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Landscape Sensitizing through Expansive Learning in Architectural Education

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Abstract: Expansive learning is a teaching–learning method adopted by the Department of Architecture of Universidad de las Américas Puebla, Mexico, to introduce architectural students to the field of landscape sensitizing. This approach has been especially valuable considering the particular cultural and natural values of the Mexican landscapes. In it, architectural students are introduced to co-configuration strategies along with co-working methods with the participation of specialists and local stakeholders and community on the “barefoot” bottom-up basis. The community of Tochimilco, Puebla, was selected as a case study through which students can learn how vulnerable rural landscapes and their natural environments can be protected, constructed, and developed. Therefore, studying natural landscape and environmental conditions of Tochimilco through data collection, fieldwork and student workshops was carried out to reinforce the understanding of landscape features, values, semiotics, and meanings in a Socio-Ecological System of landscape (SES) framework. In this context, the expansive learning processes revealed the potentiality of architectural students to become environmental facilitators for future design and planning projects to trigger sensitizing and comprehensive approaches. In these terms, architectural education prepares students to recognize and be aware of natural values, landscape narratives and the “barefoot” relationship between the landscape and the human being occupying and cultivating it.

Keywords: landscape sensitizing; Socio-Ecological System of landscape; expansive learning; “barefoot” landscape reader; Tochimilco



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1. Introduction

Volcanos, mountains, blue sky, enormous clouds, vernacular architecture, cornfields, and agaves are tangible and intangible landscape elements in Mexican collective imaginary. Those components have been represented in pre-Hispanic codex, Mexican cinema, muralism, and literature as immortal and permanent elements giving landscape framework for the everyday life (see Figure 1). The recent urban development and socioeconomic activities though, have made the tangible and intangible heritage vulnerable when facing new land use strategies, pollution, agro-industry, and mining concessions threatening their very nature. The contemporary Mexican rural landscape evidences the clash between the traditional vernacular environmental practices and public policy and planning informed by economic and real estate interests. External influences have brought new practices to rural communities and traditional, environmentally healthy ones have been abandoned: mechanized agriculture and monoculture is superseding traditional agricultural production methods.



Figure 1. A traditional Mexican landscape with the mighty Popocatepetl Volcano on the background. Source: Antonio Zepeda Pérez (Arch.) (2019) from Finca Mariana y Marcos, Tochimilco.

This is the context where bachelor students in architecture were introduced to planning and design of culturally and patrimonial relevant landscapes. However, intervening in landscape components, conservation, and planning is not an easy task when facing the challenges emerging from up-down land policies, linear spatial planning, aggressive urban planning, weak environmental regulations, lack of implementation, and feedback, etc. Thus, through architectural studies we have a unique opportunity to recognize landscape narratives from a bottom-up stance and to learn to tackle planning issues, through sensitizing the future decision makers in land management and spatial planning.

In the described context, what could “barefoot” concept mean? In order to define this basic conceptual framework we take as an example the persona of “the barefoot historian” created by Stilgoe [1]. In the context of “barefoot” landscape, this figure is adapted to the persona of an architect or urban designer facing a design project in a vulnerable and sensible context with unique environmental values of intangible culture, history, and biodiversity. Stilgoe describes the “barefoot historian” as a scholarly wanderer who offers personal observations and insights substituting the more conventional historical research. Thus, the “barefoot historian’s” viewpoint is a creative response to the professional conventions, a claim to a disciplinary stance in which subjectivity is suppressed in order to give way to an objective, authoritarian voice of a canon ([1] p. 21).

Therefore, our understanding of a “barefoot” landscape interpretation and analysis is that of environmental development practices going beyond the professional design criteria and disciplinary processes based on canonical aesthetics and functions, extending to new practices sensible to vernacular contexts of rural communities. Those people that during centuries have followed traditional landscape uses based on a sociocultural memory of an organic affinity with the natural environment are those first “barefoot” architects the trail of which contemporary architectural students should follow when working in vulnerable and sensible productive or natural environments. Thus, this paper introduces an educational and collaborative work carried out in the community of Tochimilco, Puebla, Mexico, aiming

at recovering the community memories of the relationship between the human being, the landscape, and its natural conditions. The project applies collaborative and inclusive design methods to create design proposals informed by the traditional socio-nature and bio-cultural knowledge, seeking for a multidimensional sustainability.

Ideas of Johan van Legen [1], regenerative design [2] and challenges of architectural education by Kurjenoja et al. [3] are the basis for our planning approach in landscape sensitizing and community-planning training. Based on those teachings, the main goal of this document is to demonstrate how Expansive learning helps architectural students to develop “barefoot-practices” in urban-rural design informed by landscape sensitizing.

For that reason, the following research questions were presented: what is the role of the architectural student when collaborating with local contexts of “barefoot” practices? How Expansive learning helps to sensitize students to vulnerable landscapes? What should architectural education do in order to promote landscape and environmental awareness among new generations of professionals?

