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Rethinking initial teacher training in natural sciences: a Chilean intercultural perspective in La Araucanía

Viviana Marcela Villarroel-Cárdenas* **and Katerin Elizabeth Arias-Ortega**

Universidad Católica de Temuco, Manuel Montt 056, Temuco, Chile. *Author for correspondence. Email: vvillarroel@uct.cl

ABSTRACT. The article describes initial teacher training in natural sciences from an intercultural perspective of the didactics of this subject. In this sense, the persistence and colonial roots in the formative itineraries of initial teacher training in natural sciences, which perpetuates a western Eurocentric view in the teaching and learning processes of natural sciences and its didactics, is analyzed in the socio-historical context of La Araucanía, Chile. The methodology is qualitative of a documentary-descriptive type. The main results show the urgency of a transformation of initial teacher training in natural sciences from an intercultural perspective and based on epistemological pluralism, in order to promote meaningful and contextualized educational experiences that favor a dialogue between the disciplinary contents of the school curriculum and indigenous educational knowledge. Thus, the implementation of culturally, socially and territorially relevant education is made possible in diverse educational scenarios, such as in the indigenous context. We conclude that there is a need to incorporate an intercultural educational approach in the initial teacher training process, which allows future teachers to acquire the didactic, pedagogical and curricular domain to teach in contexts of social and cultural diversity.

Keywords: scientific education; teacher training; colonialism, education

Repensar la formación inicial docente en ciencias naturales: una perspectiva intercultural chilena en La Araucanía

RESUMEN. El artículo describe la formación inicial docente en ciencias naturales desde una perspectiva intercultural de la didáctica de esta asignatura. En ese sentido, se problematiza la persistencia y arraigo colonial en los itinerarios formativos de la formación inicial docente en Ciencias Naturales, lo que perpetúa una mirada eurocéntrica occidental en los procesos de enseñanza y aprendizaje de las Ciencias Naturales y su didáctica, en el contexto sociohistórico de La Araucanía, Chile. La metodología es cualitativa de tipo documental-descriptivo. Los principales resultados dan cuenta de la urgencia de una transformación de la formación inicial docente en el área de las Ciencias Naturales con base en una perspectiva intercultural y pluralismo epistemológico. Esto, a fin de promover experiencias educativas significativas y contextualizadas que favorezcan un diálogo de saberes entre los contenidos disciplinarios del currículum escolar y los saberes y conocimientos educativos indígenas. Así, se posibilita la implementación de una educación cultural, social y territorialmente pertinente en escenarios educativos diversos, como lo es en contexto indígena. Concluimos en la necesidad de incorporar un enfoque educativo intercultural en los procesos de formación inicial docente, que permita a futuros profesores adquirir el dominio didáctico, pedagógico y curricular para desempeñarse en contextos de diversidad social y cultural.

Palabras-clave: educación científica; formación de profesores; colonialismo, educación

Repensando a formação inicial de professores em ciências naturais: uma perspectiva intercultural chilena em La Araucanía

RESUMO. O artigo descreve a formação inicial de professores na área de ciências naturais a partir de uma perspectiva intercultural da didática desta disciplina. Nesse sentido, problematiza-se a persistência e as raízes coloniais nos itinerários formativos da formação inicial de professores em ciências naturais, que perpetuam uma visão eurocêntrica ocidental nos processos de ensino e aprendizagem das ciências naturais e sua didática, no contexto sócio-histórico de La Araucanía, Chile. A metodologia é qualitativa do tipo documental-descritiva. Os principais resultados mostram a urgência de uma transformação da formação inicial de professores na área de ciências naturais a partir de uma perspectiva intercultural e do pluralismo epistemológico. Isso, a fim de promover experiências educacionais significativas e contextualizadas que

favoreçam um diálogo de saberes entre os conteúdos disciplinares do currículo escolar e os conhecimentos educacionais indígenas. Assim, possibilita-se a implementação de uma educação cultural, social e territorialmente relevante em diversos cenários educacionais, como no contexto indígena. Concluímos sobre a necessidade de incorporar uma abordagem educacional intercultural nos processos de formação inicial de professores, que permita aos futuros professores adquirir o domínio didático, pedagógico e curricular para atuar em contextos de diversidade social e cultural.

