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Toward a Decolonial University-School Link: problematizing our colonial micro-practices through epistemic care

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ABSTRACT – Toward a Decolonial University-School Link: problematizing our colonial micro-practices through epistemic care. A principle of abyssal thinking is that scientific knowledge is not equitably distributed. The university-school relationship may be read under this principle where there is a *subject* of knowledge (academic knowledge), and an *object* of knowledge (teachers and school knowledge). More specifically, we connect the problem of the (de)coloniality of power and knowledge with science education through a work of epistemic care. The case of CIDSTEM-PUCV is presented as an experimental center that challenges the traditional role of research by including the epistemic and cultural diversity that exists in schools and its communities. We reflect on the challenges of a decolonial and Latina science education capable of recognizing the plurality of knowledge with which it is related.
Keywords: **Science Education. De-Colonial Practices. Epistemic Care.**

RESUMEN – Hacia un Vínculo Decolonial Universidad-Escuela: problematizando nuestras microprácticas coloniales mediante cuidado epistémico. Un principio del pensamiento abismal es que el conocimiento científico no se distribuye equitativamente. La relación universidad-escuela puede leerse bajo este principio donde existe un *sujeto* de conocimiento, el saber académico y un *objeto* de conocimiento, el saber docente-escolar. Más específicamente, conectamos el problema de la (de)colonialidad del poder y el saber con la educación en ciencias a través de un trabajo de cuidado epistémico. Se presenta el caso de CIDSTEM-PUCV como un centro experimental que desafía el rol tradicional de la investigación para incluir la diversidad epistémica y cultural que existe en escuelas y sus comunidades. Reflexionamos sobre los desafíos de una educación científica decolonial y latina capaz de reconocer la pluralidad de saberes con que se relaciona.
Palabras-clave: **Educación en Ciencias. Prácticas de/coloniales. Cuidado Epistémico.**

Introduction

Coffee growing commenced in America in the 17th century, derived from the practices of its native growing in Africa. This traditional knowledge includes ways of growing such as shade coffee systems or the replacement of plants from the jungle or forest floor that have little effect on the ecosystem (Moguel; Toledo, 1999). In Mexico, one of the top ten coffee producers in the world, 60% of growers are indigenous communities that still preserve traditional forms of crop, which are considered sustainable (Aguirre-Cadena et al., 2018). As the *Comisión Nacional para el Conocimiento y Uso de la Biodiversidad* (n.d.) of Mexico points out, sustainable coffee growing develops biodiversity-friendly practices, achieving a crop with more nutrients and biodiversity, less weeds and pests, and better water and microclimate balance. However, in the 1970s, technological modernization changed this type of crop for monoculture, which required intensive use of agrochemicals such as DDT (dichlorodiphenyltrichloroethane). The effect of DDT and other agrochemicals led to significant soil erosion and loss of biodiversity. Still in the 1960s, the Marine Biologist Rachel Carson warned about the toxicity of DDT, which was proved to cause damage to bird populations, change plant life cycles, contaminate groundwater. There are also cases of death in humans due to pesticides (Mallén, 2012). However, her work earned her criticism from the chemical industry, politicians and several scientists who accused her of being against the progress that allowed feeding so many human lives, ruling out her evidence (Gil; Vilches, 2006). Although the United Nations Conference on the Human Environment, recognized the toxicity of agrochemicals in the 1970s, it was not until 2001, and thanks to a strong citizen movement opposed to the attitude of many scientists (Gil; Vilches, 2006), that eliminating the production of DDT was proposed (UN, 2018). DDT was used for more than 40 years in Mexico. Although the use of DDT was suspended in 1999, a study conducted in Chiapas eleven years later showed that it was present in blood samples of 64% of the local population (Rivero-Pérez; Trejo-Acevedo; Herrera-Portugal, 2014).

The case of coffee growing and the emergence of agrochemicals in the second half of the 20th century is useful for us to outline our focus of analysis: the issue of what is considered to be "valid knowledge". There are two levels of analysis that this case allows us to illustrate: firstly, it is clearly evident that there are certain types of knowledge, such as indigenous knowledge that are not considered valid knowledge, although their wide knowledge about land use and biodiversity care (Smith, 1998). On the other hand, some scientific knowledge is considered to be valid, *a priori*, as shown by the quick adoption of agrochemicals such as DDT. This first level may be understood as a struggle *between* knowledge from different epistemes (inter-epistemic conflict): indigenous knowledge versus scientific knowledge. Secondly, within the same scientific field certain knowledge seems to be more valid than others. Despite the scientific evidence earlier about the harmful effects of DDT use on the environment and people, its use in agribusiness re-

sisted these criticisms partially thanks to the endorsement of part of the scientific community. This second level may be understood as a conflict of knowledge *within* the same episteme, here the scientific episteme (intra-epistemic conflict).