To answer those enquiries, this document is divided into four sections. After the introduction, the theoretical framework on Mexican landscape vulnerabilities is described through the problem statement, theoretical concepts, and contextualization of Tochimilco. Then, the methods and an “adopted community” or case study are presented. Then, the concepts of Socio-Ecological Systems of landscape (SES), human–natural and natural–cultural interconnections, semiotics, and cultural meanings and Expansive learning are presented as methodology frameworks. Finally, in results and discussion, the importance of the role of future architectural professionals in the construction and transformation of vulnerable environments is demonstrated, as well as the impact of architectural education in the promotion of environmental and landscape awareness. Thus, we conclude that the introduction of “sensitizing-barefoot-projects” in vulnerable contexts like Tochimilco and its tangible and intangible patrimony is one of the key elements to develop professional awareness.

2. Landscape Sensitizing through Expansive Learning and SES

2.1. Problem Statement: Vulnerability of Multidimensional Landscapes in Tochimilco

Mexican rural and natural landscapes contain important values regarding bio-cultural essence of a place. As such, they are evidences of a unique socio-nature and nature–culture interrelation with a long history that should be taken into account when planning and designing environments in these kind of locations. The question is how to prepare future architectural professionals in understanding and responding adequately to the demands of these vulnerable landscapes and social and cultural practices they shelter. The focus in interacting in contexts like Tochimilco should be in the awareness of the importance of local multidimensional conditions related to community’s environmental biodiversity, history, traditions, and their relationship with the surrounding natural and productive environment. This is especially important today as localities such as Tochimilco could soon be facing neoliberal public policies taking advantage of poorly empowered habitants of traditional rural communities, triggering substantial socio-environmental and territorial transformations. In many cases, these top-down processes of community development have caused the invisibility of local inhabitants. Their everyday practices and their socio-environmental relations and dynamics that have been until now the foundations for the making and re-making the socio-nature and nature–culture-negotiations and adjustments [3].

As it was stated by Duran-Díaz et al. [4] the trends of neo-liberal policies are homogenizing places and territories in which individuality is tightly connected to the collectivity. Thus, a substantial change in the thinking of future professionals should be promoted to foster the understanding of the impact and long-term consequences of standardized urban development projects on a local scale. The traditional role of an architect is no longer useful in these cases and under these conditions in which technological tools and design skills should be correlated with complex ecological and environmental issues and user and community needs. However, landscape and environmental studies in Mexican

architectural schools are not entirely addressed due to the complexity of the territorial scale and multidimensional natural and productive conditions and cultural-functional features of the landscape, besides the instrumental understanding of the landscape. Therefore, working with key case studies like Tochimilco is essential for learning unity in complexity and diversity, as well as for raising awareness of the dependence and relationality between traditional Mexican rural communities and landscapes surrounding them.

2.2. Contextualization: Socio-Ecological Systems of Vulnerable Landscapes for Architectural Education

The bottom-up planning stance and the “barefoot” approach applied in this educational and research project required a method that promoted an active collaboration and communication between students, teachers, specialists, local stakeholders, and the community. Thus, the method of Expansive learning of Yrjö Engeström [5–8] was adapted to landscape sensitizing learning processes in environmental education applied in Tochimilco. In this case, the educational goal was to achieve awareness among participating students of the importance of local multidimensional conditions related to community’s history, traditions, and its relationship with the surrounding natural and productive environment. It was essential to sensitize students regarding the vulnerability of traditional rural communities as current public policies regarding planning and land use tend to trigger substantial socio-environmental and territorial transformations that do not respond to the local demands and needs of development [3].

Expansive learning processes, adopted by this educational project, have their foundations in the framework of critical realism (CR), as the basis for the transdisciplinary understanding of an environmental context and its reality, to achieve a real, locally sensible, and conceptually wide sustainability. Regarding environmental education, the CR approach promotes creative and critical thinking, collaboration and cooperation, problem solving and planning beyond narrow professional or political limits [9]. Thus, conceptualizing environment and landscape as a nature–culture artifact that evolves and transforms due to human practices, CR represents a cutting-edge action in environmental planning. It is not possible to understand the individuals and their community and culture without understanding the environment surrounding them as well as it is impossible to understand the environment without considering the human beings inhabiting it [8].

The framework of Cultural-Historical Activity Theory, CHAT, also provides useful conceptual tools for the study of the Socio-Ecological System of landscape (SES), such as dialogue, multiple perspectives, and networks of interacting activity systems. The collective nature–culture artifact can be observed through local network relations. Those relations are analyzed as a socio-culture and environmental discourse that reflects the multidimensional nature of a human community [5]. Following Engeström’s ideas, the human land occupation itself can be studied from the stance of local performativities and their environmental outcomes. For Tochimilco, human settlement interacts with natural and productive landscape, with water resources and biodiversity [6]. With this approach, the expansive contextual transformation framework informs the environmental education. In it, environmental design and planning goals and practices are based on the dialogue and collaboration embracing a wider horizon of possibilities of solution [8]. Thus, students are involved in constructing new, wider, and more complex goals for their own future professional practice [5] in the framework of bottom-up reflexive strategies of creation [3].

