

Dialogic Science Education in Indigenous Schools in the Mayan Highlands, México: Incorporating Traditional Knowledge from Teachers' Perspectives

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Abstract

México is a culturally diverse country. There are 365 variants of 64 different languages, and more than 24% of the population recognize themselves as Indigenous. Even though plurilingualism is recognized in México's constitution, the national curriculum only partially considers this cultural and linguistic diversity. From a pluralistic epistemology, we recognize the epistemic status of indigenous knowledge (IK). We contend that science education should facilitate and accommodate indigenous students' language, traditional ways of knowing and scientific (school) ways of knowing by creating a dialogue that explicitly aims for the inclusion of IK and social justice. There are several issues for which IK has been recognized as relevant. One example is the cultivation of maize in *milpa* (policrop system) that leads to diversity and resistance to climate change and disease.

The purpose of this chapter is to show the complexity that comes into play when teachers try to establish dialogic spaces between school and traditional knowledge in plurilingual settings. We focus on the work of teachers in secondary schools in the Mayan highlands in the state of Chiapas, México. From a critical theory perspective, we document how a group of teachers adapted IK educational bilingual materials and reflected on

activities undertaken in the classroom. Additionally, we present some key elements related to the complexity of incorporating IK in the classrooms. For example, how power relations mobilize when IK is incorporated, and how languages (Spanish, Tsotsil, and Tseltal) play a role in teaching and learning. The work presented also opens a window to comprehending teachers' professional development from their perspectives.

Keywords: Traditional knowledge, México, intercultural science education, decolonial, teachers' knowledge.

Introduction and purpose

México, like many countries in Latin America that were colonized, have a pluricultural composition. This fact is recognized in the Mexican constitution, where it is ascertained that the country will be sustained in its original cultures. However, in México's education system, the practices and languages of indigenous people have been left out of the national curriculum and pedagogical practices. The dominant educational strategy has been Hispanization: students' mother language serves only as a source to learn Spanish and be assimilated into the national culture (Hamel, 2018). As further evidence of Hispanization, the National Institute for Indigenous Languages was only created in 2003 to reinforce, revitalize, and promote indigenous languages in every sphere of the national life.

In an established tradition of assimilating indigenous people's knowledge to a national project, IK has been excluded from school and subordinated to a universal and rational knowledge considered superior, in this case, Western Modern Science (WMS) (see Corsiglia & Snively, 2001; Walls, 2014). The incorporation of IK in the classroom adds to the diverse struggles for social justice that have been constructed in intercultural education.

From a pedagogical perspective, we need to critically reflect how IK is incorporated into the classroom, not as a subordinate, but as a legitimate way of knowing, complementing other forms of knowledge and recognizing conflicts and antagonisms.

In this chapter, we present a study with an empirical base located in a specific community in southeastern México that allows us to start comprehending, through an emic perspective, which processes take place in a classroom when teachers incorporate IK. Specifically, we analyze the interests, difficulties, and strategies of a group of teachers that work in multilingual schools situated in indigenous communities. Additionally, from the students' perspective, why and to what ends should this knowledge be incorporated in their science classrooms. This group of teachers recognizes and values strategies that are used to incorporate IK in the school, trying to establish a dialogue with western scientific knowledge.

This chapter is divided into three sections. In the first section, we present our stance towards intercultural dialogue in the science classroom. Considering power relations that have been historically established, we sustain in this section that it is necessary to recognize, value, and integrate students' traditional knowledge and language in the school. We stand for an intercultural and translinguistic critical science education developed from a decolonial perspective, in which school is a social space for transformation.

In the second section, we present an approach to intercultural science education and decoloniality in the Mayan highlands in Chiapas. In this section we present the results of our study in the Mayan highlands in Chiapas, México, with teachers who are working with indigenous students integrating knowledge about *milpa*, a traditional polycrop from Mesoamerica, in their classrooms. We point out three key elements in teachers' reflections from the perspective of critical intercultural education: a) the complexity and potentiality of

incorporating IK in school and classroom; b) mobilize power relations established in the classroom; c) acknowledge that IK is communicated in a different language (Tsotsil, Tseltal, Spanish) and address the complexity of a pluricultural and plurilingual classroom.

In the third section, we present our final reflections related to the teacher preparation from their own experiences in the Chiapas highlands. In this part, we present the perspectives and possible paths that follow from this particular study. Work presented also opens a window of comprehension into the views of teachers regarding professional development designed to help them integrate IK into their schools and classrooms.

Intercultural dialogue in the science classroom

The multicultural and multilingual context in México

México, like many Latin American countries is a region of the world characterized by its biological, sociocultural, and sociolinguistic diversity. In Latin America the World Bank (2015) reports an estimated of 780 different indigenous groups that speak more than 560 languages.