Palavras-chave: educação científica; formação de professores; colonialismo, educação.

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Introduction[1]

In Chile, initial teacher training in natural sciences has historically been characterized by being standardized and based on international educational models such as the competency-based model, which is why it is not appropriate considering the reality and sociocultural and territorial contexts in which the training process in Chile is framed, specifically in La Araucanía Region (Blanco-Figueredo & Arias-Ortega, 2023). Thus, the competency-based model that underpins teacher training in La Araucanía is limited to a replication and imitation of fragmented disciplinary content, which generates rote learning that is decontextualized from the sociocultural context of the students. In the case of La Araucanía, students of Mapuche and non-Mapuche origin are thus offered a teaching and learning process devoid of meaning and positioned from a blinkered way of conceiving knowledge, thereby denying and making invisible their Indigenous social, cultural and linguistic frame of reference (Arias-Ortega & Previl, 2023). This leads to the construction of hegemonic learning, which renders imperceptible the vast educational knowledge and wisdom of Indigenous peoples. Thus, Western pedagogical practices promote memorization over understanding, offering a meaningless learning experience that leads to the devaluation and omission of the principles of Indigenous pedagogy and education in school education. These principles of Indigenous pedagogy and education refer to a body of knowledge regarding the social, cultural, natural and spiritual environment, carried out as an inductive process, that is validated by the social and cultural practices used by parents, elders, and family and community members in the transmission of educational knowledge (Quintriqueo et al., 2015). The principles of Indigenous pedagogy and education have been built on the basis of socio-historical memory, in which the manner of creating knowledge is a social construction. This means that their sociocultural identity is created with the aim of understanding and giving meaning to the educational content of nature, and of the social and cultural environment, as well as spirituality and the socio-historical context in the territory, in order to describe, understand and explain the act of learning and teaching in the human-nature-spirituality relationship, according to the key interests of each individual, family and community.

The objective of this article is to describe initial teacher training in natural sciences, from an intercultural perspective of the teaching of this subject.

Monoculturalism in initial teacher training in natural sciences

The monoculturalism present in initial teacher training originated at the beginning of the 19th century in the establishment of the school education system, as a strategy used during the colonial period to ensure the success of territorial occupation through the incorporation of the school as a colonizing agent (Arias-Ortega et al., 2023a). This Eurocentric and Western monocultural approach has remained in force in school education in relation to two purposes. The first is to homogenize people through school education, constructing an egalitarian vision of Indigenous and non-Indigenous people within the framework of national society. In this way, their ethnic, linguistic, cultural, and social differences are rendered invisible (Quintriqueo et al., 2015). The second purpose is to hegemonize and hierarchize knowledge and its construction, invalidating and denying local and Indigenous knowledge in the school curriculum implemented by the State (Arias-Ortega et al., 2023a). In this way, the school is based on a Western Eurocentric approach, which implies that the training itineraries taught in universities to future teachers respond to the demands of the monocultural

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school curriculum developed in schools. Thus, the State, through the Chilean Ministry of Education (MINEDUC) limits the development of other graduate profiles for teaching programs that could respond to a perspective of social and cultural diversity, for the purpose of training based on intercultural epistemological pluralism of professional development. This is justified given that initial teacher training in Chile is based on the Guiding Standards for Teaching Degrees (Chile, 2012). These standards are themselves based on the final version of the '*Tuning* Europe - Latin America Project' (Blanco-Figueredo & Arias-Ortega, 2023), a project tasked with establishing common points and objectives necessary for initial teacher training in the country. However, these guidelines were generated in a critical reflective framework, creating a perspective of the necessary diversity of the different countries that participated in this project from a mainly functional intercultural approach to the needs of Nation-States, without considering aspects of epistemological pluralism in the conception of training and its disciplines. This means that the *status quo* in initial teacher training remains immobile.

