral, or traditional knowledge in their initial pedagogical practice. Although the author identifies significant advances in content and strategies declared by the participants, the inclusion of local knowledge in pedagogical practice happens permanently in only one program. At the same time, it is very scarce in the other eight. As an alternative, the epistemological bridge framework contributes to the discussion and change of power relations between the epistemologies of the official curriculum and local ones. Likewise, the ITPSE of planning and data presented here are practical tools for transforming the science teacher education curriculum towards decolonial and intercultural postures.

5.4 Other considerations and contributions to the field of research

This article also specifically contributes to the knowledge production on local knowledge inclusion in science education in Spain. As the literature reviewed in the introduction and cited in the discussion shows, contextualized literature in Spain is scarce, being more abundant in Latin American contexts. The data provided are a valuable example for teachers and teacher educators in Spain, as they illustrate how to establish a culturally inclusive relationship between school science and local knowledge in Spanish rural communities.

Another contribution of this article is to the positions, teacher education, and research in decoloniality. A relevant part of the literature consulted on local, rural, or non-hegemonic knowledge in science education considers decoloniality as a frame. In this literature, decoloniality is the recognition and vindication of the knowledge of local communities, as well as its inclusion as content that teachers might teach. In this way, decolonizing the curriculum means including local knowledge that the official curriculum does not represent. Likewise, the literature establishes a connection between intercultural science education as it transforms the power relations between the colonizer and colonized cultures. Consequently, this study's foundations, methodology, and

data are linked to decolonial positions since the local emerges from the search for intercultural science education.

Finally, one of this study's limitations is the small amount of data. However, this is not due to a bad design but to the fact that the local-rural aspect emerged from the decisions made by some participants at the time of planning. This situation outlines research perspectives on teacher education in countries with cultural and epistemic hegemony.

6 CONCLUSIONS

The rural-local content that teachers might teach in the science classroom emerges in the context of a module of intercultural science teaching for pre-service science teachers in a Spanish-distance university. The module offered the theoretical framework of the epistemological bridge that describes the didactic process from epistemological pluralism and interculturality. Likewise, based on the epistemological bridge, the module offered the methodological framework of the Intercultural Teaching Practice for Science Education (ITPSE) of planning. From there, participants should plan intercultural science education by establishing a dialogue between school science and culturally differentiated epistemologies. However, some participants recognized that local communities have their knowledge that the curriculum does not represent or include, and included it in their planning.

The data provided contributes to the work of teachers and teacher educators. Thus, the data show the type of knowledge chosen by the eight participants who planned, including local: a) traditional use of medicinal plants (4 cases), b) traditional agricultural knowledge (2 cases), c) traditional river and fish knowledge (1 case) and d) traditional cheese making knowledge (1 case). In addition, the detailed case illustrates what teachers can achieve by following the planning ITPSE. Similarly, the case illustrates a way of bridging the epistemology of school science and local epistemologies.

In addition, the theoretical and methodological framework and the results presented contribute to the consolidation and expansion of the field of teacher education that includes local knowledge in intercultural dialogue with school science. This contribution is evident by contrasting the frameworks and data presented in this study with those of other reports, finding convergences that consolidate the field of research and divergences that signify advances in the field. Likewise, this study's frameworks and results align with decolonial positions on curriculum and teacher education.

1 REFERENCIAS

Avella, S., Tovar-Gálvez, J. C., Espinosa-Barrera, P., & Martínez-Pachón, D. (2024). Orientación socio ocupacional en la educación rural: Análisis bibliométrico y sistemático desde el método ProKnow-C. *Revista Española de Orientación y Psicopedagogía*, 35(1), 138–158. <https://revistas.uned.es/index.php/reop/article/view/40834>

