

# Designing Educational Material for Scientific Intercultural Education: The Harvest of Milpa in Mexico as an Example for Dialogue

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In the present paper we present a proposal to build educational materials for science education, which explicitly consider cultural diversity. We underscore the relevance of establishing relations between scientific (school) knowledge and traditional (or indigenous) knowledge in order to promote intercultural dialogue that contributes to the education of citizens who are capable of understanding the world and taking decisions that better let them realize their own life project. We present a set of criteria to evaluate educational materials that promote such dialogue and discuss these criteria for a particular example: the harvest of maize in a polycrop system known as *milpa* which is very common in the region called Mesoamérica. This example shows how specific and local contexts are relevant for science education from a dialogic and intercultural perspective.

**Keywords:** Intercultural science education; traditional knowledge; indigenous knowledge.

## Introduction

Most educational systems in the world consider science education as a key aspect in the development of economic competitiveness and in the formulation of alternatives needed to build the future of mankind.

From the onset of the twentieth century arguments about the benefits that science education could bring for all the citizens and not just for a professional elite have been crystallized in a number of projects and programs that both nationally and internationally have dedicated relevant resources to innovate in curricular design, improve the quality of teachers' preparation, improve students' performance or to promote scientific and technological culture of the whole population.

However, great expectations about citizen preparation with an ample scientific and technological culture very soon had to confront with results that showed that the lack of scientific vocations and general disinterest for science and its products were beyond the introduction of specific subjects in basic education. Despite efforts undertaken during decades, natural sciences still occupy a place far and beyond daily life for most of the

people in the world (POLINO, 2015).

On the other hand, scientific education is still fundamentally irrelevant for peoples' life. The idea that science education could provide general citizens with knowledge and abilities needed to make decisions in a democratic and just society has not been realized (ROTH; CALABRESE, 2004). We need to think in deep changes in science education, to rethink what the students need to know and how they build their perspective of science. We propose Intercultural scientific education as a possible path.

### **Science education in a multicultural society**

Since 1970 the fact that students do not learn science at school, despite the efforts of the teachers, was made evident. Studies show that every student has her own set of ideas and builds representations of phenomena according to her previous knowledge and perception. Such insight was the beginning of research programs and science education that now are considered a field of study where different perspectives in science education underscore the need to consider contextual questions. One of these perspectives, the cognitive perspective, considers students' alternative ideas and devise ways to consider them in order to develop conceptual changes (TABER, 2009). On the other hand, from a sociocultural perspective different proposals have considered the relevance of students' context and have developed situated learning strategies and problem based learning, amongst others.

However aspects related to cultural diversity are less developed in the field of science education. Atwater (2011) identifies that only until mid nineties last century the subject appeared in academic journals on teaching and learning. This implies 20 years of difference compared to the main perspectives in science education and even now it is not a well-established field of inquiry for researchers in science education, nor for science teachers.

When science education is set within the realm of cultural diversity it can be observed that despite all the efforts and invested resources we are far from promoting a better education for all, that allows for the reappropriation of the knowledge and practices needed in order to identify problems and take decisions in socially pertinent processes. Research conducted with teachers (GARCÍA FRANCO; LAZOS RAMÍREZ; ROMERO RUEDA, 2015; MOLINA, 2012) who work in contexts of cultural diversity show the complexity of teachers' conceptions and how there are configured by their own formative and working experiences. It is not uncommon that teachers do not value students' or community knowledge because they regard them as quotidian and without any relevance for school.

On the other hand, most teachers understand science as unquestionable knowledge and not as the result of a historical process of social construction. Therefore it is considered as an isolated, universal, and privileged knowledge when compared to traditional knowledge, which is regarded as local and epistemically irrelevant (GIL, et al, 2002). It is important to notice that when science is taught in opposition to local

knowledge it loses the possibility of recognizing the intercultural construction of scientific knowledge and forget that science achievements are the result of different cultures.