The framework of dialogue and collaboration invites different actors to participate in the process offering a context for sharing ideas and demands on a bottom-up functional and socially inclusive basis aiming at outcomes satisfying local needs. In the Tochimilco-project, the participants, besides students and teachers, were local stakeholders (parish, municipality administration, and a local rural guest-house), specialists (local architects, construction workers, specialist, and biologists) and local community members. In this so called co-configuration working context [7] students acquired professional knowledge and ethic stance informed by the local community, responding to its needs regarding the nature–culture and socio-nature demands. Thus, the community and its natural, productive,

and artificial landscapes were understood as a complex tissue of tangible and intangible conditions and as a human–environmental system forming a functional tissue that should be understood and respected [3].

Lewis [10] declares as a basic principle that all human landscapes have a cultural meaning. Thus, we can read the landscape as we might read a text. Lewis writes: “[w]e rarely think of landscape that way, and so the cultural record we have ‘written’ in the landscape is liable to be more truthful than most autobiographies because we are less self-conscious about how we describe ourselves” (p. 1). There is little insistence in the use own eyes and in thinking of what really appears and happens in front of them (p. 2).

Most of the academic bachelor and graduate programs in landscape architecture are covered by public universities like the Universidad Nacional Autónoma de México (UNAM), the Universidad Autónoma Metropolitana (UAM), Universidad Autónoma de Yucatán (UAY), and the Universidad Autónoma de San Luis Potosí (UASLP). According to Rojas Garrido [11] landscape studies are not new, the first course was offered by the National Architecture School at UNAM in 1964, but it was until 1985 that the program was offered with a bachelor’s degree separated from architecture studies.

For private universities, topics related to landscape architecture are available, as part of architectural design workshops, but rarely part of the formal curricula. For one side, Architectural discipline in Mexico, generally does not focus on landscape reading neither planning. This situation often takes place because the professional market seeks more architects experienced with construction, real estate, or rendering services. In other words, construction and architecture in Mexico have a short-term vision of scale and the territory, leaving aside the importance of training specialists in land management, spatial planning, or landscape architecture. On the other side, Rojas Garrido points out that landscape architecture in Mexico is intrinsically linked to urban planning; therefore, the biggest landscape projects are integrated with complex urban systems.

For Martínez Uriarte [12], few landscape architecture projects in Mexico are successful, recognized and maintained. Most of the projects failed because they depend on public budgets where the authorities’ vision do not seek for good quality neither long term. In addition, the democratization of public space, so necessary for good landscape architecture projects, will not be implemented meanwhile “keep of the grass” is the rule for every public space, recreational and natural areas.

In order to change the profession into a unitary-long-term vision with good-space quality, at Universidad de las Américas Puebla (UDLAP), we introduce landscape planning, reading and valorization to our design workshops to develop more congruent and holistic local projects.

To “read landscape” is to make cultural sense of ordinary things and elements surrounding us and constituting the environment of our everyday life (p. 3). In this sense, Lewis suggests axioms related to landscape symbolism as a clue to the culture in which the ordinary artifacts, spaces and landscapes provide a strong evidence of the kind of people occupying a place. They are evidences of who they are, who they were and, which is their process of becoming. Any local culture is imprinted in its landscape’s cosmology and cultural values. In this sense, architects and planners should have multidimensional tools at hand to be able to develop a sensible approach to vulnerable environments as that of Tochimilco, to understand the intimate correlation between people, their activities, and the surrounding landscape. Finally, Lewis suggests architects and urbanists to learn to ask simple questions: What does the landscape look like? How does it work? Is it created by nature, intervened by the human being, or totally transformed by her/him? Why? When?

3. Methods and Case Study

To develop Tochimilco as a case study, a phenomenological approach was selected based on the direct experience of the local people in describing the nature of the place in order to define its biocultural dimension. Thus studies of the local landscape and its physical and subjective features through phenomenology allows to discover local people’s

perspective and personal experiences through participative observation. On the other hand, Tochimilco as a case study fits as well based on data collection and analysis of locality's biophysical characteristics [13]. Therefore, this section describes also those biophysical conditions, besides the experiential field work done.

Thus, combining the transdisciplinary research work, experimentation and collaborations between project team members, architectural students and local community and stakeholders, the co-configuration work on the “barefoot” basis was established, following the guidelines of Engeström's Expansive learning method and the SES framework, described in this section.

3.1. The Case Study (Adopted Community)

Selecting and adopted community like Tochimilco as a case study, is useful for our Expansive learning and Bare-foot practices. The information presented in this section was the result of field-work with students, professionals and community that helped to get an holistic approach of the context. Without fieldwork and “walking” through the territory, would not be possible to develop good-project-strategies and proposals from students.

