

The *Milpa* Goes to School: Teacher Training in Climate Change Adaptation from a Situated Learning Perspective

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Abstract

In this case report, we present how we have approached the topic of the milpa in rural and indigenous contexts in Mexico as a basis for understanding the impacts of climate change, and as a traditional practice that can inform adaptation from a situated learning perspective in line with the curriculum. This research demonstrated effective ways to address climate change as a global problem that directly relates to local concerns and practices. This case used collaborative qualitative research to develop a training process in which teachers analyze learning progressions in their schools. The process included the design and implementation of relevant project materials.

Keywords: climate change; milpa; situated learning; teacher training

Introduction

To contribute to the UN Sustainable Development Goal (SDG) #13, the Institute for Research in Education, Universidad Veracruzana, Mexico, has been promoting reflection and action on climate change through agreements, research projects, and organization of outreach and training events. The training of teachers of basic education (primary and secondary schools) about the subject of climate change has been a priority for the institute given the need to approach the problem from both a global and local perspective to foster understanding and action.

This case report presents a teacher training project, The *Milpa* Goes to School, in which the design of the curriculum uses local issues to establish climate change as a topic in

schools located in rural and/or indigenous regions. This report describes how we have approached the topic of the *milpa* as a basis for a situated understanding of the impacts of climate change. The *milpa* is a widely known agricultural and cultural regimen practiced by the indigenous population including teachers and children in the rural areas of Mexico, as well as in other parts of Latin America and some regions of Africa. Thus, the focus of this research was on understanding the impacts of climate change on the *milpa* and the daily practices around it, as well as the need to anticipate future scenarios that will require adaptation.

Climate Change, *Milpa*, and Food Security

Climate change is a global phenomenon that can be considered the

greatest concern of the 21st century (González & Meira, 2019). Therefore, the educational processes that generate understanding and responding to the problem through adaptation and mitigation of its impacts are especially relevant. In the context of a climate crisis, food production is undoubtedly one of the areas of greatest risk (Dixon, 2012; Vincentnathan, 2012).

On the one hand, it is estimated that in Mexico climate change will most affect indigenous peoples who depend on the average annual periods of rain for growing food (Altieri, 2009), a process that is being disrupted by the increase in the incidence of meteorological phenomena such as droughts, floods, storms and hurricanes, and extreme temperatures (Food and Agriculture Organization [FAO] of the United Nations,

2015; Intergovernmental Panel on Climate Change [IPCC], 2014), both locally and in other parts of the world (Fisher et al., 2015; Verner, 2011). In communities observed during periods of field work for this study, these impacts were already evident in food production that is becoming increasingly difficult due to effects of climate change. Although this situation is observable globally, communities that have been marginalized historically (for social, economic, cultural and political reasons), such as indigenous communities, are those that are identified as especially vulnerable to the consequences of climate change.

The *milpa* is the traditional food production system that originated in Mesoamerica (Hernández & Bello, 1995) and consists of the associative planting of maize, pumpkin, and various legumes (Aguilar et al., 2003; Lewandowski, 1987). Depending on the climate, the soil, the altitude, the eating habits, and the locality of the indigenous community, the *milpa* produces a balanced diet because it can include a wide number of species of plants and trees. Some studies have reported up to 50 different species, whether cultivated, sponsored, or tolerated (Molina-Anzures et al., 2016). The system of crop rotation and soil preservation when cultivating maize, pumpkin, and legumes generates an increase in the production per maize plant compared to monocultural production (Alteiri et al., 2012). This process makes the *milpa* an efficient and locally sustainable model of food production and soil conservation that can help indigenous people adapt to climate change (FAO & Organización Panamericana de la Salud [OPS], 2017; Meza, 2014).

The *milpa*-based diet is balanced and healthy (Fernandez & Méndez,

2019). However, it has increasingly been displaced in indigenous rural communities by modern processed foods in a vicious cycle in which the impacts of climate change reduce food production, causing families to buy industrialized foods, which are generally of low nutritional value. In addition, over the years there has been an accompanying erosion of local knowledge about the ecological and nutritional importance of the *milpa* and the cultural production and nutrition system that supports it. In this sense, the *milpa*, as a symbol of traditional Mexican agriculture and the knowledge that emerges from it, represents a kind of insurance for obtaining healthy food for indigenous families (Parraguez et al., 2018) as they try to adapt to climate change. These issues are a focus of the teacher training project.

The *milpa* is also a sociocultural space in which intergenerational and family learning processes are triggered. The values embedded in the *milpa* are significant parts of rural and indigenous communities. Thus, it is important to develop programs and materials to familiarize teachers about the relationships between education, climate change, community health, and local food production. Climate change is addressed through the lens of the local culture (O'Donoghue, 2014) instead of through climate literacy, an approach that has been widely criticized in Ibero-American literature (González Gaudiano et al., 2020; Meira, 2020).