In México there are 365 variants of 68 different linguistic groups. With more than 119 million inhabitants (INEGI, 2015), over seven million people speak an indigenous language (6.5% of the population). However, 24% of the people in México consider themselves indigenous (INEGI, 2016). This disparity in absolute numbers shows that although the indigenous population is growing, most indigenous people are going through a process of assimilation or language loss (Hamel, 2018). This loss should be inadmissible given that every language is a mental universe uniquely structured with metaphors, associations, and ways of thinking. The Mexican philosopher Miguel León Portilla asserts

“... every language in which any woman and man learned to think, love and pray deserve to be respected as part of their fundamental human rights” (Embriz Osorio & Zamora Alarcón, 2012, p.1).

High levels of poverty and vulnerability have historically marked the indigenous population. Currently, in México, over 80% of indigenous municipalities are identified as largely marginalized with high levels of poverty and other sociocultural phenomena that disenfranchises them (INEGI, 2015). For example, there are three times more indigenous people who are illiterate than the rest of the population. However, more than 90% of indigenous students from 6-15 years are currently attending school. Educational results of indigenous students are consistently at the lower end of any evaluation (Backhoff, et al., 2017).

Intercultural education

Cultural and linguistic diversity poses a significant challenge to educational systems in Latin America. Historically in Mexico there have been opposing and contradictory approaches where ethnic diversity is celebrated but indigenous knowledge and language are barely considered. The most common approach has been Hispanization and acculturation. This means thinking of education as the way in which indigenous students acquire the national culture and language to the loss of their own language and culture.

It was not until the eighties that, in the context of larger struggles for autonomy and self-determination, indigenous people started claiming for the inclusion of indigenous language and culture in the education system (López, 2011). Intercultural bilingual education can be considered a result of such struggles. However, in many Latin American countries such position has been assumed from the national governments, has lost strength

and has not achieved a real transformation. In Mexico, official documents state: “Bilingual education will be understood as education that promotes the acquisition, strengthening, development and consolidation of [both] the indigenous language and Spanish eliminating the imposition of one over the other” (SEP, 1999, p.1).

However, according to López (2011), educational practices are still located in the racist and assimilationist paradigm that considers indigenous knowledge and language as subordinate and less valuable. Interculturality has only been functionally assumed, folklorizing knowledge to increase students’ interest and motivation (Cuevas Romo & Pérez, 2013). In the same sense, Rebeca Barriga Villanueva (2018) states:

“it is a fact that indigenous languages are not considered a priority in the so called intercultural bilingual primary schools in indigenous communities, at the most a few hours of teaching are granted in the first years of schooling (...) Spanish holds its supremacy, asphyxiating little by little every possibility of knowledge construction in the mother languages and abating their vitality. Teachers, parents and students are convinced that Spanish is a kind of freeing instrument that is learned at school and that allows to have access to success in cultural and social life, it is the national language, the one that holds prestige and knowledge, vehicle of economic and social redemption”. (p. 50-51)

Therefore, intercultural bilingual education is mostly an empty discourse that is not tangible in classrooms in México where there is a national curriculum and teacher preparation rarely considers diversity (of language and knowledge) as a relevant topic.

Using the mother tongue in the classroom is part of the recognition of linguistic rights. According to Skutnabb-Kangas and Phillipson (1994), linguistic rights imply that at an individual level every student should have a positive identification with their mother

tongue. Additionally, such identification should be accepted and respected by others, regardless of what language or dialect is spoken or which particular accent is held. This implies, at the collective level, the right of minority groups to use and develop their languages and teach it to new generations. Therefore, a part of the decolonization strategies is defending minority languages and recovering their value, granting a linguistic human right.

Traditional knowledge in the science classroom

In recent times there has been ample discussion in the science education literature regarding IK and its relation to scientific knowledge (McKinley, 2011). On one hand, there are universalist positions that consider science as a universal body of knowledge whose epistemology is superior to traditional or indigenous knowledge and, on the other hand, multiculturalist's and pluralist's positions that understand science as a product of the culture in which it is generated. We understand IK, as a dynamic set of knowledge that has been developed by people with ample histories of interaction with the natural environment and that originated independently from science in a particular cultural environment separate from occidental culture (Pérez Ruiz & Argueta Villamar, 2011). In the present work we use the term 'Indigenous Knowledge' (IK) in the same sense as 'Traditional Ecological Knowledge' (TEK). This knowledge

“... emphasizes the ecological depth of the knowledge, its persistence, consistency and reliability, its specificity, its holistic view of an interconnected world, and its moral and spiritual nature. They also describe its narrative base, where encoded metaphoric stories were often used to compress and organize important information

so that it can be readily stored and accessed, and solutions to problems can be carefully preserved, refined and reapplied”. (Carter, 2008, p.17)

We need to be aware that the term traditional does not mean that this knowledge is something static or that belongs to the past. This knowledge has been recognized as fundamental to respond to actual challenges related to climate change or biodiversity loss (International Council for Science, 2002).