Even though in Mexico there are continuous reforms to the educational systems and teachers and students are continually subjected to new proposals, attainment of significant learning is still very far. And even further are the promises of proposals that are inclusive for cultural diversity. It is common that teacher's knowledge is not enough to guide students of different profiles towards the academic achievement that has been conceived with a standard student in mind. Limited resources oblige to direct most of the resources to the performance of the majority of students even when that means a loss for students that require educational practices in specific contexts. In many cases the tendency towards curricular standardization and assessment add up against educational equity despite their promotion of a better education for everyone (SCHMELKES, 2005)

In recent years analysis towards social effects of science education have called attention towards the risks associated with promoting science as the only valid perspective to understand the world, particularly when they are established in culturally diverse societies. Among the risks are the deepening of the gap that signals educational achievement for the members of non dominant social groups, reaffirmation of negative stereotypes for cultural diversity and the exclusion of other systems of knowledge amongst them indigenous knowledge (McKINLEY, 2014).

The way science has been taught has had the following consequences:

- Invisibilizing cultural diversity by showing science and technology as the only valid form of knowledge.
- Strengthen an image of science as something far from students' practice.
- Impose a hegemonic vision that obstacles recognition and valuing of cultural diversity.
- Excluding local knowledge favoring erosion processes in the communities and contributing to cultural diversity and identity loss.
- Restricting spaces for reflection around the construction of knowledge and the recognition of contributions of different knowledge (local or traditional) in constructing specific solutions.

It is worth adding that the great disparity between educational results of indigenous and non-indigenous students persists despite years of educational reforms making evident the limits of a scientific education that does not pose deep changes in its epistemic and ethic perspective towards cultural diversity. That is the reason why many of the educational proposals for multicultural societies cast a doubt on the pertinence of scientific education for indigenous populations and even claim the possibility of an autonomic education based only in local knowledge systems (SARTORELLO, 2013).

We consider that an intercultural scientific education is indispensable to set a perspective that allows for the coexistence of different kinds of knowledge as part of the

recognition and valuation of cultural diversity. In the words of Hodson (2009, p. 127) we wish to “find ways of incorporating traditional knowledge in the curricula in order to celebrate and maintain cultural traditions and at the same time attending the national priorities that have their roots in contemporary science and technology”.

### **Foundations for an intercultural scientific education to value diversity: a reflection from the Mexican education system.**

Ever since the educational system in Mexico was established (in the beginning of the XX century) there has been a tension between what is deemed to be “the national” and “the indigenous”, understood as divergent categories. As a result the educational system can be considered, specially in basic education, as a duplicate system: on one hand, a system of indigenous education that looks after cultural diversity, meaning the ‘special needs’ of indigenous communities, and on the other hand the general system directed to the national education of all the “non indigenous” students. (RAMIREZ CASTAÑEDA, 2006).

The result is two different sub-systems with a strong asymmetry in aspects of quality and social recognition, with divergent results of indigenous and non-indigenous students. One data that reveals the profound gap between these two systems is that less than 1% of students of indigenous communities have access to higher education and data on school desertion are significantly greater for this group.

Lots of doubts appear about the role of education as the mean to eliminate asymmetries and exclusions when we observe a system that segregates and invisibilizes cultural diversity and that is why we have proposed looking at scientific education from an intercultural perspective.

The point of start for intercultural education in Mexico is the recognition that it is indeed a multicultural country, which has been already taken at a constitutional level. It is important to mention that Mexico’s cultural diversity does not only talks about indigenous populations that occupy specific territories, but also the historical processes that have given way to migration and interaction, in different form and space of social groups that have different origin, in and out of the national territory.

Intercultural education in a multicultural society such as Mexico would have the objective of promoting capacities’ development to recognize, value and preserve cultural diversity, participating in interaction spaces where the values of equity and plurality are shared (OLIVÉ, 2012). We aim for the configuration of a “intercultural subject” pointing a difference with the hegemonic ideal commonly associated with the “universal” or “occidental” subject also considered the subject of modern science (POMEROY, 1994).