From this perspective, the Guiding Standards for Teaching Degrees are a normative document (Chile, 2012) subdivided into two sections: the first outlines the competencies required for a teaching professional, and the second relates to the specific subject area taught by the teacher. Thus, the first section contains the pedagogical standards, which identify the capabilities required for a newly-graduated education professional (Chile, 2012). This section is divided into ten pedagogical standards, of which only one, number eight, relates to social and cultural diversity. This pedagogical standard refers to the competencies that teachers must possess to address and promote diversity in the classroom. In this sense, teachers must respect students, families, and their respective communities in order to prevent discrimination that could arise due to social, cultural, gender, and ethnic variables. Furthermore, it indicates that the teacher must incorporate inclusion and integration strategies into their teaching resources, in order to stimulate the development of the strengths and autonomy of their students (Chile, 2012).

In the second section, the disciplinary standards for each learning area are established. In the specific case of natural sciences, the development of scientific thought and knowledge is established as a priority (Chile, 2012). This approach is based on the vision of Western Eurocentric thought; in particular, the subject of natural sciences groups together knowledge classified as scientific-technical. This has a neutral connotation within school culture; in other words, it does not establish a relationship with cultural, territorial, political, historical, or much less ideological contexts (Carter, 2017). Therefore, in natural sciences, content, concepts, and ideas are replicated without generating critical thinking from an intercultural perspective in students that enables them to question the knowledge of the educational institution (Villarroel et al., 2022). This is one of the possible explanations for the maintenance of the hegemony of content taught in schools and which responds to their colonizing mission of society (Arias-Ortega et al., 2023b), which still determines a logic of thought that makes cultural diversity invisible within classrooms.

In relation to the above, initial teacher training is oriented towards training teachers who possess the ability to work in homogeneous groups (Quintriqueo et al., 2015) that are similar in terms of age, socioeconomic level, and culture. From this perspective, when teachers face a real classroom setting that presents social and cultural diversity, they acknowledge that they are incapable of effectively addressing that school environment (Arias-Ortega et al., 2023b). As a result of the scenario described, the traditionally homogenizing and colonizing school seeks to respond to educational demands that have emerged today from different social movements, which have managed to make diverse, varied, and socially inequitable educational scenarios visible. This raises the debate about the role of schools today, a space that should be understood as a heterogeneous place associated with the diversity of the context in which it is inserted (Ferrada et al., 2013). In this way, the school is currently the institution legitimized to impart knowledge and, being part of the State apparatus, it embraces the Eurocentric and Western-based curriculum, causing students with social and cultural differences to experience decontextualized, rote, and meaningless learning processes (Quintriqueo et al., 2015). This is because students who possess their own educational knowledge and understanding as a result of Indigenous family education processes see their epistemological frames of reference systematically denied and rendered invisible in the hegemonic school that has been institutionalized in Indigenous territory.

In short, initial teacher training for natural sciences teachers reveals a gap in compliance with initial teacher training standards (Chile, 2012). This gap lies in the fact that areas of learning that contribute to Eurocentric and Western thinking are favored. Specifically, for teachers in initial teacher training for natural

sciences programs, a Western view of the relationship between people and nature is constructed. Thus, teachers in training learn about this relationship, ignoring the rich knowledge of the relationship between people and nature that Mapuche culture possesses, which is framed within a relationship of balance, respect, and reciprocity with the tangible and intangible assets that make up the cosmos (Pacheco & Osses, 2015). This approach denies the opportunity of integrating Indigenous knowledge into the teaching and learning of natural sciences from an intercultural perspective, mainly in relation to the "Organism and Environment" axis, which addresses the relationship between humans and nature (Chile, 2012). Thus, the worldview of the person-nature relationship from Eurocentric Western thought prevails in initial teacher training.