Aikenhead and Michell (2011) identify a series of reasons for integrating indigenous knowledge into the school science curriculum. Amongst the most relevant are equity and social justice, the strength of a nation’s economy, improvement of Eurocentric science, indigenous sovereignty and cultural survival. Even if there is a certain consensus for incorporating traditional knowledge in the science classroom there are different ways in which this can be done. From a pluralist perspective it is recognized that each kind of knowledge is valid in its own realm and has its own epistemology (Olivé, 2007). However, most of the time when IK is incorporated in the classroom it will be subsumed under WMS and considered only to the degree that the former confirms the latter (Dentzau, 2019). A contribution of this chapter is oriented towards identifying some elements associated with the value of incorporating IK in such ways that a genuine dialogue can be established with WMS and where its integration is not in terms of subordination. In this chapter we describe teachers’ perspectives, although in other work we have underscored students’ point of view (García Franco, Farrera Reyes & Gómez Galindo, submitted).

Proposals to include IK in the classroom are inextricably associated with the theoretical stance regarding the relation between scientific knowledge (WMS) and traditional knowledge (IK). Some of the most common approaches are:

- WMS is used to validate traditional knowledge or practices (i.e. Snively & Corsiglia, 2001).
- Introduce traditional knowledge and establish demarcation relations between MWS and IK identifying different contexts of use (i.e. Baptista & El-Hany, 2009).
- Frame science learning as crossing cultural borders (see Aikenhead, 1996; 1997; 2001; Aikenhead & Michell, 2011).

The idea of learning science as crossing cultural borders identify science as a culture *per se* and, given that students belong to different cultures, science learning can be comprehended as a cross-cultural event. Teachers are considered as facilitators who aid students to identify differences in these cultures and support the process of *cultural border crossing*. This approach goes beyond demarcation or validation proposals because it integrates the possibility of intercultural dialogues. However, it evades the political aspects inherent to relations between IK and WMS. A critical revision of these stances allows us to open up and problematize the way in which we understand intercultural dialogues (Carter, 2008; Carter & Smith, 2003).

Elizabeth McKinley, a Maori scholar from New Zealand, has strongly argued for the inclusion of language in the debates of science education, “While language (English or similar) is inherent in the arguments surrounding WMS it is resoundingly absent from debates on TEK and IK. TEK and IK were not developed in a void absent of language” (McKinley, 2005, p.232). Language is more than a technical tool for communication but rather encompasses our whole existence therefore we need to address language issues when discussing about science learning in plurilingual and pluricultural contexts.

Science literacy in linguistic diverse context

Currently there are a number of plurilingual school spaces. In Mexico, there is a need to do more research about bilingualism in the different indigenous communities in order to adapt educational programs to each particular case. The most common situation is that indigenous languages are spoken in the communities and survive in specific spaces, such as schools, coexisting with Spanish (Castillo Hernández, 2004).

In the Mayan Highlands, where teachers participant in this study work, there are different languages spoken, specially Tsotsil and Tseltal. However, every community has a particular situation. Some of the participant teachers teach groups where a fraction of the students speaks Tsotsil and some other Tseltal. Most of the students speak Spanish though with different levels of command. Most of the teachers do not speak any indigenous languages. As has been previously mentioned indigenous students are not alphabetized in their own language (very few can read and write) and their Spanish proficiency is very diverse. From middle school students are instructed only in Spanish. Science teachers teach in Spanish, even though the majority of students speak in their own language with each other.

In this context, that can be considered of transit to bilingualism, science students encounter a third language; the language of science. Several authors consider science as a culture that has specific ways of explaining natural phenomena and that occurs in a community that shares methods, representations, and language (Lemke, 2001). The language of science is different from everyday language (Lemke, 1990). Therefore, science teachers are also language teachers, who should teach students to talk science. Teachers, who speak Spanish (and not students' first language), introduce a new language: science.

This represents several challenges for teachers some of which are documented in this chapter.

In plurilingual science classrooms, translanguaging has been used as analytical lenses to understand communicative and meaning making processes recognizing the versatile and adaptive way in which bilingual students deploy semiotic resources to support complex meaning making in science (Moore, Evnitskaya & Ramos-de Robles, 2017; Ünsal, Jakobson, Bengt-Olov & Wickman, 2018). We argue for a critical translanguaging that recognizes that language usage is not neutral but is inserted, at least in the present case, in power relations and processes of historical colonialism. Science content is fundamental because it can enhance the incorporation of different languages in this complex meaning making system, determining the way in which knowledge systems are positioned. Therefore, incorporating IK in the science classroom can play a critical role because it promotes meaning making in a space where students' mother tongue and knowledge (both students' and community) is not subordinated to science knowledge and its language.