### **A pluralistic view**

In a multicultural society, relations become intercultural when besides the recognition of diversity you have the necessary elements to understand and leave the others act in an autonomous way according to the sense they have assumed from the

perspective of their culture, incorporating, according with their preferences, the values and principles from other frameworks of cultural reference (VILLORO, 1998)

The coexistence of different cultures that follow the principle of equity needs a pluralistic conception as an alternative to ideas that suppose the existence of only one valid conception of the world that is universal because its foundations are beyond local contexts. It is worth mentioning that the idea of the existence of a unique set of criteria to assess valid knowledge is at the foundation of considering science as a universal knowledge. A pluralistic view of knowledge accepts the existence of different ways of acting and knowing, recognizing the diversity of forms of life that have as reference a plurality of moral, juridical, and politic norms that can be incompatible but have their own legitimacy in different cultures.

It is important to mention that recognition of plurality of ways of living and their legitimacy does not assume that this different forms of living would be isolated, each one framed in its own cultural references. On the contrary the recognition of plurality is directly associated with the permanent search for legitimacy because coexistence of different perspectives require continuously making explicit justifications for every culture as well as establishing agreements to validate such actions between different cultural frameworks of reference.

From a pluralistic perspective, recognition of the plurality of cultures and the continuous search for legitimacy require establishing spaces of communication, setting dialogue as the foundation for coexistence between different cultural frameworks and a necessary condition to understand and participate of what is diverse (OLIVE, 1999).

The capacity to establish dialogue is one of the main objectives of intercultural education, considering dialogue as the foundation for the construction of spaces where reasons are exposed and listen to the sense that each individual or community has assumed from their own perspectives of the world (VILLORO, 1998). Intercultural education would have two objectives: first the development of capabilities that allow for the recognition and valuation of cultural diversity, and second, the development of capacities and conditions that generate autonomy for making decisions to implement cultural practices that are pertinent from their framework (BONFIL, 1991).

The role of science education as part of intercultural education is tightly related to the development of capacities to establish dialog between diverse knowledge and the relation with identity and culture. Moreover, science education from a pluralistic view contributes to the recognition of different system of validation as a result of the diverse interactions and agreements among subjects and communities.

In order to be effective, intercultural science education has to come from a pluralistic conception, following inclusive values that allow inserting diverse knowledge and also promoting the dialogue of knowledge by generating spaces and resources to communicate science as well as local and traditional knowledge:

Epistemic, ethic, and juridical pluralism assert that there is non-universal and absolute set of criteria to decide upon the validity of specific norms.

Validity is to be judged in every particular case with respect to criteria that is proper for the conceptual frame of every culture. But this does not mean that every set of norms is valid and acceptable as long as it is built upon an adequate set of knowledge that justifies its validity. Pluralism is not to be confused with extreme relativism (ALCALÁ, et al, 2012, p. 34)

Intercultural science education would be one of the most relevant spaces to develop the capacity for dialogue by getting in contact with different systems of knowledge and their particular ways of epistemic validation in specific contexts. In this sense science education offers the possibility to approach complex problems that require intervention from diverse knowledge, and that problem solving requires establishing agreements to evaluate them by counting on the participation of groups involved, without assuming that all of them have the same validity in a specific context (ALCALÁ, et. al. 2012)

In this sense, intercultural science education represents an opportunity for every person of every cultural group to transform her own culture without giving up on her identity, making profit of scientific-technological knowledge, and other types of knowledge relevant to reach their own ends and values.

It is worth noting that from a pluralistic perspective, intercultural education is not directed exclusively towards indigenous communities and it should not be considered as an educational approach only for vulnerable or minority ethnic groups. Science intercultural education reaffirms that we all have the right to recognize that there are different ways of knowing and that we can choose that which best adequates to our own means and values.

Intercultural science education should give us the tools to analyze situations and make decisions on issues related to both, traditional knowledge and technical abilities (EL-HANI; MORTIMER, 2007). Intercultural science education should prepare citizens with the necessary capacities and competences not only to get information but also interpret it and process it in order to participate and make decisions according to their own objectives and interests. Obviously, science education should prepare students who wish to pursue science in further studies but it should also let students look critically to the societies and values that hold them and ask themselves what could they do to construct a more fair and democratic society (HODSON, 2006; ROTH; CALABRESE, 2004).

In the words of Paulo Freire, intercultural science education would give students tool to read their own world.