Methodology

The methodology is qualitative, of the documentary-descriptive type, given that this approach enables the discovery of implicit and latent reflections present in the reviewed scientific literature, in order to understand in depth the object of study. The method of information analysis is historical-hermeneutic, understood as the theory and practice of interpretation, which implies the development of the capacity to interpret and understand a text, place it in context, and account for the knowledge, content and intention that the author wishes to transmit through content analysis (Bardin, 1996). Thus, the analysis of the information corpus is based on the approach of Creswell (2014), who indicates that the scientific validity of analytical text processing is obtained from the rigor, systematization and an appropriate reading of texts, opening up new knowledge, and positioning the researcher as an interpreter of the reality that is analyzed. In this way, it is possible to summarize and integrate the results reported by different researchers on the initial training of teachers in natural sciences.

Operationally, the descriptive documentary review considered the following phases. In the first phase, diverse and sufficient literature was selected to allow for the construction of a decolonizing theoretical framework regarding the urgency of rethinking natural sciences training from an intercultural educational perspective. Thus, the literature search began with a review of scientific articles, books, and normative literature in English, French, Portuguese, and Spanish, based on the following keywords: a) monoculturalism in initial teacher training; b) intercultural perspective in initial teacher training; c) meaningful learning and contextualization; d) complex thinking and education; e) intercultural perspective; f) natural sciences; g) natural sciences didactics; and h) person-nature worldview from Western and Indigenous perspectives. We emphasize that although the keywords are not equivalent concepts in different languages, together they essentially capture the meanings and significance associated with the object of study. The search in both national and international contexts is justified because it ensures that the literature on the object of study reflects how this problem has been addressed in different settings and from different scientific and epistemological positions, according to the social and cultural frameworks of each territory. This allows us to understand, from different logics and contexts, the methodological approaches to similar educational problems that arise in school education systems in the context of colonization (Arias-Ortega et al., 2023a). As a result of this first phase, 125 texts were selected. In a second phase, the selected literature was filtered, which involved discarding articles that did not come from databases (WoS, Scopus, Scielo). This is justified because selecting articles from academically recognized databases ensures that the literature consulted corresponds to research results that express judgments validated by experts in the object of study. This filter reduced the texts analyzed to 87. In the final phase, the 87 selected texts were further filtered by reviewing those scientific abstracts that explicitly address the subject of study. In this process, 20 texts were selected to comprise the final analytical corpus of this research.

Worldview of the person-nature relationship from a Western-Eurocentric perspective

The worldview of Western thought on the relationship between people and nature is based on the Cartesian and Kantian approaches (Callahan, 1972). The former alludes to the division between matter and spirit as a pragmatism that is transversal to scientific knowledge present in the axiological dimension, where the conception of values that are inherent to the lives of human beings is reconfigured (Castillo et al., 2017). The latter refers to the thought proposed by Kant, which is related to what should be and is a contribution to the utilitarian tradition, which establishes the belief in indefinite progress towards perfection, making use and abuse of technological resources and

nature (Callahan, 1972; Castillo et al., 2017). Both currents of thought have shaped a subject equipped with a strong rationality and a tradition of utilitarianism; the sum of both complements the ideology called pragmatism of Western thought. The human positioned in this combined approach is considered to have omnipotence regarding both the outside world and about themself, that is, the human being takes for themself the fruits of the earth and according to their economic ambitions, exploits the resources provided by nature (Pacheco & Osses 2015; Castillo et al., 2017).

In this sense, the relationship that individuals establish with nature is absolutely utilitarian, benefiting only humans to the detriment of nature. Humans position themselves as superior to nature and use it for food and economic gain (Callahan, 1972; Castillo et al., 2017). This constitutes one of the epistemological conflicts between Western Eurocentric knowledge and that of Indigenous peoples, in which the latter establish a relationship of reciprocity and balance with nature. However, this logic of thought in initial teacher training is rejected and rendered invisible. According to the above, the relationship between people and nature that emerges from Western Eurocentric thought is the one that remains in force and is promoted today, and is one of the main causes of environmental deterioration and irresponsibility toward the natural environment that surrounds us (Callahan, 1972; Pacheco & Osses, 2015; Castillo et al., 2017), as it promotes the use of the environment for economic development, without considering the damage that can be caused to nature and the resulting short- and long-term effects on human beings themselves. In short, this worldview is contrary to the Mapuche worldview of the human-nature relationship.