Critical intercultural science education

Critical intercultural science education pretends to go beyond validation of traditional knowledge, demarcation or culture crossing. We expect that the incorporation of IK and language, contributes to the generation of social justice and therefore to a transformative school. We revise Freire's and Giroux's critical pedagogy, that assume that students should comprehend the transformative possibilities that lie in the students' experiences. Teachers' work is fundamental; they should ensure that knowledge in the classroom is relevant for students' lives in such a way that they have a voice and vote (Freire, 1990; 2010). Curricular content and pedagogical practices proposed by teachers should find resonance in

vital experiences of students inviting them to turn their own experience into something problematic. Critical direction is essential in helping students recognize the moral and political implications of their own experiences (Giroux, 1997). This approach aims to contribute to students' personal affirmation by enriching students' funds of identity, understood as "resources socially distributed, historically accumulated and culturally developed that are essential to the self-comprehension, self-expression, and self-definition" (Subero & Esteban-Guitart, 2020, p.220).

Those experiences that Freire and Giroux talk about point, on the one hand, to the recovery of students' traditional knowledge, and on the other, to their school experience. When critical pedagogy is related to intercultural science education from a decolonizing stance, students' voices are incorporated in the discussion of current issues such as globalization, concerns of the new millennia and, specifically, how power relations between scientific and indigenous knowledge have been historically established. According to McKinley (2000) "those who live the historically and socially specific encounters between colonized and colonizers will never be satisfied with a model of cultural diversity that does not account for power relationships" (p.75).

Global concerns and traditional knowledge are materialized for every group of students in specific practices and spaces. Particular to this chapter, we have explored knowledge and practices of students of the Mayan highlands in Chiapas associated with milpa cultivation in which traditional knowledge is recovered, recreated and transformed. Most of milpa cultivation IK is associated with ethnobotany, agronomy and ecology. This IK includes resource handling native species conservation and its diversification through artificial selection, conservation, processing and interchange of seeds and food. Besides this wealth of knowledge, indigenous communities recognize the struggles related to the

preservation of cultural practices, languages, and the achievement of autonomy and self-determination. Around cultivating milpa several struggles and debate take place. Paradigmatic examples are the introduction of transgenic maize or the use of chemical fertilizers.

Approaching intercultural science education and decoloniality in the Mayan highlands in Chiapas

Using the book “Aprendiendo en la milpa” as an axis to discuss and recover teachers’ ideas

As educational researchers we have been working several years with teachers and students in indigenous communities. Recognizing ourselves as guests (as mentioned by Hough & Skutnabb-Kangas (2005) we are “manuhiri”, when invited, we may also participate in the struggle from within the indigenous communities, and we must understand that we are always the guest), we identify milpa as a paradigmatic space for knowledge generation where traditional and scientific knowledge can potentially concur (see Gómez Galindo, García Franco & Koller Hernández, 2017; Gómez Galindo, García Franco, González & Torres Frías, 2019). Through discussing educational possibilities of milpa, designing together, and sharing activities with different teachers, we have identified possibilities and obstacles in specific contexts. From this identification we elaborated the book: “Aprendiendo en la milpa” (Learning in the milpa) (García Franco & Gómez Galindo, in press). This book is directed to students from 11 to 15 years old and is presented in Spanish, Tsotsil and Tseltal. It retrieves traditional knowledge about milpa as well as students’ ideas and drawings, along with Western scientific knowledge.

Milpa is an agro-ecological system considered fundamental in the constitution of Mesoamerican societies (Carrillo Trueba, 2010). It is a policrop based in sowing maize, bean and squash together. It integrates other edible vegetables (known as *quelites*), flowers and trees that form a system that has been recognized as strategic to promote identity (Ramos-de Robles, Garibay Chávez & Curiel Ballesteros, 2019), guarantee food sovereignty, biodiversity conservation and allow adaptation to climate change (Álvarez-Buylla, Carreón & San Vicente, 2011; Boege Schmidt, 2008). Milpa is fundamental to communities' social life and is in the center of rituals, social and community practices (Carrillo Trueba, 2016). In many communities it is the main source of subsistence.

We acknowledge that there are several works documenting cultivation in milpa, however we did not find educational materials on the subject that were specifically directed to indigenous students, that were written in their language, and that incorporate both traditional and scientific knowledge. The book “Aprendiendo en la milpa” has three chapters. In the first one we present the characteristics of milpa, associated crops, and describe how maize, bean and squash generate a system that brings different elements to improve crop yield. We develop a section on nitrogen fixation through the bacteria nodules present in the root of beans. In the second chapter we incorporate the different ways in which the products from the milpa are used to produce nutritionally balanced food; we include a section on nixtamalization of maize, an ancestral biotechnological process where the pericarp (the outer layer of corn kernel) is removed by using calcium oxide. This process generates changes in the composition of maize dough which is then used to make tortillas and many other foods that are essential in the Mexican diet. In the third chapter we approach maize diversity, its relevance and the way in which artificial selection of the grain

is undertaken in milpa. In this chapter we point to *teocintle* as the ancestor of maize and introduce some ideas about maize reproduction.