## **Criteria to design material for intercultural science education**

Educational materials have been a privileged vehicle to share with teachers different educational perspectives as well as to cover specific subjects. It is a reality that not many teachers have considered explicitly the relevance of cultural diversity in their classrooms and for this reason we consider that is very important to have materials of intercultural

education in order to explicitly propose the reflection and articulation among school content and traditional knowledge. There are several examples of materials developed for science intercultural education (AIKENHEAD, 2001; GROS, 2010; IGNAS, 2004) that have been used in different contexts. In the present paper we set forth some criteria that can be orientative for the development of materials for intercultural science education.

The following criteria could aid in the development of materials that consider discussion about the status of traditional knowledge and their relation to science knowledge:

- 1) Sociocultural perspective of learning.
- 2) Coexistence of local knowledge with scientific and technological knowledge.
- 3) Recognition of students and teachers as members of a knowledge community and also as knowledge producers.
- 4) Recognition of the communitary and traditional character of knowledge and their validation systems based upon dialogue and interchange.
- 5) Promotion of dialogue between different knowledge: epistemic, practice and ethic value of traditional knowledge.

In the next section we present the criteria aforementioned.

### **Sociocultural perspective of learning**

The development of educational materials considers a sociocultural perspective of learning that considers that knowledge and its comprehension are culturally constructed through dialogic interactions about relevant problems and through the use of different tools to participate and make decisions.

In this sense, the step for choosing content is therefore fundamental because it is always a cultural selection and depends on the relation that is established between knowledge and culture:

The selection within a culture has a double importance: with it cultural contents are re-elaborated which are transmitted to the new generations; but is not culture that is transmitted as a symbolique, unique repertoire. On the contrary, such transmission is subject to the randomness of the symbolic relation and interpretation conflict (FORQUIN, 1981, apud MOLINA, 2010, p. 97).

### **Incorporation of local knowledge**

There is an inherent tension in the inclusion of local knowledge in educational materials and the way they are related to science knowledge. This tension exists between scientific culture with its pretensions of universality and the local culture that, by definition, circumscribes to a specific time and space.

Every time it is more evident that the complex problems faced by humanity currently cannot be solved from a single perspective. Internationally there has been changes in the last two decades in the relations between science and other systems of knowledge, which has been reflected in the explicit recognition of indigenous and local knowledge in different global forums of environmental governance such as those related to biodiversity and climate change. This is evident in different programs sustained by organisms such as UNESCO, which promote the incorporation of traditional knowledge in the discussions. Programs like LINKS (Local and Indigenous Knowledge Systems) are particularly relevant and have generated research and materials that underscore the relevance of local and traditional knowledge on the understanding of complex phenomena that are also interesting for the scientific communities.

Nevertheless the new relations between traditional and scientific knowledge has not come to the school yet. In almost all the world, formal education maintains a system in which science has a superior role when compared to the rest of knowledge. Opportunities are lost for children and youth to recognize and value communitarian knowledge, which does not favor the cultural transmission of knowledge.

### **Recognizing students and teachers as knowledge subjects**

An intercultural science education demands that teachers and students are subjects of knowledge, which do more than accepting that which is mandated in central administration. It is essential new ways to design materials assuming an active role of professors and students as knowledge producers and considering school as a territory where the knowledge and its meaning are constructed. This is relevant because teachers and national curricula designers rarely see indigenous or rural spaces as spaces where knowledge is generated and can establish a relation with science knowledge.

In formal education the communitarian knowledge of students and their parents (which are mostly peasants and indigenous) has been invisibilized (MOLINA, 2012). School has played the key part in devaluing local knowledge. This is particularly relevant when it is widely accepted that the transmission of local knowledge is indispensable to face situations such as natural disasters, climate change and diversity loss (NAKASHIMA, 2013). For that reason we need initiatives to bring the traditional knowledge back to school not only to promote the transmission of local knowledge but also to expand the capacities of the subjects who are members of those communities.

A science education that recognizes subjects as knowledge producers also allows for students “to expand their sense of agency, the space they have to maneuver and the possibilities they have to act and change their life conditions” (ROTH; CALABRESE, 2004, p. 17).