This debate is useful to problematize the important international agenda that aims at promoting Scientific Literacy (SL) in science education. The purpose of SL is that the population learns and appropriates the core practices and knowledge of scientific work, understanding and participating in the impact that this knowledge has on their realities. The concept of SL was coined in the late 1950s to draw attention to the need to specify a curriculum appropriate for students who did not plan to pursue further studies in science (Roberts, 2007). This agenda, in half a century, has managed to consolidate itself as the strategic objective of science education worldwide, giving rise to important discussions within it. Thus, at least three visions of SL have been developed in this half century. The first one focuses on the learning of scientific contents and processes for further application. The second one, under the slogan "science for all", focuses on students understanding the usefulness of scientific knowledge in life and society by learning science based on their contexts. The third one, more recent and less widespread, involves a practical view as the previous version, but in addition integrates an understanding of human culture as sociopolitical action, being the most critical version of SL (Sjöström; Eilks, 2018).

This paper adheres to the third version of SL by problematizing the potential colonial micro-practices (since sociopolitical exploration) existing in SL in the educational field. The SL assumes that school communities shall develop a way of educating in science that enables students to be able to "read" their world in the scientific light. The starting point of SL is that there is "scientific illiteracy" among the population, and in school communities in particular. To this end, it legitimizes the rooms for production of scientific knowledge, such as universities and academic centers. Here we ask ourselves: How does the political agenda of SL relate to other types of knowledge and non-scientific knowledge built on a daily basis in the territories where schools are located? Is there any risk that this agenda may be allowing the deployment of colonial micro-practices in the face of teacher-school knowledge, advocating for one knowledge as valid and impugning others as illegitimate? How could scientific-university knowledge be enabled to respectfully participate in the ecology of knowledge of the school territory?

The questions above attempt to open a problematization and analysis of SL by distinguishing knowledge presenting differences, but belonging to the same field of knowledge. Thus, although we distinguish academic knowledge and teaching-school knowledge, analytically forcing an analysis on an inter-epistemic level, the fact is that this problematization and analysis belong to the same field of knowledge: science education. In this sense, we are encouraged by an intra-epistemic problematization that responds to the question: In what way can scientific knowledge deploy practices of epistemic care that allow an

observation of its work? More specifically, we seek to reflect over and analyze our own practice as researchers who, participating in the political agenda of SL, have built the *Centro de Investigación en Didáctica de las Ciencias y Educación STEM (CIDSTEM)* at the *Pontificia Universidad Católica de Valparaíso* (PUCV). As CIDSTEM, the main link we establish is with school communities, through a political-pedagogical relationship between University and Schools. It is based on the analysis of our practice that we can point out that the political project of the SL is not a homogeneous one, but may have different directions and meanings. We are interested in contributing to strengthen a political project capable of recognizing the plurality or ecology of knowledge that constitutes human knowledge, where scientific knowledge is one additional knowledge (Santos, 2014).

After introducing the conceptual framework with which we will observe our practice, the article will present a brief methodological description of the work experience that we, as a Center, have carried out with science teachers. This will allow us to provide an analysis structured in a description and reflection on our colonial practices, and on moments of deployment of decolonial practices. This analysis will allow us to carry out a closing discussion, where we will reflect on the argument of the article: the university knowledge, in its needed SL agenda, may incur in colonial micro-practices when it relates to the diverse teaching-school knowledge. The objective is, recognizing this trend, to problematize these micro-practices present in our own experience, so as to deconstruct them by means of devices of reflection and epistemic care of this endeavor.

Conceptual framework

The scientific literacy agenda may be theoretically read as one that seeks to produce a new subjective experience in the everyday life of people, through the valuing of scientific knowledge and its teaching as practical knowledge required to navigate the complexity of today's world. This implies intervening in the power relations referring to what is considered true knowledge, and its consequent possibilities of subjectivation (Foucault, 1982).

Participating in a culture where scientific knowledge prevails is opposed to participating in a culture where lay, popular or indigenous knowledge prevails. In the latter case, the person has no experience or formal knowledge of science, and cannot decode or codify the world, *their* world from a scientific episteme. In its most traditional meaning scientific literacy is, then, a practice that seeks to alter the power relationship between both knowledge, privileging the scientific over the popular, lay or indigenous.

In line with Quijano (2011), we problematize the scientific literacy agenda, understanding it as a political agenda aimed at transforming the factors of social classification and identification of the population.

Quijano reviews the pattern of domination between European colonizers and American cultures in a historical-cultural light, arguing that this pattern was forged on the basis of the idea of "race" and around the generic identity of "indigenous". The socio-cultural differences of Mayas, Incas or Mapuches were subsumed in the notion of indigenous. In face of this, the "Europeans" appear generically, establishing a "hierarchical and unequal relationship between such "European" and "non-European" identities, and the supremacy of the former over the latter in every instance of power: economic, social, cultural, intersubjective, political" (our translation, p. 4). This identity subordination reduces colonized populations to peasants and illiterate, despite the fact that many of these American societies had "a sophisticated urban culture and, some of them, writing" (our translation, p. 4). Thus, Quijano (2011, p. 5) adds:

> Stripped of their urban culture and of their writing, those who had it, the subdued populations were enclosed in subcultures that were not only peasant and enlightened but, worse, repressed and continuously suffered the interference of alien and enemy patterns and elements. In the colonial society, only some among the colonized people could have access to the letter, to writing, and exclusively in the language of the rulers and for their purposes.

The new pattern of power expresses a symbolic pattern of intersubjective relations, imaginaries, social memory and knowledge typical to a Eurocentric episteme, where an "instrumental or technocratic rationality" prevails (p. 7). And, although the subdued populations preserve in their community-family sphere some autonomous practical knowledge, they have to continually reset that knowledge to this hegemonic Eurocentric episteme. This pattern of power in colonial times, added with social exploitation under capitalist logics, Quijano calls "coloniality of power" (Quijano, 2014).