Approaching teachers' ideas through an ecology of data

With an interest of understanding the way in which teachers that work in indigenous communities incorporate IK in their classrooms, we collected an ecology of data. We approached teachers' ideas through a recursive quest for meaning. Such a quest was guided by our research interests, considering the teachers' point of view about incorporating IK in the classroom. Such perspective is inserted in critical theory (Johnson, 2008) which aims to identify structures in science education that can originate or perpetuate inequalities and subordination relations and, from there, revalue forms and work traditions in the classroom. Our intention is to document and expose the possibilities and complexities that we find in real situations, with teachers who work in particular communities and retrieve different experiences. We want to go beyond the assertion that it would be good to introduce IK in the classroom, or that such introduction should be implemented using students' language, we aim to recognize concrete elements that enhance or hinder such processes.

Taking as the point of departure the book "Aprendiendo en la milpa" we undertook three different actions that allowed us to gather information. Firstly, we worked with teacher Laura (pseudonym) documenting the way she implemented different activities related to milpa. Laura works in a secondary school (13-16 years old) in an indigenous community in Chiapas highlands, Yoxhib. The main language in the community is Tseltal. Laura does not speak this language. We had three one-hour remote meetings (via Skype) that were recorded and transcribed for analysis. Laura shared with us students' products in these activities.

Secondly, we imparted a one-day workshop with teachers in San Cristobal de las Casas, Chiapas (the largest city in the Highlands). The workshop was convened to present the book “Aprendiendo en la Milpa” and reflect in ways in which it could be used in the classroom. In this workshop we retrieved written exercises, recorded conversations and transcribed selected sections. A large number of the teachers in the workshop have collaborated in projects related to science and mathematics education and many of them belong to *Red de Huertos Escolares* (School Gardens Association). Some of the participant teachers know each other and have had the chance to collaborate in previous educational projects (some of them with ourselves). Both Laura and Camila were in the workshop.

Thirdly, after the workshop we decided to interview Camila (pseudonym). She is a teacher who has worked many years in indigenous communities and with whom we have had previous experiences. Camila is currently the headmaster in a secondary school. We tried to extend some of the things we learned at the workshop, particularly about strategies that she and other teachers have developed to work with students whose language is not Spanish. This interview was audiotaped and transcribed.

Complexity and potentiality of incorporating IK in the classroom

Through the above process we identified some key ideas: a) complexity and potentiality of incorporating IK in the classroom and the different ways in which the didactic material about milpa could be used in school; b) what happens with power relations when IK about milpa is incorporated in the classroom; c) recognition that knowledge comes ‘in another language’, that is to say, how do students’ language (Tsotsil and Tseltal) coexist in the classroom with teachers’ language (Spanish).

a) Complexity and potentiality of incorporating IK in the classroom

Some teachers have identified the difficulty of considering students' experiences when the curriculum is imparted using Western scientific concepts. However, in the workshop, teachers visualized the possibility of using students' traditional knowledge as a point of departure for proposing different experiences that show their creativity, interest and commitment. We group some of the ideas in two dimensions: recognition and integration of students' ways of learning in their communities and integrating the community in the activities.

- Recognition and integration of students' ways of learning in their communities.

It has been recognized that students get to the classroom with knowledge that has been culturally constructed and that this knowledge is manifested through behaviors and attitudes that, if valued, can facilitate learning. For example, Paradise (1991) underscores Mazahua students' capacity for observation and the importance of teachers knowing and incorporating this expertise into their teaching is fundamental for the organization of school knowledge. In a similar vein, Maurer (1977) points out that for Tseltal children learning in their community is realized through "actively approaching their environment with the aim of knowing it", he signals the saying "You cannot teach the Tseltal kid, he learns" (p. 94). In the non formal sphere learning takes place through observation-action.

Teachers participating in this study acknowledge the relevance of observation and manipulative activities in their students' learning. They note that in the community youngsters and kids learn by doing. These teachers consider experience as fundamental and reflect so in their discourse and in the kind of activities they propose, which always begin

with concrete experiences and direct observations. We identify some examples in the following excerpts:

I have the purpose of doing all this process of feedback and see *in situ* what is going on, in the milpa, in each family, how this knowledge is developed, how they are applying it and if it is really valuable for the family of every student.

(Laura, first virtual meeting)

A challenge is not having a milpa close by to observe and perform experiments in it.

(Anelli, workshop)

As Anelli points out, teachers consider that not having spaces where direct observations and direct interventions can be undertaken is an obstacle. When they propose experimental activities, they are not thinking in laboratories or in classrooms, but in cultivation spaces, such as having two parcels where different sowing conditions could be registered or using planting pots. Almost every activity suggested by the teachers during the workshop is developed in open spaces and requires an extended amount of time, which represents a challenge.

- Integrating the community in the activities: mothers, fathers and elders.