Worldview of the person-nature relationship from a Mapuche perspective

The Mapuche worldview of the human-nature relationship is, first and foremost, based on the symbiotic relationship between them (Quintriqueo et al., 2015). Second, they feel that their relationship with nature constitutes a gift and a miracle in which the earth offers them fruits, medicine, life, and health for balanced and harmonious development for themselves, their families, and the intangible spiritual beings that inhabit the territory (Vergara & Albanese, 2017). Because of this, one of the pillars of Indigenous knowledge is the agricultural cycle, whose relevance is the subsistence of food for animals and for Mapuche families themselves. Caring for the land is a knowledge that enables the sustainable use of nature because it underpins respect for agricultural cycles, avoiding exploitation and erosion (Pacheco & Osses, 2015).

From this perspective, based on the Indigenous knowledge of the Mapuche people, families live according to the principles they observe in nature (Quintriqueo et al., 2015), associated with land use that is not conditioned by economic factors. On the contrary, for the Mapuche, their main objective of working the land is to feed their families and animals, without harming the environment. Indeed, Mapuche culture and educational knowledge emanate pro-ecological, moderate, generous, and distributive behaviors, as well as care for the land due to a sense of belonging and the sustainable use of resources, in addition to risk identification and future projection (Pacheco & Osses, 2015).

In this sense, the Mapuche are possessors of a worldview that relates humans with nature; currently, this logic is called ethnoscience, a discipline that emerged in the mid-20th century (Carrillo, 2002). In ethnoscience, local Indigenous knowledge that is held about nature is recognized and established as a scientific vision that addresses the immediate context of human beings who inhabit a certain place and that promotes a vision of sustainability with the environment (Pérez & Argueta, 2015). This worldview is based on a preservationist code that is shared through orality (Grebe, 2000), instruction via educational methods specific to Mapuche family education, all the time teaching and learning within the framework of a relationship of respect and care for nature (*ekuwün*) (Quintriqueo et al., 2015). Consequently, Mapuche educational knowledge of the relationship between people and nature is based on the direct interaction of human beings with the natural, social, cultural, and spiritual environment. In this process, the Mapuche learn to live daily, respecting and caring for their environment, without feeling like owners of the land, but rather establishing a sustainable relationship with their natural environment. This Mapuche educational approach should be integrated into school education and the teaching of natural sciences.

Didactics of natural sciences

The teaching of natural sciences focuses on the traditional model of teaching and learning, which is fundamentally concerned with the genesis of scientific knowledge, based on processes of observation and experimentation from the rationality of human thought. Traditional teaching and learning of natural sciences

is based on conceptual knowledge, experimental knowledge, and attitudinal knowledge (Chile, 2012). The traditional approach to natural sciences is based on three fundamental pillars: a) disciplinary knowledge, which focuses on the minimum mandatory content established by the Chilean Ministry of Education (Chile, 2012); b) experimental knowledge, which is related to experimental learning and replicating what has been learned in everyday life; and c) attitudinal knowledge, which promotes respect, tolerance, and the Eurocentric-Western scientific value as the "sole and valid" value for the construction of knowledge (Vergara & Albanese, 2017). One of the complexities present in the didactics of teaching and learning processes in the natural sciences relates to the disciplinary knowledge that teachers must teach (Vergara & Albanese, 2017). This is because the teacher's role is not only focused on teaching and learning processes but also includes administrative educational functions. This translates into limited hours of preparation for teaching and for activities that contribute to meaningful learning for all students.