The history of Tochimilco, a rural community located on the lower part of the slopes of the Popocatepetl volcano (Figures 1 and 2), on the Central Plateau of Mexico, extends far away to the Mesoamerican past. During the pre-Hispanic times it was known by the name of Ocopetlyuca and its current location is not the original one as shortly after the Spanish conquest, with the establishment of the Franciscan monastery, the community was moved and re-established on its current site. In some descriptions of the 18th century, the village was called Tochimilco-Ocopetlyuca, “land of many flowers” distinguishing it as the principal center for the life of the surrounding Atlixco-valley [14]. Tochimilco alone is a Nahuatl language name consisting of the words “tochtli”, rabbit; “i”, a possessive pronoun expressing his or her; “milli”, reproduction, and “co”, in; meaning “the place where rabbits breed”([15] p. 15).

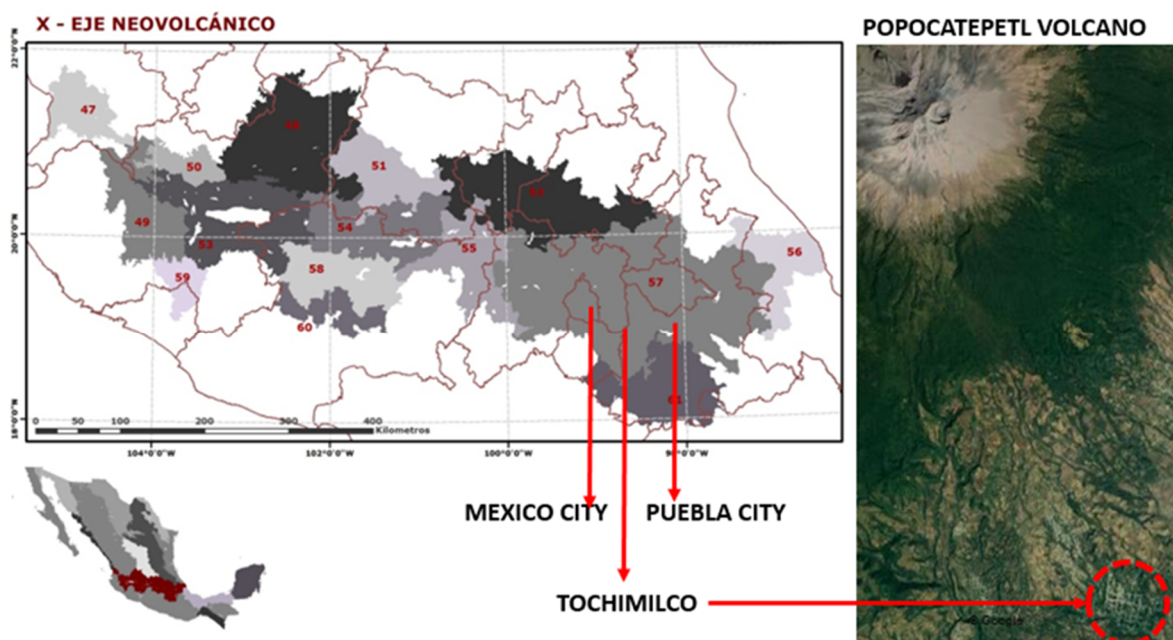


Figure 2. Location of Tochimilco in the Trans-Mexican Volcanic Belt and its physical relation with Popocatepetl volcano. Source: Adapted from Provincias y Subprovincias Geográficas de México INEGI, GoogleMaps, (2020).

From the very beginning, the community emerged due to the abundant water resources provided by the Popocatepetl volcano's glaciers. Local rivers, streams, and wells nurtured the first agricultural settlements and permitted them to grow and flourish. Water gave form to the landscape and vegetation, and further on to the built landscape of the

community as its urban structure was molded by the *apantle* (acequia or water-canal) network. Still today, this pre-Hispanic hydraulic infrastructure distributes fresh water to different parts of the town. The importance of water for the local culture and identity can be seen in the pre-Hispanic Tochimilcas' worship for Chalchiuhtlicue, Goddess of Rivers and Fountains, and for Tlaloc, God of Rain [16].

In addition to water, landscape and topography have been an important part of the local identity as three gullies, Matadero, Temascalac, and Amesaque, have been articulating the greenscape as a natural conduct of water and barrier against cold winds. In this context, by the year 1500 A.D. the pre-Hispanic caciques of Tochimilco were the absolute rulers of the water of the Atlixco-valley and the value of those pieces of land with avocado orchards irrigated by *apantle* (acequia) increased; those times these orchards produced three harvests a year [17] being avocado the greatest pride and identity element for the community.