Quijano's reading is crucial for its analogical power, as it allows us to open questions regarding the political agenda of scientific literacy: Who are illiterate? What kind of scientific knowledge needs to be learned? Where is this knowledge built? Who builds it and in whose favor is this scientific knowledge built? There is an important difference between the indigenous knowledge analyzed by Quijano, and the teacher-school knowledge that is the focus of analysis in this paper. Here we are interested in emphasizing the hierarchical difference between knowledge. To that emphasis, the work by Santos (2014) in more relevant. The author questions scientific knowledge as the most sophisticated form of modern knowledge arguing that: "Modern knowledge and law represent the most complete manifestations of abysmal thinking" (our translation, p. 23). By abysmal thinking the author means a system of visible and invisible distinctions where the unobserved distinctions make up the ground of the observed ones.

As Santos (2014, p. 23) points out: "In the field of knowledge, abysmal thinking consists in granting modern science the monopoly of the

universal distinction between true and false, to the detriment of two alternative bodies of knowledge: philosophy and theology." [our translation]. This is the visible distinction taking place on the one side. However, and this is Santos' (2014, p. 23) emphasis:

> Their visibility is raised on the invisibility of forms of knowledge that cannot be adapted to either of these forms of knowledge. I am referring to popular, lay, plebeian, peasant or indigenous knowledge on the other side. They disappear as relevant or measurable knowledge because they are beyond truth and falsehood.

The visible line, where scientific knowledge dwells, raises on an invisible line of other knowledge historically placed in a colonial zone. In the case of coffee growing presented in the introduction, the problem is that the wide range of knowledge surrounding traditional and sustainable coffee growing is made invisible by modern science, which claims a monopoly on what is true and false.

To countervail the presence and strength of abysmal thinking, Santos (2014, p. 38) advocates for an "epistemological resistance" based on the ecology of knowledge. The starting point is to recognize the persistence of abysmal thinking to prevent reproducing these chains of invisibilization of other knowledge. Secondly, it is necessary to generate "a radical rupture with modern Western ways of thinking and acting" (p. 40, our translation). It implies recognizing and valuing social experience and popular, secular, plebeian, peasant or indigenous knowledge.

> Post-abysmal thinking can thus be summarized as learning from the South through an epistemology of the South. It confronts the monoculture of modern science with the ecology of knowledge. It is an ecology because it is based on the recognition of the heterogeneous knowledge plurality (one of them being modern science), and on the continuous and dynamic interactions between them, not damaging their autonomy (Santos, 2014, p. 40).

More specifically, Santos (2014) highlights three core ideas: the radical co-presence between knowledge, being all contemporary; the epistemological diversity and plurality of knowledge beyond scientific knowledge; the necessary relationship between knowledge and ignorance "learning given forms of knowledge may imply forgetting others and, ultimately, becoming ignorant of them" (Santos, 2014, p. 43, our translation).

To highlight, recognize and value the non-scientific knowledge advocated by the ecology of knowledge and the epistemologies of the south,

> […] does not imply discrediting scientific knowledge. It simply implies its counter-hegemonic use. That use consists, on the one hand, in exploring the internal plurality of science, i.e., alternative scientific practices that have been made visible by feminist and post-colonial episte-

mologies and, on the other hand, promoting the interaction and interdependence between scientific and non-scientific knowledge (Santos, 2014, p. 44, our translation).

If the political agenda of SL is inflexible, perceiving scientific knowledge as the truest and most legitimate to understand and intervene in reality, it may be blindly advocating for a colonial practice in the field of knowledge, typical of an abysmal thinking that denies and invisibilizes other knowledge and wisdoms. We strongly believe that the spirit that animates SL is not this. Rather, it seeks to bring scientific knowledge into a fruitful dialogue and interaction with other knowledge. Here, the key is that knowledge is not conceived in abstraction, but as practices that intervene in reality on a daily basis. Therefore, the relationship and hierarchy of knowledge always depends on the context in terms of its practical performance (Santos, 2014).

Considering the foregoing, we build a problematic relationship between academic knowledge and teacher-school knowledge. By the first, we understand the set of practices, knowledge and wisdoms that are forged in the university room, specifically in the work of science education and SL carried out by the CIDSTEM in PUCV. By the second, we understand the set of practices, knowledge and wisdoms that are forged in the school room and its surroundings, specifically the work carried out by the learning communities of teachers with which CIDSTEM works. According to Catherine Walsh (2006, p. 56), this analysis may be understood as a type of border thinking, in the sense that we seek to "[…] mediate the knowledge and thought built within modern colonial histories […] and local knowledge linked to colonial difference". University academic knowledge belongs to modern/colonial thinking. Although teacher-school thinking is also built in spaces of modern/colonial thinking, and seeks to "educate" students and communities in this type of thinking. At the same time, it participates in a broader ecology of knowledge where there are other types of local knowledge. However - and this is the emphasis we adopt in this paper - "there is a verticality of one-way relationship", as Walsh (2006, p. 56, our translation) would say, between both kinds of knowledge, with a hegemony of academic knowledge against science education as the only epistemological perspective. This verticality and hierarchization of knowledge is what we call forth with the notion of colonial micro-practices of the academic knowledge over the teacher-school knowledge.