Teachers recognize that within the community there are persons considered by their wisdom, and value their input to traditional knowledge. They recognize that in order to

integrate IK in the classroom they need to access different sources. They need to learn about recognition and organization of knowledge, analyze and even learn students' language, at least learn how everything is named. They also point out the relevance of cultivating and strengthening the bonds with the community. Some parts of the conversations stress this aspect (answers are originally in Spanish and translated by authors):

It is a challenge to involve fathers and mothers with teachers and students.

(Blanca Lilia, workshop)

We need to establish bridges between the school and the community, not only invite elders to the school, but also take to the community what has been learned in school: posters, theater plays, let students take knowledge out of the school.

(Camila, workshop)

... the proposal is engaging fathers, mothers, this is what we were talking about, as teachers we lack lots of knowledge, as a community in the school, we should devote time to these endeavors.

(Estela, workshop)

... here in our land, what did grandparents do? Those who only sowed maize died of hunger but those who sowed yams, those who buried under earth that is how they survived. The deepest reflection to make with the

students is which is the relevance of such diversity. This is what we are suffering now with coffee, those who only plant one variety it is finished with fungus, but those who have planted different varieties have plants that survived. You notice the relevance of diversity, it is very good to know the history and how you can use it.

(Artemio, workshop)

b. Mobilize power relations installed in the classroom

The distinction between WMS and IK has traditionally acted as a potent exclusion principle. Colonial culture considers universality and knowledge rationalism leaving aside particular ways of knowing, the diverse forms in which practical knowledge develops, and the language in which this reality is conceived and named. This leaves IK, and the associated language, out of what is considered valuable in the school curriculum. As we have pointed out previously, we are arguing not only for the inclusion of IK in the classroom but also comprehend where its contribution lies, at the same time that antagonisms, divisions and conflicts are presented. We are trying to promote a radical change in discourses, practices and social relations in the classroom, where IK cannot be constructed as a subordinate to WMS. Through the incorporation of knowledge about milpa in the classroom the role between the one who teaches and the one who learns is mobilized. This implies a change in the roles that affects power relations in the classroom. In this case, not only IK is not subordinated to WMS, but also the role of the teacher as the one who knows is diluted and confronted.

During the workshop teachers pointed out that traditional knowledge belongs to students. Some of them mention that they know some things related to the milpa because of

their origin (some of them were born in indigenous communities, some of them recognize themselves as indigenous), however their work as teachers has taken them elsewhere, and they perceive they no longer know. Teachers recognize students' knowledge and the possibility of establishing a dialogue between what they know and what students know. Some examples in the way they express some thoughts:

We need to recognize the practical part and its relevance when it relates to theory. Students hold the practical knowledge, we hang more on the theoretical part.

(Laura, workshop)

I am from a farming region, in my childhood, in my native town, I lived a lot of experiences. I need to re-value and make the effort of retrieving, because I know too. I can do that thanks to my students.

(Carlos, workshop)

Monitoring activities undertaken by the teacher Laura, it is clear that students identify such changes in roles and point out that they are the ones who 'own the knowledge'. In this specific case, when the teacher asks her students to write an answer to why do they think that they are reviewing these topics in classroom, students answer that the teacher wants to know what they do and learn from them, specially how could she have a milpa using good practices installed in the community, privileging non chemical fertilizers. We present some of the students' answers originally written in Spanish, we have translated in English trying to preserve meaning.

Porque la maestra también quiere aprender sobre el maíz para vivir cambie que siembra su milpa de no dar fertilizante porque si es posible muere la maceta porque no sabe que va a hacer con el maíz porque esa la maestra quiere aprender la todo lo que hacemos con el maíz si tal vez va aprender todo sobre la comida.

(Georgina, alumna)

The teacher wants to learn about maize, to live and change her harvest and how not to use fertilizers because the pot dies. She doesn't know what she is going to do with her maize, because the teacher wants to learn what we do with maize, and maybe she is going to learn about the food.

(Georgina, student)

Mi maestra para que quiere estar haciendo todas las preguntas. somos campesinos y sabemos sembrar toda la semilla de maíz, frijol, calabaza y chiles y quiere saber como sembraron la milpa. A veces que sabes sembrar, la maestra o maestros o no sabes sembrar la milpa pero las gentes de Yochib (Adelina, alumna)

My teacher, why does she want to ask all these questions? We are farmers and we know how to sow all the seeds of maize, beans, squash and chilies and she wants to know how we cultivate milpa. We know how to cultivate, the teacher, and other teachers don't know how to cultivate milpa, but the people in Yoxhib [name of her community] know.