Tochimilco is located on the altitude from 1800 to 2100 mamsl, with an average yearly temperature between 12 °C and 18 °C. The Figure 2, shows the location of Tochimilco, situated 49 km to the Northeast of the city of Puebla, the State capital, on the Northwestern edge of the Atlixco valley [18]. The municipality adjoins with the community of San Nicolás de los Ranchos in the North, the municipalities of Atzitzihuacán and Cohuecán in the South, the municipalities of Tianguismanalco and Atlixco in the East, and with the state of Morelos and the Popocatepetl-volcano in the West [19].

The region of the Mexican territory to which Tochimilco area belongs, is covered with temperate forest, the total extension of which is that of 32 million hectares. According to the Mexican Ministry for Environment and Natural Resources (SEMARNAT), 66% of this area corresponds to primary vegetation and 44% to the secondary one [20]. This kind of temperate forest is covering the great part of mountainous zones of Mexico with the altitude superior to 2000 mamsl. Those extensive woodlands are consisting mainly of pines, oaks or of the combination of the two and containing more than 50% of all the species of pine in the world and more than 150 species of oak (See: Figure 3) ([21,22], cited in [23] pp. 21–22). As a resume, these forests contain approximately 7000 species of vegetation, being 25% of all the flora of Mexico ([6,24]). In general, the most important ecosystemic services provided by these temperate forests are raw material for forestry, water, bioenergy, and genetic resources. They also regulate the climate, the erosion, the flows of water, and they filter environmental pollution ([25], cited in [6]), besides being important providers of a beneficial climate for the human wellbeing and for the agricultural production. Thus, these zones have been inhabited, cultivated and transformed during centuries by logging, cattle breeding and agriculture, forestry and intensive land use ([26,27], cited in [23] p. 24). In many parts of this region, the human activities have caused an ecological deterioration of the ecosystem, observable in deforestation, soil erosion and alterations to the biogeochemical cycles ([24,28] cited in [23] p. 24).



Figure 3. Collaborative stage and community-based approach. Source: M. Schumacher (2020).

The territory of Tochimilco belongs to the Trans-Mexican Volcanic Belt of active and inactive volcanoes forming the southern edge of the Mexican highlands, as it is shown in Figures 1 and 2. Most of this region has been formed by volcanism related to the subduction of small plates below the North American topography. One of the main characteristics of the area is multiple cones of volcanic ash, altitude of which varies between 1500 and 2500 mamsl ([22,29], cited in [23] p. 31).

In the central region of the Trans-Mexican Volcanic Belt, between the limits of the states of Mexico, Puebla, and Morelos, extends the Sierra Nevada-mountain chain, the altitude of which ranges from 3000 to 5450 mamsl with the Iztaccíhuatl and the Popocatepetl volcanos as its highest peaks ([22,30], cited in [23] p. 31). Iztaccíhuatl (5220 mamsl) is a volcano stratum that began to develop 900,000 years ago and its volcanic activity ceased in the late Pleistocene (80,000 years ago) meanwhile Popocatepetl (5450 mamsl) of a conical shape and located about 15 km south of Iztaccíhuatl, has had multiple moderate eruptions and small explosions during the last 1000 years causing local seismicity and emissions of ash ([22,30] cited in [23] pp. 31–32). Both volcanoes are united by the Aqualco plateau, in the place called Tlamacaxco, also known as Paso de Cortés ([23] p. 34).

The Neartic and Neotropical biogeographic zones converge in the Trans-Mexican Volcanic Belt (Figure 2), the intricate topography of which has given origin to a high ecosystemic diversity of flora, fauna, and fungi. In this so called Izta-Popo region, we can find the most important remnant of the ancient temperate forest of the central Mexico ([31], cited in [23]). The vegetation distribution here can be divided into three ecotones: mixed forest, pine forest (includes alpine grassland) and oyamel (*Abies religiosa*) forest ([24,30,31], cited in [23] pp. 34–35). Area's pine forests are mature, some of them in good conditions of conservation, others in the process of natural regeneration and some areas reforested. The decree of Protected Natural Areas (ANP) promulgated already in 1935, established the area of Iztaccíhuatl and Popocatepetl as a national park with its lower limit on the level curve of 3000 mamsl expropriating land tenure rights of 30 ejidos that once occupied these extensions of land ([6] pp. 35, 37).

The average amount of rain in Tochimilco varies from 800 to 1300 mms during the rainy season of summer. 69% of the municipality territory has a tempered sub-humid climate, meanwhile 24% of it has a semi-cold, sub-humid one. Only 5% of Tochimilco territory has a cold climate and 2% of it, a semi-hot sub-humid climate [32]. It is situated, thus, in the transitional zone between tempered and warm climates of the Atlixco valley [18].

In ancient times, Tochimilco might have been covered by above mentioned kind of dense forests that were later on cut down to get raw material for construction as well as to adapt land for agriculture. Though, still today it is possible to find original type of forest in sites with the most difficult topographic conditions. In the Southern and Southeastern extremes of Tochimilco territory, there are also reduced areas of deciduous trees and induced grasslands. Additionally, in the deep volcano foothills and the higher places in the North, it is possible to find oyameal (*Abies religiosa*) woodlands, as well as belts of pine trees and highland grasslands.