Teacher Training for Climate Change Adaptation

Begun in February 2019 as a collaborative research project, this study used a qualitative approach within the critical constructivist paradigm

(Lincoln et al., 2011), focused on developing relevant curriculum for teachers to use to analyze the implementation of learning progressions in their schools. Its first phase will be concluded in November 2022.

Since the project's inception, we have carried out 10 formal trainings with 435 teachers in different regions of the country under different modalities (face-to-face, blended, and virtual). The teachers who have been involved are already implementing exemplars or designing their own curriculum based on a situated pedagogy that engages intergenerational patterns of food production as a local practice related to adaptation and mitigation of climate change. In the trainings, topics covered included: educational challenges, socio-ecological challenges, working with local stories, design and implementation of learning progressions, and systematization of the experience.

Two years into this phase, there is emerging evidence that the training has contributed to fostering situated learning and the development of capacities to adapt to climate change. The emphasis on local knowledge about the traditional *milpa* as it relates to curricular content has been redirecting the approach to engage climate change. Participants have identified curriculum content that can be addressed using the *milpa* as a source of knowledge that links to natural sciences, history, knowledge of the environment, mathematics, and other disciplines. The approach is oriented toward understanding and acting in the face of the risks manifested by climate change in the local context. Through *The Milpa Goes to School*, topics such as a healthy diet, soil care, and the selection of resistant seeds are addressed as necessary activities for adapting to

the extreme climate conditions (excess water during the rainy season or long droughts during the dry season) occurring in the communities where the project's teacher training is taking place.

Pedagogically, the project was informed by the four-quadrant task sequencing model adapted by O'Donoghue et al. (2020) from the work of Edwards (2014) to train teachers in South Africa. It was modeled on the cultural historical activity theory (CHAT) from Engeström (2015), which expands the sociolinguistic learning theories proposed by Vygotsky. In this project, learning progressions were developed around the concept of situated education.

The curricula were designed through a co-engaged learning progression. In quadrant 1, the goal was to explore and assess students' prior knowledge about the *milpa* and associated practices. To analyze the curricula's validity and importance in the context of students' daily lives, the materials include a local story about a woman who changed her eating habits based on the diet of the *milpa*. She had been consuming processed foods, which contributed to emerging chronic diseases, among them, calcium deficiency. The curricula cites a report that says calcium is found in maize but it is made available only through the nixtamalization* process, a familiar practice for students.

The materials also stressed the importance of having a diversified *milpa*, selecting seeds that are resistant to droughts and floods, caring for the soil, and avoiding the consumption of industrialized, processed foods.

*Nixtamalization is a Mesoamerican process with great potential for improving the nutritional quality of maize-based foods. (Wacher, 2003.)

In quadrant 2, the students make inquiries into their own community through hands-on experiential learning. Guided by the teacher, they explore the following questions:

- How is maize cooked in my house?
- What foods is it combined with?
- Where do these foods come from?
- What are the soil conditions where we establish the *milpa*?
- What is the variety of seeds that we have?
- What are the weather-related conditions that are hampering local food production?

In quadrant 3, the results of the *milpa* inquiry are taken to the classroom and analyzed and compared so students can share their insights.

Finally, in quadrant 4, students, with the support of their teacher (and preferably in collaboration with the community), apply what they have learned in the classroom by suggesting solutions aimed at solving immediate problems around the *milpa* and climate change, such as the following:

- *Milpa* monitors: students monitor the diversity of species that are planted, the quality of the soil, and the resistance of these species to extreme climatic conditions.
- Creation of a seed bank to conserve native varieties of nutritional importance in each species.
- Addition of compost to enrich soil conditions.

Follow-Up and Lessons Learned

The follow-up to the implementation of the pedagogy was conducted by

master's degree and doctoral students who had been involved with research for the project. These students are developing materials for this project. They are also developing collaborative species monitoring in order to support teachers in the design and implementation of learning progressions in the classroom. This research revealed that the teachers are now addressing climate change in the classroom from a situated learning perspective. By connecting through the materials and local concerns about climate change as a global problem, students and their families are learning to revalue the *milpa* not only as a cultural practice, but as a viable response in adapting to climate change.

This project may be of interest in other regions of the world such as other areas of Mexico, Central America, South America, and sub-Saharan Africa, where the production of food based on maize, legumes, and associated species is helping families to access food security and to be better prepared to face climate change and its effects. In this way, the *milpa* is becoming a relevant axis around which curriculum content can be articulated in ways that are locally relevant. The curriculum ceases to be static and becomes dynamic if it is approached from what is familiar and relevant to students and their families.

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