Walsh's (2006) notion of *inter-epistemology* is primary to us to approach such colonial micro-practices. The author proposes an epistemological effort around the intercultural issue that seeks to overcome the blending of forms of knowledge coming from different worlds, and that often invisibilizes the relations of power between such knowledge. Walsh's concept of *inter-episteme* helps us to understand our work as one that engenders a new epistemological room, where there are important differences in power relations. Specifically, CIDSTEM, as a university team that scientifically "educates" and "alphabetizes" several school communities, produces hierarchical relations. On the one

hand, CIDSTEM (academic-university knowledge) appears as the *subject* of knowledge and, on the other hand, teachers appear as the *object* of knowledge (teacher-school knowledge). The concrete way in which we analyze the inter-epistemic spaces that we build in our links with the teaching-school knowledge is through an effort that, according to Walsh, we could call *intra-systemic*. In other words, the consideration and analysis of the way in which we (re)produce and understand scientific knowledge. The epistemological focus of analysis may be understood as the creation of a space of *epistemic care* in two senses: i) to critically analyze the ways in which we generate links based on science education and SL with school communities; and, ii) to critically analyze the meaning of our scientific work.

Methodology

The work of epistemic care that we will carry out on the relationship that CIDSTEM establishes with teacher-school knowledge is based on a set of empirical data that have two different sources. The first one is the analysis of the work performed by the team in the *Programa de Indagación Científica para la Educación en Ciencias de Profundización* (ICECP) in 2017-2018. The ICECP is a course developed under a collaboration agreement with the Ministry of Education in Chile. Since 2015 to date the PUCV, along with 12 other universities in the country, celebrate this agreement with the Ministry, renewable every two years. The ICEC program includes a series of spaces of continuous training where university professors train school teachers (Kindergarten, Elementary and Middle School[1]) in scientific inquiry. In 2017, the PUCV held its first version of the ICECP course, which consisted of 11 sessions (Saturdays from 10:00 to 17:00), in which 21 school teachers participated. The course focuses were: (1) great ideas in science; (2) contextualization to the local territory; (3) learning communities; and (4) scientific inquiry.The ICECP is a concrete example of the institution of an *inter-epistemic* space, where our knowledge on science education and SL set up the relationships we established with teacher-school knowledge. In terms of design, 12 facilitators and other participants from the university team (as scientific advisors) periodically met in a series of meetings to prepare (design and evaluation) the 11 sessions of the course. Both the preparation meetings and the 11 training sessions were held from June 2017 to January 2018, and were audio-recorded with prior consent of the participants.

The second study is the *Proyecto Sentidos* (Senses Project), which is basically *intra-epistemic* in nature, caring for our work and the relationships we establish with school communities. It was developed in the first half of 2020, under the supervision of the CIDSTEM's internal research team. The overall objective of the project was to clarify the meanings that drive CIDSTEM's work, under the assumption that such clarification allows the Center to more accurately and consciously instruct its research agenda. This work is inspired by the idea of epistemic

care as a form of internal reflection on one's own work. The methodological approach consisted of working with narratives and conversations with the 22 people who make up the Center. It was organized in three moments: an individual moment, in which each member of the Center completed an online questionnaire answering questions on the meaning of working in the Center, the individual contribution and the special characteristics of the work developed. In a second moment of work each member met with their respective team to share their individual meanings, and build group meanings. Finally, there was a third moment in which all the CIDSTEM team members participated to share the work done and review, based on the above, the mission, vision and principles of the Center. The work methodology purpose was to build meanings from the individual to the group.

The results presented below are based on both research projects. Regarding the analysis of the ICECP project data, we have selected episodes that illustrate the way in which an "inter-systemic" space is built, highlighting specific aspects of our practice that we believe that could be read in a colonial or decolonial dichotomous light. Besides anonymizing names and other identifying data, the analysis performed based on these episodes is thematic and reflexive (Braun; Clarke, 2019). The theme that guided the selection of episodes was the idea of "de/colonial micro-practices". Thus, we selected a set of episodes that raised a discourse where verticality and hierarchy of academic knowledge over teacher-school knowledge is expressed. By analyzing this vertical and hierarchical discourse, we took on a task of epistemic care. On the other hand, the analysis carried out in the case of the *Proyecto Sentidos* is simpler, since it consists of presenting the most important elements ensuing from this work: the three cores that give meaning to our work.

Results

We have systematized the work of analysis and reflection about our practices into two major themes. First, we will analyze two episodes of work at ICECP where we found colonial micro-practices. Although we use these two episodes to illustrate them, it is important to point out that these types of practices were observed in the group of facilitators. This way, we illustrate practices that we all engage in, but which at the time went unnoticed to our eyes. Epistemic care, then, invites us to become aware, to make these situations visible, and to observe how we build our relationship with other knowledge. Not to be excessively self-critical of our work, but to understand where we exercise epistemic violence that, although subtle, legitimizes university knowledge over teaching-school knowledge, producing a threshold with colonizing potential. Secondly, we analyze the dialogic space set within ICECP, and the work that led to the identification of the three cores of meaning of the Center that make up the section *Decolonial micro-practices between university knowledge and teacher-school knowledge.*

Colonial micro-practices of university knowledge in its relationship with school knowledge

Episode 1: "But everyone's knowledge, although rich and diverse, is not enough".