From this perspective, one of the challenges facing the teaching and learning of natural sciences is overcoming the belief that it is solely a subject of the scientific discipline, but rather that it seeks to transmit a synthesis of scientific knowledge related to the study of nature. This is the reason why it does not consider experience, personal practices, sociocultural interactions, students' ways of reasoning, and, finally, the affective variables that could affect students (Villarroel et al., 2022). This poses the challenge of delving deeper into the varied experiences of students in relation to their natural, social, and cultural diversity in the educational process of teaching natural sciences (Chile, 2012).

The thinking skills that the natural sciences educational process aims to develop are identification, inquiry, explanation, communication, and teamwork (Chile, 2012). These skills must be developed through the mediating role that the teacher must play, leaving behind their role as transmitter of knowledge and giving way to a social dimension of knowledge and a changing landscape of nature. Therefore, teachers need to know their students and the knowledge they bring with them that is relevant to the subject (Quintriqueo et al., 2015). In line with the above, one of the main difficulties teachers report is their lack of understanding of their students' traditional knowledge about natural sciences (Ferrada et al., 2013). This has an impact on teaching and learning planning, given that it does not consider knowledge relevant to their students' context in the development of educational activities, thus limiting teaching from an intercultural perspective. Furthermore, it is difficult for students to associate school content with their own knowledge within the framework of Indigenous knowledge transmitted to them from their families and communities. Therefore, natural science content is offered that is alien and decontextualized from students' social, cultural, and territorial realities, limiting their understanding of the content in their everyday lives. In this sense, intercultural teaching of natural sciences becomes urgent.

Teaching natural sciences with an intercultural perspective

An intercultural perspective of teaching natural sciences must be configured in educational proposals that take into account specific cultural realities. This requires educational communities to reconceptualize the content addressed in order to improve the educational process considering social and cultural diversity (Vergara & Albanese, 2017). That is, teachers must have mastery of the knowledge their students possess and then articulate it with the contents of the school curriculum, offering teaching and learning strategies with sociocultural and territorial relevance, which incorporate the principles of Indigenous pedagogy and education within the framework of the relationship between human beings and the natural environment (Bascopé & Caniguan, 2016).

In this sense, considering the teaching of natural sciences from an intercultural perspective implies promoting and developing territorial roots and a balanced relationship with the natural, social, cultural, and spiritual environments (Vergara & Albanese, 2017). That is, teachers should know their students and, based on their cultural diversity, propose meaningful learning activities that promote respect and the inclusion of their own knowledge in the classroom. In this regard, Bascopé and Caniguan (2016) propose a didactic approach to life sciences based on the dynamic process of cultural identity construction. This approach emphasizes the role of pedagogy in the teaching-learning process and establishes relationships between teaching strategies and the construction of identity in Mapuche students through family-oriented educational methods (Quintriqueo et al., 2015). The purpose of this teaching model is to establish a dialogue of knowledge and in this way build an 'open model' (Bascopé & Caniguan, 2016), which recognizes mutual differences as a methodological proposal between one's own knowledge and a recognition of the other.

In this sense, considering the teaching of natural sciences in Indigenous educational contexts, such as the Mapuche case in La Araucanía, implies highlighting the principles of Mapuche family education, in which children, for example, learn from an early age in their daily and family contexts through their own educational methods (Quilaqueo Rapimán et al., 2022). In this way, three teaching methods stand out. First, observing-doing; this form of learning is related to the experience of children between 4 and 5 years old who learn to select seeds according to a classification, which can be by size, shape, and color. From the Western perspective of natural sciences, this type of learning is known as taxonomy, which is the science that allows the classification of natural elements according to stipulated scientific parameters. By carrying out this classification activity, Indigenous children develop logical thinking, systematization, and exercise fine motor skills (Bascopé & Caniguan, 2016). A second teaching practice is play-imitation, a method used by Indigenous children that allows them to develop social skills, since through the exchange and communication of experiences among peers, they are able to recreate situations of daily life (Quintriqueo et al., 2015). In this way, they imitate the experiences and attitudes they observe in their parents and grandparents, reinforcing social rules and norms of coexistence. In educational establishments, this is not possible because recreational opportunities for students are scarce and often in spaces outside the classroom (recess or break), such that they are not intended for play but rather are an opportunity to eat and go to the bathroom. Finally, the third teaching method used in Mapuche families is listening-remembering, via the importance of the oral transmission of norms, behaviors, rituals and songs, among others (Quintriqueo et al., 2015). These allow students, firstly, to listen and value what others have to teach, and secondly, to transmit and reproduce the worldview that contributes to their cultural identity and perception of the world (Bascopé & Caniguan, 2016). However, the prevailing school system encourages the homogenization of identity, which focuses on establishing commonalities and obscuring differences (Quintriqueo et al., 2015).