Due to its abundant water resources, 44% of the land is used for agriculture and only 3% of it is urbanized. The rest of it, 43% is covered by trees. Three percent of the land is arid and without vegetation and the last 3% can be considered as woodlands [32]. Regarding the soil, the dominating types are regosol, phaeozem, andosol, cambisol, fluvisol, and lithosol [18,19].

There is no doubt of the richness of the natural patrimony of Tochimilco; therefore, its vulnerability as an ecosystemn can be exposed and physically transformed due to the next factors:

- (a) Lack of environmental protection for its unique flora and fauna;
- (b) Socioeconomic & cultural changes due to local migration to USA and big Mexican cities,
- (c) Lack of accountability from local and State authorities to stop illegal loggers;
- (d) Abandonment of agricultural activities for urban work; and

(e) Pollution of water sources and productive rural soil.

Specially the last one, Tochimilco is rich in water resources, today is still managed by its local community. Thus, Tochimilco's blue treasure is in danger due to the water shortage in the city of Puebla, and the private concessions for fracking and mining that are looking for clean water sources all over the country.

3.2. Socio Ecological System of Landscape in Tochimilco

Bürgi and Gimmi [10] developed the concept of "Socio-Ecological System of the landscape" (SES) based on three objectives. First, the authors highlight the importance of preserving the cultural heritage of landscapes as the loss of traditional knowledge and agricultural techniques represent a deterioration of the world's cultural memory. Thus, landscape change studies require detailed information of human activities, especially of traditional agricultural techniques that have not been documented. Secondly, it is essential to understand the historical trajectories of the processes in the landscape through historical analysis. This will provide vital information about human activities and their patterns, and of the historical processes of the landscape. In order to be able to develop sustainable landscape and land management strategies and techniques, it is important to assess the intensity of human activities in the landscape. Finally, it is important to provide information for the future landscape management. A detailed history of the land use is essential to assess the potential impact and consequences of future land management regarding the relationship between human activities and the conservation and restoration of the landscape and its biodiversity. The preservation and restoration activities should not though aim at generating pristine ecosystems, but at the development of sustainable anthropogenic landscapes ([11] pp. 12–13). In these terms, the here presented concepts provide a framework for the analysis of the interaction and conditions of co-existence between the landscape, its biodiversity and the human community.

In the SES framework, the concept of "ecosystem services" established by Flint et al. [13] has several approaches from the ecological or anthropogenic point of view, considering the direct or indirect benefits that humans receive from ecosystems ([14] cited in [11] p. 21). From the socio-ecological point of view, the study of ecosystem services as providers of benefits promote conservation of landscapes and biodiversity through the improvement of land management and use ([13] cited in [11] p. 21). The focus point in the "Socio-Ecological System of landscape", SES, is the sensible and comprehensive human–nature relationship ([13] cited in [11] p. 21).

Constanza et al. ([15] cited in [11] p. 21) define this relationship as the flow of materials and energy that come from the natural landscape combining with the cultural one to promote human well-being. Thus, the "barefoot" landscape analysis through collaborative methods provides sustainable means for bottom-up planning strategies.

Communities like Tochimilco, have a collection of meanings and signs that represent the human–nature relationship and bio-cultural essence of place. Whichever environment is a text with a specific language that the transmitter and the receiver understand because of their shared sociocultural background. Thus, the environmental semiotics deals with the relationship between human community and its landscape [33]. Apropos these environmental messages and discourses, Humberto Eco (1987) mentions denotative signs transmitting functional meanings of a space or landscape, and connotative signs loaded with symbolic meanings of the context. Thus, environments conserve and transmit a historical memory important for the construction of the individual and collective identity [34]. Thus, adapting Eco's ideas, Table 1 exemplifies the socio-nature and nature–culture relationships observable in Tochimilco.

Table 1. Landscape interpretation applying Eco’s concepts. Source: A.K. Kurjenoja, (2020).