In the first session of the ICECP in November 2017, the university teaching team introduces the notion of *territory* based on geographical knowledge in relation to science education. To do that, Gustavo is invited as an expert in geography. Gustavo explains that a local territory comprises the problems of those who inhabit that space. Then, he invites school teachers to gather in their localities and identify socio-environmental problems and heritage elements in their territories. The activity lasts about 45 minutes.

By identifying socio-environmental conflicts and heritage issues, the several groups of teachers gather a wide range of knowledge and wisdoms about their territories. For example, when talking about socio-environmental issues, they talk about water and air pollution produced by copper companies (in Puchuncaví) or cement companies (in La Calera); they also highlighted heritage aspects such as traditional dances, old churches, the national tramway or national parks.

Gustavo interrupts the work, asking silence to hold a plenary moment to summarize the activity and learning of the day. He asks: "*What have you learn to do today*?". This gives rise to the next dialogue, where Iván, Ricardo and Karla - school teachers - respond, and then Gustavo makes a final intervention to close the morning session:

> Iván: […] It is hard to position ourselves, which I also think is a complex job for each one of us. What you mentioned that, both in our surroundings and in our classroom, there are a great number of values that perhaps we have not considered, and that could be a contribution to what we are supposed to do.
> Ricardo: […] What I found interesting is that [the students] see that their city is important, some things that have happened in the commune and have influenced the history of Chile and they like to learn that, they feel more fulfilled to know that the commune has somehow helped the development of Chile.
> Karla: We also realize that we have similar issues in terms of the commune. So, it is curious that, despite all the dimensions, we share almost the same problems.
> Gustavo: […] we are here and we are part of a set that we are not necessarily looking at, and we have things we share and things we do not […]. To close and meet the deadline, in session three we will provide you more systematized information from different sources on these two things: heritages and problems, because what we did today was to gather, systematize and socialize everyone's knowledge, *but everyone's knowledge, even if it is rich and diverse, is not enough to explain why things happen and how we can teach them. So, we are going to provide you with more information about these two elements, so that you can enrich what we should also do with the students.*

This first episode is highly relevant because it calls forth the crucial stress that we are interested in analyzing. On the one hand, the

team of university professors makes an effort to build a new space of knowledge, where the experiences and knowledge of school teachers are listened to and valued. The thoughts of Iván, Ricardo and Karla show that this inter-epistemic space manages to bring about interesting reflections in teachers. Iván evokes the idea that contexts comprise a set of knowledge of high value that is not always considered by teachers. Ricardo recognizes patrimonial and historical knowledge that can be useful for science education. And Karla makes perhaps one of the most interesting observations: the different territories where these teachers work share a set of problems that grant them some kind of shared identity. In a way, this first activity invites knowledge based on school-local experience to have a presence and a voice in the course. However, and in our opinion this is a colonial micro-practice, university knowledge, here embodied in Gustavo's voice, recognizing that "*what we did today was to raise and systematize and socialize everyone's knowledge*", quickly formulates a "*but*" that hierarchizes and distinguishes this knowledge: "*everyone's knowledge, although rich and diverse, is not enough to explain why things happen and how we can teach them.*" This hierarchy is epistemological in nature, since the difference between this knowledge and academic knowledge is that it cannot explain a given truth (why do things happen?) and, therefore, it has no power as knowledge for science education (how can we teach it?). This knowledge has a deficit of truth, a lack, sort of emptiness, which university academic knowledge assumes as its task to solve and fill: "*we are going to provide you with more information about these two elements, so that you can enrich what we should also do with the students*". Additional academic information to enrich lay or popular knowledge. Here academic knowledge, including the experience of school and territorial knowledge, quickly hierarchizes and positions the latter as inferior to it.

Episode 2: "We cannot disregard limitations, but we cannot stay there".

The second episode takes place at the end of the same first session of the course. Before the end of the morning session, Gustavo allowed room for teachers to write in their reflective notebooks "*What have I learned? How do I feel? How does it relate with my practice?*". Thus, in the afternoon, a plenary session was held along with the introduction of the notion of "scientific inquiry" to identify relationships between the use of local territory as a pedagogical set, and scientific inquiry as a science teaching strategy. This question gave rise to a dialogue between Paulina, from the course coordination team, and Karla, a school teacher, who raised some concerns about the school context. The dialogue shows once again some stress between both types of knowledge:

Paulina: We may be or not in some difficulty. What we wanted to do was to problematize the surroundings, what we saw with the maps, and think in a way that deals more theoretically with socio-scientific issues. How do we match what we see with the maps and how do we teach science with scientific inquiry? Do you think that is possible? […]
Karla: I loved everything we did today, I hope that everything you said

may come true, but it is still a very complex task for us because, as you said, the curriculum sets the line we have to follow, even if we don't want to, because we have the PSU [University Selection Test or Prueba de Selección Universitaria] and external evaluations that do not measure everything one can do. Hopefully we will be able to have all these new strategies in the short time. We have been able to use them and we know that they work and we are moving toward them, towards integral activities, *but we have certain limitations that are added every day.* For example, now we need individual authorizations to take the children out of the schools, to take them to the street. So, *every day new limitations are added every day that do not necessarily have to do with the children's learning.*
Paulina: Yes, I agree, we cannot ignore that they are part of the context that the school sets, we cannot ignore the limitations that are put by the school and public policy, *but we cannot stay there.*