## **Recognizing the communitarian and traditional character of local knowledge**

It is every time more evident that indigenous knowledge about nature belong to a very complex lattice that includes practices and that is inseparable of values and ways of being in this world. It is not possible to separate indigenous knowledge about certain phenomena to put it into relation with school or scientific knowledge. Indigenous knowledge is distributed and communitarian. According to Berkes (2012), traditional knowledge is “a cumulative corpus of practices, knowledge and beliefs about the relations amongst living beings (including humans) and their environment that evolve through adaptive processes and is transmitted culturally between generations”.

Traditional knowledge cannot be separated from the persons and communities that produce them. By trying to do so they get fragmented, decontextualized, reduced and therefore the way in which they are produced is devalued. Attempts to isolate or separate indigenous knowledge have acted against indigenous people because “once the knowledge of indigenous communities is separated from them and preserved, there are few reasons to pay attention to indigenous communities” (AGRAWAL, 1999 apud CARRILLO TRUEBA, 2006)

## **Promoting knowledge dialog: epistemic, practical and ethic values of knowledge.**

How can two asymmetric systems of knowledge coexist? Dialogue between knowledge won't be possible if we think or suppose that science has to validate traditional knowledge. A dialogue is not possible if we would be trying to systematize traditional knowledge from a western science perspective.

Pluralist epistemology allows us conceptualizing dialogue between two knowledge systems, considering that each one has its own ambit of validity and conditions internally defined to identify what is objective, valuable and possible. It is not a relativist position in which all knowledge is equally valid. It is a position according to which knowledge are adequate according to their application ambit and validity.

According to Pérez Ruiz and Argueta Vilamar (2011)

Within the framework of epistemological plurality, objectivity understood as rational acceptability supposes that it is present in any cognitive system, either grouped in a similar conceptual framework or built in different epistemic conditions and within particular intercultural dialogues (PÉREZ RUIZ; ARGUETA VILAMAR, 2011, p. 44).

## **A Mexican example: cultivating milpa**

Different researchers have shown relations between cultural diversity and biological diversity (MAFFI, 1999). This makes it imperative for science education to promote valuing this diversity that allows us to sustain life and that is fundamental for

life in the planet.

Mexico is a megadiverse country where coexist more than 62 ethnic groups that have more that 365 different languages. Indigenous population in Mexico is 10% of the total population, which means more than seven million people being recognized as indigenous. This pluricultural composition is recognized in the constitution.

Despite such diversity, in Mexico the school curricula is national and even if one of the educational axis is interculturality, in textbooks and educational materials there are few opportunities that can be used for teachers to recognize and value different ways of understanding the world

### **Maize, *Milpa***

Even if indigenous communities in Mexico are very diverse, most of them share a characteristic that comes from Mesoamerica, which is the cultivation of maize in a system known as *milpa*. Milpa is a production system that involves diverse species that have a different importance in different times of the year. The main trilogy in la milpa is corn, squash and bean. Association of this three species is a very virtuous one because the stem of the corn plant is the support for the beans which are in time a natural fertilizer because it allows fixating nitrogen, and the squash with its large leaves that permits that moisture is conserved (LINARES; BYE, 2011). Besides these three species there are always quelites (non cultivated herbal plants), chili, flowers, medicinal plants and animals that are adapted to live in this agro- ecosystem. Milpa has something different products every season of the year.

The history of maize and human beings run parallel in Mesoamerica. According to Bonfil Batalla (1982), maize is a plant that has been culturally created because it would not exist without the intelligent and intentioned intervention of the human beings. In many senses we can ascertain that the corn plant was not domesticated but created by the human beings who from teocinte (a small plant with a very hard kernel) managed to generate the immense variety of maices that we have nowadays. Mexican territory is the domestication centre of corn plant, during a process over 6000 years long. The indigenous people through their practices of selection have generated more than sixty different varieties and such genetic diversity allows the adaptation of crops to climate change and also permits some responses in the presence of certain diseases. This is why it is imperative to protect, conserve, and develop the knowledge that gives origin to this diversity and we believe that intercultural science education has a role to play.