- Avery, L. M. (2013). Rural Science Education: Valuing Local Knowledge. *Theory into Practice*, 52(1), 28–35. <http://www.jstor.org/stable/23362856>
- Avery, L. M., & Kassam, K.-A. (2011). Phronesis: Children's local rural knowledge of science and engineering. *Journal of Research in Rural Education*, 26(2), 1-18.
- Baronnet, B., & Morales-González, M. (2018). Racismo y currículum de educación indígena. *Ra Ximhai*, 14(2), 19-32. <https://bit.ly/3DGiexA>
- Barraza Escamilla, N. (2018). El currículum, análisis y reformulación del concepto. *Dictamen Libre*, 22, 113–118. <https://doi.org/10.18041/2619-4244/dl.22.5032>
- Bascope, M., & Caniguan, N. I. (2016). Propuesta pedagógica para la incorporación de conocimientos tradicionales de Ciencias Naturales en primaria. *Revista Electrónica de Investigación Educativa*, 18(3), 161-175. <http://redie.uabc.mx/redie/article/view/1143>
- Cabral, O., Márquez, F., & Garzón, E. J. (2021). Circular economy and reducing consumption from a decolonial approach. *Cuadernos de Administración*, 37(70), e5110905. <https://doi.org/10.25100/cdea.v37i70.10905>
- Canizález, A., Alfaro, N., & Ticas, P. (2023). Identificar la hegemonía curricular en la enseñanza de las ciencias en la escuela rural salvadoreña y sus desafíos multiculturales: una aproximación exploratoria e interpretativa. En Hernández, R., Sanabria, Q. y Pedraza, Y. (Comps.). *Enseñanza de las ciencias, interculturalidad y contexto rural: una mirada Latinoamericana*, (79-108). Editorial UPTC.
- Castaño, N. (2009). Construcción Social de Universidad para la Inclusión: la formación de maestros con pertinencia y en contexto, desde una perspectiva intercultural. En D. Mato (coord.), *Educación Superior, Colaboración Intercultural y Desarrollo Sostenible/Buen Vivir. Experiencias en América Latina*, (183-206). UNESCO.
- Castillo, M. C., Rodríguez, L. K., & Pachón, N. A. (2023). Etnobotánica: una aproximación al diálogo de saberes en escenarios educativos no formales. *Revista Electrónica EDUCyT*, 14(Extra), 139-147.
- Cisterna, F. (2005). Categorización y triangulación como procesos de validación del conocimiento en investigación cualitativa. *Theoria*, 14(1), 61-71. <http://www.redalyc.org/pdf/299/29900107.pdf>
- Conte, I. I., & Ribeiro, M. (2017). Escola do campo: relação entre conhecimentos, saberes e culturas. *Educação E Pesquisa*, 43(3), 847-862. <https://doi.org/10.1590/s1517-9702201707160785>
- Ferrell V., & Tharpe A. (2024). Enhancing Rural Science Education through School District–University Partnership. *Education Sciences*, 14(7), 712. <https://doi.org/10.3390/educsci14070712>
- Figueroa-Iberico, A. M. (2020). Vinculación de conocimientos locales a la práctica pedagógica en contextos rurales. *Educación y Educadores*, 23(3), 379-401. <https://doi.org/10.5294/edu.2020.23.3.2>

- Galván, L. (2020). Educación rural en América Latina: escenarios, tendencias y horizontes de investigación. *Márgenes, Revista de Educación de la Universidad de Málaga*, 1(2), 48-69. <https://doi.org/10.24310/mgnmar.v1i2.8598>
- González, V., Quiceno, Y., Correa, D., Vélez, Y., & Montoya, L. (2022). El maestro novel y la enseñanza de las ciencias naturales en contextos rurales. *Praxis & Saber*, 13(34), e14162. <https://doi.org/10.19053/22160159.v13.n34.2022.14162>
- Grajales Fonseca, Y. A., & Tascón Escalona, E. E. (2023). Saberes de mi tierra: propuesta para la educación en contextos culturalmente diversos. *Revista Electrónica EDUCyT*, 14(Extra), 165-170.
- Hsieh, H-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-88. <http://jrre.psu.edu/articles/26-2.pdf>
- Kavalek, D. S., dos Reis, A. M. S. & Pinheiro, R. N. (2022). Educação do Campo e História da Ciência: uma proposta didática expressa em planos de aula. *História da Ciência e Ensino*, 25(Especial), 370-389. <https://doi.org/10.23925/2178-2911.2022v25espp370-389>
- Martin, F., & Pirbhai-Illich, F. (2016). Towards Decolonising Teacher Education: Criticality, Relationality and Intercultural Understanding. *Journal of Intercultural Studies*, 37(4), 355–372. <https://doi.org/10.1080/07256868.2016.1190697>
- Martínez-Tovar, J., Pomares, D., Sierra, M., & Martínez, M. (2021). Racismo y segregación en Colombia: salud, educación y trabajo en la población afrodescendiente del pacífico. *Trans-Pasando Fronteras*, 16, 93-122. <https://doi.org/10.18046/retf.i16.4102>
- Marzuca Nassr, N. (2023). Educación intercultural en la enseñanza de las ciencias naturales: Un desafío para la igualdad de oportunidades. *Revista Reflexión E Investigación Educativa*, 4(2), 121–131. <https://doi.org/10.22320/reined.v4i2.5786>
- Meinardi, E. (2017). Interculturalidad y enseñanza de las ciencias: una perspectiva que nos lleva a revisar críticamente nuestras concepciones tradicionales sobre las finalidades de la educación. *Revista De Educación En Biología*, 20(2), 113–119. <https://doi.org/10.59524/2344-9225.v20.n2.22521>
- Muñoz, A. I., Toma, R. B., Martínez-Hernández, C., Bermejo, N., & Sánchez, P. J. (2022). Identidad rural e identidad científica. Una intervención educativa en la España vaciada. *Enseñanza de las Ciencias*, 40(3), 125-145. <https://doi.org/10.5565/rev/ensciencias.5693>
- Muñoz Ramírez, N. L. (2021). Interculturalidad y enseñanza de las ciencias, una oportunidad para aprender en relación dialógica con el otro. *Revista Lumen Gentium*, 3(1), 99–110.
- Ocoró, A. (2021). El papel del currículo en la reproducción de desigualdades étnico-raciales. Una mirada al caso argentino en perspectiva latinoamericana. *Revista INTEREDU*, 1(4), 41-68. <http://dx.doi.org/10.32735/S2735-65232021000490>