This second episode goes a step further. Here it is not only a matter of hierarchizing which knowledge has or does not have explanatory capacity, as in the previous episode, but also of delegitimizing the reading of reality that such knowledge aims to propose. Paulina invites to a dialogue about the possibilities that teachers find in their daily lives of matching scientific inquiry and territorial work externally to the classroom. Karla's response is that she likes the didactic work proposed; however, she introduces a "*but*" on behalf of teacher-school knowledge. Karla identifies that "*we have certain limitations*" on a daily basis, such as the difficulty in going out into the field with the students. Once again, a stressful and contradictory practice is observed: academic knowledge invites teaching-school knowledge to speak based on its concrete experience, validating its reading of reality. However, when teaching-school knowledge manifests a limit instead of going deeper into this limitation as a structuring element of the context of practice, academic knowledge recognizes it in order to deny it: "*we cannot ignore that they are part of the context that the school sets, we cannot ignore the limitations that are put by the school and public policy, but we cannot stay there*". Not being able to stay there means, in epistemological terms, not being able to *stay*/pause in their reading of the context, in their knowledge of reality.

Decolonial micro-practices of university knowledge in its relationship with school knowledge: Dialogue and the construction of a hybrid learning space

The work we develop through the ICECP is based on the logic of designing a hybrid space of relationship between both worlds: academic knowledge and teaching knowledge. Here it is worth recalling Santos (2014) when he points out that the epistemic building of an ecology of knowledge is not an easy task. The first task to advance in this building, according to this author, is to ask oneself:

> From what perspective can the different types of knowledge be identified? How can scientific knowledge be differentiated from non-scientific knowledge? How can we distinguish the many types of non-scientific knowledge?

> […] What is the setup of hybrid knowledge that mix Western and non-Western components? (Santos, 2014, p. 51-52, our translation).

The way the ICECP was designed and organized was exactly as a space that allowed hybridization of knowledge. In practice this happened in several ways. One example was the way in which the course was designed, consisting of periodic meetings in which seven (out of 12) facilitators, on average, participated in each meeting. The meetings we held not only engendered the design and redesign of the ICECP, but we also started thinking about our own learning, as a community of facilitators, about how we understand the spaces of continuing teacher's training. In the words of one of the facilitators, what we were doing was a *helical model* of the solar system brought to continuing education. In that sense, the ICECP was like a spiral where it was designed and redesigned as a result of the previous classes. Therefore, it brainstormed on the learning of school teachers and facilitators, all together, spinning at different rhythms (in different orbits), but with a common goal.

Another example of knowledge hybridization has to do with the number of facilitators per session, and the arrangement of the course themes. Although the course had four core thematic axes (with facilitators in charge of each axis, such as Gustavo in the axis of contextualization to the local territory), we worked on two axes per session. In spite of this division in thematic axes, we intended to interweave these four themes in each session. This led to having at least six facilitators present each day. In this way, at least two people were in charge of the activities of the day, while the rest of the team acted in support of the activity and thought over the link between their axis and the other axes. In this sense, on the one hand, the interaction was between six university professors and 21 school teachers. This allowed a more focused consistent conversation in small groups. On the other hand, the whole university team was aware of the activities of each axis, trying to link scientific inquiry, the great ideas of science, the local territory, and the building of learning communities.

In the design of this space, it was important that a member of the university team (Paulina) conducted part of her doctoral research within the ICECP. In the context of her research and talking to another facilitator of the university team and director of the ICEC-PUCV program (Corina), the concept of *Hybrid Learning Space* was coined. It considered the teaching of great ideas in science (incorporated in the Chilean national curriculum since 2012 at all levels of schooling) as a central theme, with teachers designing their own great ideas and the possibilities of implementation these ideas in their schools. To some extent, a process of reflection and self-inspection that accompanied the course from its design and implementation was also carried out (and continues to be carried out) in the framework of this work. Both episodes referred to in the previous section, especially the first one, illustrate how these dialogic spaces came into life.

Having said that, the specific focus of analysis of this article is precisely to problematize when the above is not achieved, for example, when the initial idea of building a hybrid of knowledge may be invisibilizing the hierarchical differences between knowledge or power relations between the university (and within it) and in its relationship with the school.

Questioning the meanings that drive university knowledge

The ICECP design and redesign meetings were the antecedent of the *Proyecto Sentidos*, where the focus of our work was for the first time explicitly oriented toward investigating and analyzing the meaning of our practices. The relevance of this research project is that it triggers a process of internal dialogue in the Center about the meaning of its work. The main result, through the conversation, first individual and then in group, was the identification of three cores of meaning to the Center's work, as shown in Table 1.

Table 1 – Cores of meaning that instruct the work of CIDSTEM

Cores of Meaning	Description
Skills and Interests of the Self	Refers to the meaning provided by recognizing that my own skills and interests contribute to the Center's development that, in turn, contributes to my development.
Ethic of "ourselves"	Refers to the meaning provided by belonging to a human group where collaboration, teamwork, appreciation and respect for the practices and knowledge of all prevail.
Contribution and Service to Society	Refers to the meaning provided by the feeling of contributing to society through the development of education in science at the service of citizenship.