(Adelina, student)

This change in the classroom about who is the expert seems vital. Incorporating traditional knowledge in the classroom can constitute a key element to modify power dynamics established in the classroom and the traditional ways to exercise power. This kind of change in students' perception about their own role can enhance subjectivation processes in the development of their identities (Subero & Esteban-Guitart, 2020). This requires that every participant in the dialogue estimates that she or he has something of value to bring to such dialogue. Students' answers recognize their own knowledge as valuable, in the sense that the teacher is genuinely interested in knowing about, far beyond from a traditional academic interchange.

c. Recognize that this knowledge “comes in a different language”

Students' language is related to discourse, to practices and constructed symbols that configure a culture different to the teachers' own practices and symbols. The use of their mother tongue is associated with the development of identities and to the consolidation and overcoming of ambivalences that is characteristic of groups of indigenous youngsters living in a globalized time (Messing, 2009). Teachers recognize the relevance of the language that is used in the classroom and the conflicts that are associated. In the same vein, teachers' participants in this study incorporate their concerns about language use and how to cope with the fact that their mother tongue and the students' mother tongue is not the same.

The different strategies associated with language use that were identified in participating teachers can be considered translinguistic, but also come from a sensitization directed towards achieving a comprehensive communication and respect to students'

identity. Teachers recognize this is a complex search and a huge challenge that implies personal engagement:

... during a long time I have been working, analyzing, suffering, living the fact of how I can establish a link between my students' mother language and my own language...

(Laura, workshop)

Teachers have constructed a complex notion of the relation language - culture - school, and it is brought about in this search for communication and the construction of spaces elaborated collaboratively. We find examples in the following fragments:

A challenge is that you have a referent and you think that the student has it. I have been surprised that the other does not understand the concept I am trying to explain. I now ask lots of questions and try to understand their mental processes and the vision of the world they [the students] actually live in.

(Guadalupe, workshop)

One of the challenges I have found is that the knowledge they have is more profound in their own language, all this knowledge they have and they can share is in their own language.

(Laura, first virtual meeting)

Teachers engage in this process of generating sensitivity towards their students' language. They express concern trying that the students reflect about language use and its openness to the combination of ways of expressing. Laura points out in the following fragment:

... at this moment I have recordings of students in Tseltal so I can use some of what they reflect in their own language, and how I can share knowledge in their own language and of the things they observed. It is rather hard for them because I tell them it sounds like Spanglish, because there are words they don't know and they end up speaking Tseltal-Spanish, not Tseltanglish, not TselSpanish (laughs).

(Laura, first virtual meeting)

Besides these long-term processes, teachers implement different specific strategies to work in the classroom where students speak a different language that can be considered translingual. For example:

- Look for a translator (another student) in the classroom. (Blanca Lilia, workshop)
- Look for a translator of students' work amongst other colleagues who speak the students' language. (Laura, first virtual meeting)
- Identify, since the planning stage, some important terminology and concepts and look for their translation in students' language. This is hard in physics where sometimes [words] do not exist in their language or [words] mean different things. (Camila, interview)

All this path is recognized by teachers who share a fundamental process of becoming teachers who teach indigenous students. This path involves the construction of their own identity but also of bridges with students, with the community. For example, Laura points out:

... in the beginning students told me anything and they thought I wasn't going to understand [when they spoke and wrote in their language] and they talked and talked even things that did not relate to the topic, and when I started to tell them about what they wrote and showed them translations of their observations (which I got from searching help to translate writing and recordings) they were very surprised, and started taking it very seriously. Because at the beginning they thought I was unable to understand and they could say whatever they wanted, after that they became more engaged.

(Laura, second virtual meeting)

These bridges associated with language use diversify and allow for the recognition of students' characteristics and the difficulties that arise either in Spanish or in their first language.

In the beginning the students did not speak fully in Spanish, I saw plenty of difficulties in Spanish, so I asked them to share their comments in Tzeltal. What I could notice is that students who shared a lot in Spanish also shared a lot in Tzeltal and students who did not share in Spanish neither shared in

Tseltal. They seemed to lack abilities to speak or write in either language...

I have spoken to students' parents and they say that it is similar in their homes. Then I start analyzing life stories.

(Laura, second virtual meeting)

We need to go beyond translanguaging to understand the complexity involved in the situations described. As McKinley (2005) asserts language is not only an instrumental tool. In this case, teachers in plurilingual contexts choose not only to allow students to use a diversified repertory of semiotic resources (translanguaging) but recognize that this usage is related to identity and power structures.

Final reflections. Teacher preparation from their own experiences in the Chiapas highlands.

We have pointed out that in a country like México with a multicultural composition, traditional knowledge should be considered and included in the school, not as subordinate, but from a position of decolonization that recognizes and questions power relations. The construction of a transformative school requires teachers committed to change their classroom into a space where students' voices are valuable and considered with a transforming potential. Within this horizon we try to establish the contribution of the experience we have analyzed to the professional development of teachers.