Tochimilco’s Landscape Interpretation			
Landscape Element	Landscape Type	Denotative Sign	Connotative Sign
Forest	Natural	Wood	Provider of complementary economic, health and food resources; collateral force that has to be understood to maintain a balanced co-existence between the human and the non-human environment.
Volcano	Natural	Mountain	Ancient divinity; danger; provider of wealth and health as the origin of water resources.
Topography	Natural	Hills, valleys, slopes and gorges	Conductors and concentrators of water as providers of health and prosperity.
Wells, Streams and Rivers	Natural	Water reservoirs	Provider of power and prosperity through their connection to the <i>apantle (acequia)</i> system; Tlaloc and Jesus Christ as local divine forces related to water.
White Willow (<i>Salix bonplandiana</i>)	Natural Wetlands	<i>Iztachuexotl</i> tree	Sacred city of Cholula, union between the moon and water (represented in the local 17th century coat of arms).
Forest Under-Growth	Natural	Plants	Health and healing; emergency source for complementary food.
Forest Under-Growth	Natural	<i>Ocopetlal</i> , ferns	Memory of the pre-columbine ceremonial use (represented in the local 17th century coat of arms).
Forest Under-Growth	Natural	Fungi	Emergency source for complementary food
<i>Apantle (Acequia)</i>	Built and Productive	Irrigation and distribution water for urban and agricultural uses	Memory of the past; right for the use of water; power and social hierarchy.
Avocado Orchard	Productive	Unproductive and abandoned lands	Symbol and memory of the local agricultural tradition; local icon.
Arable Land	Productive	Rural landscape	Soil as the source of fertility and continuity. Harmonious co-existence.
Chia	Productive	Traditional agricultural production: plants and methods	Cultural memory, co-existence with the nature, augmented family income achieved due to the type of plant cultivated.
Amaranth	Productive	Traditional agricultural production: plants and methods	Cultural memory, co-existence with the nature, augmented family income achieved due to the type of plant cultivated.
Corn, Beans and Squash	Productive	Traditional agricultural production: plants and methods	Cultural memory of the occupation of the pre-columbine method of “three sisters”, auto-consumption.

Krampen [35] on the other hand, establishes the concept of “ecological semiotics” to describe the reciprocal interrelation between human beings, their communities, and their environments. In it, he highlights the importance of understanding the ecological approach to meaning based on the mentioned reciprocity between different environmental actors. As Krampen points out, no organism exists without its environment, and thus it would be impossible to have an environment without the organism. In these terms multi-dimensionally focused environmental education for architectural students, the idea of the “barefoot” landscape and its construction can be introduced. Thus, the idea of understanding traditional and culturally sensible human environments as a discourse and a condensation of traditions and symbolisms could be promoted in order to create projects to respond the demands with sensibility not to trigger destructive sociocultural ruptures

negatively impacting the community structures and identities. As Zukin [36] confirms, the environment as a cultural context reinforces the social structure of a community. She points out the special sensibility of vernacular landscapes as social environments, describing them with the concept of Gottdiener [37] of “settlement space” as contexts in which lived experiences of communities are fused together with environmental meanings to make understandable the signs of a collective identity, as also observable in Table 1.

3.3. Barefoot Approach

In the community of Tochimilco, there is a long tradition of a sensible affinity between Indigenous people and the surrounding landscape. In it, cycles of rainy and dry seasons have been taken advantage of with a great respect, as also of the water resources, soil, and biodiversity, understanding their environmental role and the dependence of the human being of them. In addition to the functional aspects of this relationship, it also has had its symbolic dimension beyond the social or economic importance.

González Jácome ([38] p. 15, cited in [17] p. 792) points out how the inherited and ancestral systems of cultivation in Mexico are the evidence of their capacity to conserve their continuity and permanence. They are evidences of the ability to select adequate plant varieties, the high adaptability of their means and methods to the local conditions, and the use of agricultural practices as the result of continuous experimentation. In rural communities, the culture and the agriculture have been evolving simultaneously adapting themselves to the changing environment. This can be seen in the interconnection between the rainy season and the seedtime, how to manage the dry season, hailstorms, stormy winds, plagues, types of soil, management of fertilizers and tools, and responses, in the case of Tochimilco, to the dangers of volcanic eruptions (p. 792). Muñoz Máximo [5] points out that the inherited traditional systems of cultivating should be conserved and reinforced to resist pressures of industrialized agriculture, and its economic interests. Moreover, it is important to remember the forest and grassland landscapes surrounding communities as Tochimilco, as sources for complementary food and suppliers of natural ingredients for traditional practices of health, besides providers of construction materials and even locations for symbolic and identity elements as the ocopetlal ferns.

Thus, the landscape reading implemented by the Department of Architecture of UDLAP, proposed to study the different interdependencies between the human, social, cultural, and semiotic dimensions, and the natural and productive landscape. Professors, agreed with Marques et al. [39] to encourage students into community-building through “informed place-making in at least two ways: first, by providing depth and breadth for understanding the social, cultural, economic, environmental, and spatial dimensions that underlie space; and second, by formulating culturally sensitive intervention strategies that address the needs and desires of the community” (p. 12).

The project aimed at achieving a multidimensional sustainability in order to recover the local knowledge regarding the linkages between the community and the surrounding landscape and its resources and forces. To develop “barefoot” strategies on community-based work, the project was carried out in three stages implemented by one generation of students from 2018 to 2019: collaborative approach (research), new design criteria (analysis), and collaborative workshop project development).

3.3.1. STAGE 1—Collaborative Approach (Research)

This stage was focused on the conservation of landscapes and their biodiversity, paying attention to the strategies of land management and use that could give continuity to the ancient comprehensive human–nature relationship in which the natural and cultural landscapes are combined to provide human well-being. The following diagram in Figure 3 describes the community based collaborative approach of the architectural workshops carried out in Tochimilco.