Source: Authors' elaboration.

One of the most interesting ways in which this table can be understood is that the core of meaning "ethics of ourselves" is placed in the middle, between the other two cores. This is very important because this core configures an "ourselves", a collective view where one of the main aspects is to feel that both one's own practices and knowledge and the practices and knowledge of others are respected and valued. The concrete way in which this is achieved is through group work and collaboration. On the one hand, this core articulates the skills and interests of the "I", i.e., the diversity of individualities present in the many work teams of the Center. These "I's" seek to grow in their individuality thanks to their belonging to the "ourselves", and hope to make this "ourselves" grow by putting their own skills and interests at the service of this "ourselves". It is precisely the ethical core of the "ourselves" that makes it possible to be confident that the many "I's" are listened to, welcomed and can flourish. On the other hand, the contribution to society appears as a fundamental core of meaning that gives purpose to the "ourselves" as it heads its action not only to the individual development of its different "I's", but also to the design of science at the service of

citizenship and school communities. The ethics of "ourselves" emanates this purpose by building a relationship with citizenship based on respect and appreciation for school communities, their practices and knowledge.

These three cores of meaning identified lead the work of CIDSTEM, serving as an ethical-political navigation chart. This is the most relevant aspect of the *Proyecto Sentidos*: the importance of making more explicit and conscious the shared ethical-political vision that is built daily in CIDSTEM, understanding that science education is a socio-political practice. This allows us to develop with greater clarity and verve the daily work that the different groups carry out and, especially, to contribute to the nurturing of research skills in these groups.

The foregoing opens the question about concrete uses of these cores of meaning. A clear use is to use the cores of meaning as a reflective-guiding matrix about a wide range of practices and knowledge that CIDSTEM seeks to put in place and build, such as the design and delivery of research projects; the training , work and dialogue with learning communities and their knowledge; the creation of didactic resources; the planning and development of training seminars, among others.

Discussion

On the inter-epistemic: moving toward spaces for epistemic encounter

The ICECP course was a very enriching experience for the university team that led it. The space of constant design and re-design meetings allowed us to engender deep reflections and discussions about the work on science education and SL that the team was carrying out. We would like to focus on the idea of building a *Hybrid Learning Space*. As we pointed out, this was one of the notions that framed the work, which effectively introduced consistent moments of dialogue, inclusion, respect and collaborative work with teacher-school knowledge.

Now, as Walsh (2006) points out, when working with knowledge that comes from different cultural spaces, as can be considered the knowledge about science that is built in the university space and in the school space, the "objective is not the blending or hybridization of forms of knowledge, nor a form of invention of the best of the two possible worlds" (Walsh, 2006, p. 33, our translation); rather, it is committed to "build possibilities of thinking *from* situated and subjective positioning, toward multi-directional intersubjective encounters that seek to "dialogue with", thus bypassing historical subduing" (p. 58). Both episodes of colonial micro-practices reviewed can be construed as aimed at generating a *better matching* of knowledge around the scientific work. On the one hand, when the richness and diversity of teaching-school knowledge is accepted, but it is pointed out that it is not enough to explain why things happen and how they may be taught, the aim is to limit its validity and legitimacy as epistemological knowledge and as pedagogical knowledge. The academic-university knowledge positions itself

as welcoming the richness and diversity of knowledge, which can enrich the teaching-school knowledge so that it can do its job well. On the other hand, when invited to talk about the possibilities they see for the work done in the course, the teaching-school knowledge manifests that it observes some limitations that hinder this work. The academic-university knowledge, although it recognizes this reality in principle, ends by denying it. In both cases, the hybrid space is working in the same way: it fosters fruitful dialogue that allows teaching-school knowledge to express itself. After this knowledge has spoken, academic-university knowledge speaks as if it were a peer knowledge that knows what to do with the students or with the context-related limits. Here a blending of knowledge is produced, where academic-university knowledge subtly positions itself as superior.

In this sense, we observed that the so-called hybrid learning space, although inspired by principles of dialogue and horizontality, in practice allowed the deployment of a set of colonial micro-practices and the establishment of relations of knowledge hierarchization, and power of one knowledge over others. This is in line with the work by Roth (2008) who points out that, given that hybridity is inherent to all forms of knowledge, science education should concretely specify which practices it considers hybrid within and across individuals and groups, rather than create new hybridizations that hide power differences. Likewise, Bazzul (2016) points out that the notion of hybridity should be politicized to promote a multiplicity of ways of constituting the other, allowing the political recognition of otherness. This implies spending time in reflecting and analyzing how people are constituted as subjects.

The present work is the first attempt we made as a team to analyze our colonial and decolonial practices in our relation with the knowledge of school communities. Above all, this critical exercise seeks to recognize that the SL agenda puts into action relations of hierarchization of knowledge and power that benefit specific social spaces where the production of scientific knowledge is recognized and legitimized, such as the university. Here we may be refreshing a specific form of coloniality of power (Quijano, 2014) that disregards and renders invisible "popular, lay, plebeian, peasant or indigenous knowledge" (Santos, 2014, p. 23, our translation). It is a matter of not disregarding or refusing this dimension of epistemological violence of the SL agenda. By addressing these differences, hierarchies and inequalities of power one may advance in the construction of spaces of inter-epistemic respect as Walsh (2006) points out, or where an ecology of knowledge can coexist as Santos (2014) points out.