As a starting point we value the possibility of generating spaces for teachers who are interested in integrating students' traditional knowledge in their science classroom. The book "Aprendiendo en la milpa" was presented in Spanish, Tsotsil and Tseltal and

introduced a specific set of traditional knowledge that allowed for teachers to problematize, retrieve and analyze their practice, and aim for the social construction of a new shared knowledge. Given that constructing didactic material is one of most common strategies in intercultural education, we believe it is important to underscore the role that content and language play, given that they promote dialogue and allow for different appropriation levels. In this case, even if it is true that many of the teachers were familiar with teaching strategies related to school's gardens, the milpa opened a new horizon, partly because it allowed for the recognition of students as subjects who hold relevant knowledge. It was also possible to position and emphasize the struggles and resistance of indigenous people associated with the milpa in the school environment. The construction of these materials from a decolonial stance allows for recognizing their own knowledge and community contributions that have been unnoticed, not just by school curriculum or textbooks, but even by the same teachers and members of the community who see more custom than knowledge in them.

It is important to point out that traditional knowledge has been recognized as fundamental to confront events such as climate change and the loss of diversity. In each community this phenomenon reaches different dimensions and have particular effects. In this case, teachers recognize the existence of knowledge in the community (especially that of elders) that may not be necessarily identified by students. Teachers are fundamental to bring this knowledge to the fore in their classroom, from a decolonial and critical stance, and to propose experiences where students recognize themselves as subjects and producers of relevant knowledge. In teachers' proposals for activities it is evident how they want to incorporate IK to the classroom. However, we need to recognize that this runs counter to the official school curriculum and to the more acceptable pedagogical approaches. There

are a lot of structural aspects that could hinder or limit teachers' ambitions. This is why spaces for teachers to accompany and support each other are fundamental.

We have observed how the quest guided by teachers' intuitions, as well as by their capacity of observation and reflection, about the relevance of using students' first language and its relation to learning, have been confirmed in different studies around the world (e.g. Feltes & Reese 2014; Hamel 2018). Hough and Skutnabb-Kangas (2005) point out in the following terms:

... across all the models, those students who reached the highest levels of both bilingualism and school achievement were the ones where the children's mother tongue was the main medium of education for the most extended period of time. The amount of education in the mother tongue was the strongest predictor of both the children's competence and gains in English, and of their school achievement. (p.114)

Such results are implicitly integrated in teachers' concerns. The different strategies used to work with students that speak a different language, come from a large path of sensitivity about the relevance of students' mother tongue. This journey has taken place over time, because they have been "working, analyzing, suffering, living" as teacher Laura expresses. Strategies such as the ones we have described are not suggested or favored by school authorities because it is considered that middle school students (13-16 years old) speak fluently in Spanish (even if their mother tongue is different). For teachers it is evident that there is no way to propose true learning experiences if the language in which their students think and communicate is ignored.

A more proactive position would lead to incorporating such insights in teachers' initial preparation, as well as including topics related to traslingualism. We consider not only that indigenous students' teachers should be involved in such formative processes but, in countries like México, this should be part of all the teacher preparation programs. Elizabeth McKinley (2005) states:

“... the recovery of our indigenous histories, knowledges, experiences and identity in inextricably linked to the recovery of our languages because languages are our view of the world (...) there is a need to move away from viewing language as a technical tool of communication and viewing language as encompassing our existence” (p.232)

Teachers recognize the relevance of language and point out how the kind of activities should be in accord to students' ways of learning and to the valuing of the knowledge of elders, and their links to students' families.

We want to underscore the finding that when you bring this kind of knowledge to the classroom students really modify their role, they find that they have something meaningful to say, things that they know about (and their teachers don't). This is a crucial element in the development of a critical pedagogy because it requires that learning experiences talk to students, give them voice, allowing them to place their experience in the center of the learning process. Students in these communities in the Mayan Highlands have been going to the milpa ever since they were babies, they take part in the work involved and in rituals and festivities related. Therefore, the proposal is not for teachers to teach them about milpa, but to give space to this knowledge so a dialogue can be opened with

school knowledge, allowing to position their own knowledge, and their community, in the center of the learning process.

The ideas that teachers have expressed throughout this process can be suggestive of a teacher preparation from their own experiences. In professional development processes, teachers as the ones who attended this workshop become colleagues that recognize that each one is following her own path, but that can be supportive of others in the path. Hillsman Johnson and Atwater (2014) point out some of the characteristics of teachers committed to equity and social justice that we have identified in the teachers that worked with us in this experience:

“These teachers must enter these classrooms and teaching positions by choice and not by assignment, they should possess or actively seek knowledge about different cultural groups, they must understand how vital and critically important it is to help students experience success and become excited about science”. (p.89).

One possible path to follow for teachers’ professional development is related to the analysis of specific cases where IK is incorporated in dialogue with scientific knowledge. In this path we can construct a diversity of relations. According to Mouffe’s and Moreno’s ideas (1993) entities such as ‘traditional knowledge’ and ‘scientific knowledge’ are constructed in interaction and are not previously determined. There are not two antagonistic entities but a multiplicity of relations where the struggle against subordination should be set in specific and differentiated terms, and teachers are a fundamental piece to construct such relations.

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