- Olivé, L. (2009). Por una auténtica interculturalidad basada en el reconocimiento de la pluralidad epistemológica. En L. Tapia. (Coord.), *Pluralismo Epistemológico*. CLACSO y CIDES-UMSA.
- Osorio, M. (2017). El currículo: perspectivas para acercarnos a su comprensión. *Zona Próxima*, 26, 140-151. <https://doi.org/10.14482/zp.26.10205>
- Ribadeneira, F. M. (2020). Estrategias didácticas en el proceso educativo de la zona rural. *Revista Conrado*, 16(72), 242–247. <https://conrado.ucf.edu.cu/index.php/conrado/article/view/1237>
- Salgado, R. M., Keyser, U., & Ruiz de La Torre, G. (2018). Conocimientos y saberes locales en tres propuestas curriculares para educación indígena. *Sinética*, 50, 1-18. [https://doi.org/10.31391/s2007-7033\(2018\)0050-003](https://doi.org/10.31391/s2007-7033(2018)0050-003)
- Sandoval, W. A. (2003). Conceptual and epistemic aspects of students' scientific explanations. *Journal of the Learning Sciences*, 12(1), 5–51.
- Silva, M. J. R., & Bizerril, M. X. A. (2020). Educação do campo e abordagem ciência, tecnologia e sociedade: um diálogo possível. *Linha mestra*, 42, 82-91. <https://doi.org/10.34112/1980-9026a2020n42p82-91>
- Souza, J. (2021). A educação científica do campo. *Revista Educar Mais*, 5(4), 709–713. <https://doi.org/10.15536/reducarmais.5.2021.2440>
- Souza, J., de Ostermann, F., & Rezende, F. (2021). Educação Científica do Campo: uma Proposta Formativa e Curricular de Educação Científica para as Licenciaturas em Educação do Campo. *Revista Brasileira De Pesquisa Em Educação Em Ciências*, e29403, 1–30. <https://doi.org/10.28976/1984-2686rbpec2021u15151544>
- Tamimi, N., Khalawi, H., Jallow, M., Torres Valencia, O., & Jumbo, E. (2024). Towards decolonising higher education: a case study from a UK university. *Higher Education*, 88, 815–837. <https://doi.org/10.1007/s10734-023-01144-3>
- Tovar-Gálvez, J. C., & Acher, A. (2021). Diseño de prácticas interculturales de enseñanza de las ciencias basado en evidencia. *Enseñanza de las Ciencias*, 39(1), 99-115. <https://doi.org/10.5565/rev/ensciencias.2891>
- Tovar-Gálvez, J. C. (2020). La planificación de contenidos como oportunidad para establecer puentes entre la epistemología de las ciencias y epistemologías tradicionales. *Revista Electrónica EDUCyT*, 1(Extra), 49-61. <https://bit.ly/3u6aEe6>
- Tovar-Gálvez, J. C. (2021). The epistemological bridge as a framework to guide teachers to design culturally inclusive practices. *International Journal of Science Education*, 43(5), 760-776. <https://doi.org/10.1080/09500693.2021.1883203>
- Tovar-Gálvez, J. C. (2023 a). Bringing cultural inclusion to the classroom through intercultural teaching practices for science education (ITPSE) and guiding tools. *Science Education*, 107(5), 1101-1125. <https://doi.org/10.1002/sce.21798>