On the intra-epistemic: recognizing the socio-political dimension of science education

The reflection above is strongly linked to the work with the ICECP course. It is what led part of the CIDSTEM team to carry out in early 2020 a work of self-examination regarding its own work to show that sci-

ence education needs epistemic care, so that it does not blindly reproduce colonial practices. On this path, it has been crucial to nourish the self with a decolonial literature that tackles head-on the issue of power and politics in the building of knowledge. This is very scarce in the field of science education. As Carter (2017, p. 1077) points out, after all, the process of decolonization requires continuous efforts aimed at challenging and unveiling the colonial influences hidden in our past and in our current beliefs and practices, so as to enable us to bring about collective consciousness and responsibility.

The work carried out with the *Proyecto Sentidos* to identify the cores that systematize the work of CIDSTEM is a practice oriented along the lines proposed by Carter. This project allowed us as a team to take "epistemological distance", as Freire (1972) points out, that is, to be able to observe our own practice from afar, almost as an object of knowledge, in order to be able to re-name it. This is crucial because the work of continuing teacher's training in science education is typically based on improving the practices of school teachers (Kasi et al., 2020), placing the responsibility for the failure or success of these training programs solely on the teaching staff. However, as Smith (2003) rightly points out, it is legitimate to ask about the training of teacher's trainers, what are the principles that guide their practice as scientific literacy educators.

It is this last challenge that we undertook with the *Proyecto Sentidos*. It has been important for the Center as a whole to observe that the articulating core of the work is one that we call the *Ethics of Ourselves*, since it emphasizes the way of relating and working that makes sense to the people of the Center. This ethical form, whose core is collaboration along with respect and appreciation of other individuals' practices and knowledge allows, on the one hand, people to feel included, heard to and recognized and, on the other hand, that the work with school communities takes place in a way that unfolds in a coherent and organic manner. It is not a matter of telling others what and how to do or how to teach in science, but of contributing and being at their service, having science education as an element on which to reflect and act in reality.

The relevance of the foregoing is that it offers a concrete practical experience of how to make explicit the ethical-political vision of CIDSTEM. This allows us to understand that science education is a socio-political practice, bringing us closer and making much more understandable for us the recent turn to understand, open and question the sociopolitical dimension of science education (Bazzul, 2012; Carter, 2014; Kayumova, 2015). The socio-political dimension of science education proposes to take an active stance, facing challenges of major global relevance such as the climate crisis and growing social inequalities (Bazzul; Bencze; Alsop, 2019). This call in the Latin American context is particularly interesting, having in mind the question of what it means to scientifically literate the Latin American population, without forgetting the decolonial lens. This last agenda is the one we have just started to work on as a team.

Closure

What are we doing when we educate in science? This question points out to the very meaning of our work. A question that acknowledges that university knowledge, like all knowledge, is historical and mobilizes some hierarchies of knowledge and power relations. As a team we adhere to the SL agenda. The challenges of our current world require the democratization of scientific knowledge. However, we recognize that this agenda can put into action colonial practices, subduing and denying other traditional knowledges that in this article we analytically locate in school communities. We advocate (and also raise it as a desire) for a humble university with respect to its knowledge, and respectful of the knowledge of other groups and cultures that starts by recognizing in its own practices what may be delegitimizing this otherness. Therefore, we position ourselves as vulnerable and object of questioning with the same critical lens with which we look at science education and its SL agenda.

We consider *epistemic care* as crucial to move in this direction. We have intuitively advanced in the construction of hybrid inter-epistemic spaces that respect the ecology of knowledge that is called upon therein. The epistemic care work carried out in this article aims at becoming more aware of this work. Analyze our way of linking ourselves with other knowledge and, very importantly, with scientific knowledge itself. We understand the production of scientific knowledge as a political act, and we consider crucial that those who participate in science education and scientific literacy recognize their own ethical-political visions of their work. The ecology of knowledge, respectful spaces of inter-epistemic encounter, require some conflict solved within the epistemes themselves in favor of the recognition of the ethical-political dimension that every act of knowledge production implies.

This article is one more step in a long journey of work in science education that attempts to problematize our colonial micro-practices. Spaces such as the ICEC training courses are of great value in order to generate spaces of encounter and dialogue between knowledge. They allow us to unleash a wide range of reflections. The challenge is to continue experimenting in these spaces with practices that, by recognizing the differences enter into fruitful dialogues of (co)learning between knowledge from diverse cultural worlds. We recognize that this position is not easy. Indeed, this critical look at our practice has also made us face stressful and controversial conversations (yes, we have had several 'heated' conversations along the way!) but at the same time they become generative and make us see the 'cracks' of which Walsh (2013) speaks, as small hopes that provide spaces of light because they reveal the emergence of possibilities, as in this case, to build a decolonial link between university communities and school communities and within the university itself.

Note

1 We believe it is important to emphasize that this joint continuing education between the three levels of schooling is an unprecedented initiative in the country (https://basica.mineduc.cl/programa-icec-2/).

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