However this diversity is declining (DYER, et al, 2014). In a consultation process to identify the risks of introducing transgenic corn in Mexico, the commission for Environmental Cooperation concluded, “in rural communities the level of information about vegetal genetics and transgenic technologies is scarce, and at the same time in the scientific and political communities the information about social and cultural concerns is very reduced” (CCA, 2004). This prevents that public policy can be generated with a solid scientific base and being socially acceptable. This gets us back to the knowledge

society as proposed by Olive (2012) because the members of any indigenous community where corn is cultivated should have a minimum preparation in order to take informed decisions consistent with the life they are willing to live. We are not talking about denying the introduction of foreign technology or to accept it acritically. It is not possible to critique indigenous communities for making decisions “against progress”, if one does not know the profound relation that exists between maize and indigenous communities. This is way the milpa is a fundamental space to establish dialogue.

In this sense we need to recognize indigenous people as agents in conservation and development. Knowledge and energy of these communities represent a relevant social energy indispensable to stop social, cultural and environmental deterioration (BOEGE, 2008). In a multicultural country recognizing the aportations of those who are generally considered as ‘the others’ and that are commonly represented as people lacking knowledge and not accepting progress is fundamental in the construction of a plural society more democratic and fair.

It is necessary that a student from all over the country (not only indigenous) now about practices such as milpa and that is why the development of educational materials is fundamental. Many teachers in the northern part of the country do not have any aid about the diversity of corn in the country, much less how this diversity relates to cultural diversity and science.

Although science has recognized the relevance of the milpa as an efficient agroecological system that can face climate change events and that can be fundamental for our food security there is not a reference to this practice in the whole curricula. From our point of view this is a lost opportunity for everyone in this country.

### **The book of la milpa**

As a way of making concrete the principles that have been exposed in the second part of this work we will make a description of a material that was constructed in a process or participative action with indigenous teachers in la Montaña, Guerrero, where people meeph’a live. It is not our intention to describe the methodology because that has been done (GARCÍA FRANCO, 2015) but mainly we want to emphasize how the principles for building materials are realized in specific production in a school.

Constructing materials from our own knowledge is a practice that has been recognized as a way of empowering teachers and students (AIKENHEAD, 2001; BERTELLY, 2009), and as a possibility to recognize the territory and the subjects that live in it as subjects of knowledge (CHINN, 2007).

The book of la milpa is set forth as an activity which allows the recognition of knowledge of studies and community members since everyone has a tight relation with the production of maize and its handling. The subject of la milpa was decided in working sessions with teachers and it came about when looking for possibilities for kids to express more (both orally and written) and also establish relations with knowledge of the natural world.

First author of this work and facilitator in the workshops, made a first proposal to teachers in which possible activities are established and related to the official curricula. This is important because as has been discussed the curricula is national and for many teachers it is very uncommon to do anything beside the textbooks. The perspective of allowing the same students and their families to generate the materials in which we would be studying was very interesting for teachers.

As has been said, la milpa is the center of the life of indigenous communities. Bringing it to the center of the educational activity is a declaration of principles that recognizes the relevance of the community subjects: kids, parents, grandparents, and that identifies them as knowledge producers. La milpa is a clear example of how community and territory are knowledge spaces and that was very relevant for teachers who developed a different way of looking at their own community because it is common for authorities and teachers sometimes look at the community with contempt.

To start this book we proposed some chapters: What is in the milpa? Milpa recipes; Milpa in my community. This initial proposal let us work with teachers establishing relations between community knowledge and school knowledge. In the activities that are made for this book, teachers and students do research on a specific subject (recipes, for example). For smaller kids students ask their mothers to tell them how they cook something brought from the milpa; kids can also go visit someone who is actually preparing some dish. After that they bring this activity to the classroom and work with it. This places sets la milpa, and knowledge around it in the center of the activity. By writing recipes and sharing them, students practice communicative abilities and generate a product that collects community knowledge to give it back to the community. Students develop scientific abilities such as classification and observation.

According to the interests of teachers and the requirement of the study program, students make different activities with the material that is produced. For example they discuss about the states of matter using *atole* and corn flour as reference. In different school levels students discuss transformation of matter, chemical and physical changes that occur to materials when cooked.