In the context of La Araucanía, the teaching of natural sciences is rooted in a colonial process, therefore, it is necessary to reflect on its implications from an intercultural perspective and an Indigenous context. Vergara and Albanese (2017) have investigated intercultural education in Argentina and conclude that, to achieve an intercultural perspective of the sciences, the ecology of knowledge must be considered. In the opinion of Castillo et al., (2017), the dialogue should allow the recognition of other knowledges and an "intercultural translation" that refers to the reciprocal understanding of experiences, establishing an interchange between cultures. This is consistent with the research results of Quintriqueo et al. (2015), who highlight Mapuche cultural knowledge related to the area of natural sciences, which provides inputs such as categories of educational content that are supported by cultural knowledge and that can be incorporated into the school curriculum, establishing a dialogue between knowledge from an interdisciplinary perspective. In short, intercultural didactics invites the establishment of a dialogical relationship between the different types of knowledge in the natural sciences, which then leads to reflection and in-depth study in a classroom setting. This enables teachers and students to give meaning to scientific content by contextualizing the educational process, enriching it and generating meaningful learning with social, cultural and territorial relevance, which promotes an understanding of the world from a local and global perspective, progressively advancing in the development of intercultural thinking, where epistemological pluralism is the articulating axis.

Discussion

According to the scientific and regulatory literature reviewed, it is evident that initial teacher training in the subject of natural sciences requires a training itinerary that places the teacher in training in the regional and national context in which they will work. This, with the aim of integrating the students' context into the educational process, giving meaning to their learning and allowing them to relate the knowledge of natural sciences to their daily lives, thus acquiring significance and validity. This involves rethinking initial teacher training, promoting the development of intercultural pedagogical thinking among future teachers of natural sciences. The development of intercultural pedagogical thinking is based on recognizing the existence of other modes and worlds, in order to understand the teaching and learning processes within today's societies (Musaio, 2021). Thus, the development of intercultural pedagogical thinking must be able to generate intellectual, social, emotional, and political empowerment in teachers that favors socially, culturally, and territorially relevant teaching and learning, through the incorporation of students' own knowledge and expertise in conjunction with school knowledge, to offer learning with sociocultural significance (Rodríguez-Izquierdo & González-Faraco, 2021). This necessarily implies that during the process of planning the teaching

and learning of natural sciences, teachers must become capable of establishing encounters with the 'other', that is, teacher-student-family-community (Lobytsyna et al., 2020). Thus, the development of intercultural pedagogical thinking for the teaching of natural sciences puts under tension: 1) the institutionality of the school based on the questioning of its policies and values, which have historically made diversity invisible; 2) the teachers' personal thinking in their cognitive and emotional spheres, regarding their receptivity to cultural diversity, which has been historically constructed from an approach of denial and rejection of diversity; and 3) the educational action associated with strategies, materials, teaching activities, and evaluation methods that have been characterized by the hegemonic and traditional logic that does not consider diversity in educational processes (Rodríguez-Izquierdo & González-Faraco, 2021; Musaio, 2021).