- Tovar-Gálvez, J. C. (2023 b). Intercultural teaching practices for science education to support teachers in culturally diverse classrooms. *Teaching Education*, 34(4). <https://doi.org/10.1080/10476210.2023.2167975>
- Uribe-Pérez, M. (2017). La descolonización del conocimiento científico en la enseñanza de las ciencias: una mirada desde el enfoque intercultural. En Amador, J. C. (editor). *Cultura, saber y poder en Colombia: Diálogos entre estudios culturales y pedagogías críticas*, (205-221). Universidad Distrital Francisco José de Caldas.
- Uribe-Pérez, M. (2019). Saberes ancestrales y tradicionales vinculados a la práctica pedagógica desde un enfoque intercultural: un estudio realizado con profesores de ciencias en formación inicial. *Educación y Ciudad*, 37, 57–71. <https://doi.org/10.36737/01230425.v2.n37.2019.2148>
- Walsh, C. (2009). *Interculturalidad, estado, sociedad: luchas (de)coloniales de nuestra época*. Universidad Andina Simón Bolívar.
- Westermeyer, M., & Quilaqueo, D. (2023). Violencia epistemológica detrás del discurso de la alfabetización científica. En Hernández, R., Sanabria, Q. y Pedraza, Y. (Comps.). *Enseñanza de las ciencias, interculturalidad y contexto rural: una mirada Latinoamericana*, (127-148). Editorial UPTC.
- Wigdorovitz, A. (2017). Ensayos: tendencias y formatos en el currículo universitario. *Itinerarios Educativos*, 9, 59–87. <https://doi.org/10.14409/ie.v0i9.6536>
- Zapata, R., & Vlasic, V. (2023). Enseñanza de las Ciencias Naturales en la Escuela Secundaria Rural: una mirada del vínculo con el contexto. *Ciencia, Docencia Y Tecnología*, 34(68), 1-12. <https://doi.org/10.33255/3468/1600>
- Zinger, D., Sandholtz, J. H., & Ringstaff, C. (2020). Teaching science in rural elementary schools: Affordances and constraints in the age of NGSS. *The Rural Educator*, 41(2), 14-30. <https://doi.org/10.35608/ruraled.v41i2.558>

HOW TO CITE THIS ARTICLE:

Tovar-Gálvez, J. C., & Fernández-Aragón, C. (2025). Emergence of the local in intercultural science teaching: pre-service teachers building bridges between cultures. *Holos*, 2 (41), 1 – 18. <https://doi.org/10.15628/holos.2025.18952>

ABOUT THE AUTHORS:

J. C. TOVAR-GÁLVEZ

Doctor of education (Martin-Luther-Universität Halle-Wittenberg). Master's degree in chemistry teaching (Nacional Pedagogical University). Teaching certificate in chemistry (Nacional Pedagogical University). Visiting profesor, master's degree in secondary education teacher training, distance university of Madrid, Madrid, Spain. E-mail: joule_tg@yahoo.com

ORCID ID: <https://orcid.org/0000-0001-7008-5140>

C. FERNÁNDEZ-ARAGÓN

PhD in Ecology (Rey Juan Carlos University), Bachelor of Science in Biology (Complutense University of Madrid). Professor in the Bachelor's degree in early childhood education and the master's degree in secondary education teacher training at the distance University of Madrid, Madrid, Spain. E-mail: mariacristina.fernandez.a@udima.es

ORCID: <https://orcid.org/0000-0001-6016-1226>

Editor: Francinaide de Lima Silva Nascimento

Ad Hoc Reviewer: Francisco Ranulfo Freitas Martins Júnior and Iure Coutre



Submitted: August 11, 2025

Accepted: October 24, 2025

Published: November 14, 2025