Nixtamalización is a very clear example in which teachers decided to establish relations between local and school knowledge. It is a process where kernels are cooked in a calcium oxide solution and the kernel is let to sit in such water for some hours. All the members of the community know this process and students (specially girls) accompany the mothers to turn these kernels into flour. There are prehispanic a registry of this process and allows the amino acids in the corn to be available and also elevates the percentage of dietary fiber and bioavailable calcium (PAREDES LÓPEZ, 2009). According to school level it is possible to establish different activities around nixtamalización considering and recognizing the knowledge of people that cultivate and harvest corn.

Traditional knowledge about la milpa that include practical knowledge such as nixtamalización also has ethical and epistemic dimensions that we need to recognize. The way in which milpa is cultivated, the rituals that surround is, the decisions taken

about the cultivation, about animal accompanying the production, show a very complex system of knowledge that has a proper epistemology and that does not need to be explained by the school but needs to be valued by students and teachers.

The making of a book that includes research activities in which not only teachers and students participate but also other members of the community is very important because it helps breaking the barriers established between school and community. Once students constructed the book (drew a cover, an index and ordering all the different activities), they organized an activity where different members of the community (parents, authorities, etc.) were invited and saw themselves reflected in this work and found it strange and amusing that this kind of knowledge was present in the school. The development of a product such as a book is consistent with the sociocultural perspective on teaching and is also part of 'expanding the agency' of students because a book is an artifact that belongs to school and does not have relation with the community. In this experience the book of la milpa, turned into a proof of the role that local knowledge can play in the school and in different ways in which the school helps to think about daily life activities from other perspective and with different tools.

We are currently working with teachers in the state of Chiapas with secondary teachers designing teaching sequences that can establish a relation between the knowledge of natural selection (as an explicative model for evolution) and maize domestication (GARCIA FRANCO; GÓMEZ GALINDO, 2015). We have found very interesting fields to recognize how local and traditional knowledge have been fundamental in the generation of over 65 varieties of corn in Mexico (CONABIO, 2011) and also to discuss school models such as natural selection and evolution. Experiences with these activities with students and teachers show that knowledge that students have about la milpa and the way in which seeds are selected is relevant to the way they interact with such activities (DE LA CRUZ TORRES FRÍAS, in press). That is why it is fundamental to have an intercultural perspective when designing these activities, to find different ways in which they can be pertinent for different cultural groups.

This material allows the establishing of the relation between natural selection, artificial selection (directed differential reproduction) and maize domestication. The cultivation of maize in milpa and maize domestication show the synchronicity and complementarity of plants and animals cycles, in a system that make use of characteristics that can only be understood by years of observations and trials from a cosmovision (worldview) that makes emphasis in the interactions of every being in the world as part of a dynamical equilibrium, an holistic view, integral, more ecological. This diversity of relations allows appreciating the complexity that other epistemic traditions (non scientific) hold, and their capacity to intervene in the world.

## Conclusions

Educational materials are fundamental to get change in formal education. Materials provide us with opportunities so teachers can generate new approaches to

subjects that are not very familiar to them. The aim is to construct with teachers, new ways of approaching certain knowledge.

In formal education systems that have traditionally invalidated local or traditional knowledge, educational materials can be vehicles to enhance the recognition of its relevance and that can put it in dialogue with school knowledge.

According to our experience this dialogue almost never occurs. Even when teachers usually explore students' previous knowledge there is no opportunity for them to reelaborate their knowledge and put it in relation with school knowledge.

These materials also allow for students who are non indigenous to recognize the relevant role that has had traditional knowledge in biodiversity conservation, or its relevance to face climate change and natural disaster.

A national curriculum that unilaterally prescribes which should be the contents revised by students, regardless of their cultural identity and context, and that prescribes the order in which they should be taught does not consider the inclusion of cultural diversity in the curricula and causes the erosion of knowledges and identities.

There is a need for greater autonomy for teachers and schools but it is also necessary to give them access to materials that accompany them in this path of considering cultural diversity when they are planning for the science class, either as an integrative axis or as a part of explicit activities aiming for its recognition and valoration.

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