In this sense, an intercultural perspective in initial teacher training in the La Araucanía region is justified by the region's high indigenous population (Chile, 2012). Therefore, it is a context of social and cultural diversity that would enrich the educational process of Mapuche and non-Mapuche students, as they would achieve the construction of knowledge contextualized to the place where they live. In this way, rethinking teaching and learning processes from an intercultural pedagogical perspective in today's society poses the challenge of recognizing that school education systems are characterized by becoming increasingly diverse pluricultural microcosms (Rodríguez-Izquierdo & González-Faraco, 2021). Thus, it is necessary for the conception of teaching and learning in the natural sciences to be based on intercultural pedagogical thinking that promotes attitudes for encountering others, given the coexistence of multiple perspectives regarding the identity of subjects who enter into constant interaction, conflict, negotiation, and mediation from their own frames of reference.

Conclusion

In this context, we conclude that the teaching of natural sciences must be reconceptualized based on the recognition of prior knowledge related to the core concepts of the subject. Consequently, the Mapuche worldview should be made known in the educational context, given that we live in a globalized world in need of sustainable practices and use of resources. Therefore, it is pertinent to incorporate the value of local knowledge into the learning area of natural sciences, which is focused on addressing the current environmental crisis, through contextualized teaching-learning processes for both Mapuche and non-Mapuche students. From this perspective, some of the avenues for rethinking initial teacher training for natural sciences teachers in La Araucanía, Chile, involve bringing students in training closer to Indigenous families and communities, so that they can understand, through practical activities, other ways of conceiving social, cultural, and natural phenomena that have high symbolic and spiritual implications from the Mapuche episteme. Thus, for example, it is essential to teach natural sciences based on other types of relationship between the subject and nature, considering that, according to Mapuche knowledge, their relationship with nature is subjective and interdependent, and there is no hierarchy or supremacy between the material and immaterial beings that coexist in the natural environment. Thus, knowledge of nature, based on Mapuche episteme, assumes subjectivity as a way in which subjects construct their knowledge based on life experiences and epistemic practices with nature. Likewise, a relationship of interdependence is established in which material and immaterial beings need to live in balance, which implies a relationship of reciprocity to coexist in harmony in the earthly world and the cosmos. This, from the perspective of Indigenous knowledge, goes beyond the physical and tangible, in that the religious and spiritual are also fundamental in the construction of a relational ontology. This poses the challenge of transmitting this foundation of Indigenous knowledge and understanding of the sciences to new generations of pre-service teachers in general, and natural science teachers in particular.

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INFORMATION ABOUT THE AUTHORS

Viviana Villarroel Cárdenas: PhD in Educational Sciences. Postdoctoral fellow at the Center for Research, Innovation and Creation of the Universidad Católica de Temuco (CIIC). Professor at the Departments of Psychology and of Inclusion and Interculturality of the Universidad Católica de Temuco (UCT). Researcher and author of scientific articles and presentations at international and national conferences on education, interculturality, and the teaching of natural sciences.
ORCID: https://orcid.org/0000-0003-0408-8794
Email: vvillarroel@uct.cl

Katerin Arias-Ortega: Associate Professor at the Universidad Católica de Temuco (UCT). PhD in Educational Sciences. Academic at the Department of Psychology, Faculty of Health Sciences of the UCT, Chile. Associate researcher at the Laboratoire d'Études, de Recherche et de Didactique de l'Univers Social-LERDUS Campus de Rouyn-Noranda, Québéc, Canada.
ORCID: https://orcid.org/0000-0001-8099-0670
Email: karias@uct.cl

NOTE:
Viviana Villarroel: Conceptualization, methodology, analysis, writing of the original draft, review, and editing. Katerin Arias-Ortega: Conceptualization, methodology, analysis, writing of the original draft, review, and editing. All authors have read and accepted the final version of the manuscript.

Associate editors responsible:
Terezínhha Oliveira (UEM)
ORCID: http://orcid.org/0000-0001-5349-1059
Email: teleoliv@gmail.com

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