Simultaneously to the collaborative stage, the collection of samples of plant species and fungi was continued followed by a wider field analysis of the municipality territory

in order to determine the variety of environments found in it. This work was done under the guidance of the local population as the community assigned a guide with a wide knowledge of the local landscape and of its elements to accompany the team during the fieldwork, which his wisdom and knowledge helped academics and students to understand the nature and vocation of the place [2]. During these studies and collection of plants, a great number of fern species were found. The variety of ferns (ocopetlal) present in the deciduous forest surrounding the community evidence their symbolic meaning imprinted also in the 17th century colonial coat of arms of the locality, as an element supposed of having had a ceremonial meaning in the pre-Hispanic and early colonial period [27].

3.3.2. STAGE 2—New Design Criteria (Analysis)

What we learnt about Tochimilco's features and practical educational exercises is the importance of integrating meaning and reality through the analysis of different uses and functions represented in Jan Gehl's [40] proposal of scales. In the interrelation between the primary user (life) and her/his sensible and sensorial connection to the human environment, the landscape and the biodiversity should play the central role in a new environmental project. For Gehl, it is essential to understand how the context works and the common life co-exists with other local elements.

Thus, new design criteria were needed to provide tools to incorporate multimodal environmental data through an approach that considers the key elements in the processes of the evolution of human–nonhuman relationalities. The Table 2 exemplifies the observed about these relationalities in the environment of Tochimilco through natural and productive landscape. In this table, interrelation between experiential and human–non-human collaboration is described as key elements of context analysis, environmental comprehension, local knowledge, stakeholder's analysis, and landscape recognition.

Table 2. Analysis of the socio-nature relationality in Tochimilco. Source: A.K. Kurjenoja (2020) inspired by Jan Gehl (2010).

Socio-Natural Relationality		
	Experiential	Human-Non-Human
Natural landscape	Maintenance of nature–human knowledge of wellbeing and health as the basis for human practices.	Understanding of environmental conditions and conditioners of life: climate, geomorphological conditions, water and soil.
Artificial landscape	Maintenance of traditional symbolism as a non-textual discourse and narrative of place,	Understanding of the functional juxtaposition of environmental and human elements forming a tissue of a comprehensive co-existence.
Productive landscape	Maintenance of inherited and ancestral systems of cultivation due to their capacity to conserve their continuity.	Understanding of the environmental importance of flexible and creative methods of appropriation of nature, adaptation of productive strategies to the environment and of the permanence of the high adaptability of their means and methods to the local natural conditions.

However, the understanding of rural world and the improvement of rural landscape conservation, was a true challenge for architectural students more familiar with urban and peri-urban realities. The comprehension of the landscape as an dynamic context of constantly active processes influencing the human life was a new concept for students accustomed to consider it as a mere passive background for architectural objects.

3.3.3. STAGE 3—Collaborative Workshop (Project Development)

After the initial workshop and analysis of the environment itself as the provider of favourable habitat conditions and ecosystem services [10], students explored how to give continuity to the rural community image and land through a design contest. The objective was to create sustainable facilities for an herbarium, seed bank, and bio-cultural ethnobotanical garden located in the extension of land belonging to the Finca Mariana y Marcos, the local rural guesthouse. The project was intentioned to trigger the preservation of local knowledge of traditional agriculture, land use, landscape observation, preservation of water resources, endemic vegetation and landscape, and research work of vernacular uses of plants for alimentation and practices of healing. The important condition here was also to understand the adaptability of new spaces to the terrain and its vegetation and to the local climate besides developing ideas for a sustainable use of local resources of materials provided by the landscape itself.

In the beginning of the project, students organized in teams, were taken to the municipality to recognize the area and its landscape, as well as to explore the local climatic conditions essential to consider in the design project. The other important aspect to take into consideration was the natural and sociocultural environment of the municipality. Likewise, students took advantage of their stay in Tochimilco to begin to interact with the community and to collect traditional knowledge about the different species of plants, environmental conditions and landscape construction traditions present in the region, followed by the process of developing design proposals of which the jury of academics, researchers and local stakeholders, selected finalists. Of these, after further development, the winner was chosen.

The students of the winner team had meetings with different specialists in earth construction and biologists in order to adjust the needs required for the materialization of the project in terms of the “barefoot” concept, in addition to complying with the adaptability to the Tochimilco community landscape (Figure 4).



Figure 4. Architectural students involved in different activities in Tochimilco. First the earth-construction and traditional techniques workshop in Finca Mariana y Marcos (local rural guest house) with Antonio Zepeda (Arch.). Second, adobe-block workshop and building of telluric-rural kitchen for first semester students. Third, acequia (apantle) water canals recognition with local guide Saul Ramos and community service students. Source: M. Schumacher (2018, 2019).

For all the students, the collaboration with key stakeholders like the municipal authorities of Tochimilco, the local parish, the Finca Mariana y Marcos owner (Figure 5), and local habitants was essential as representatives of the community, and as those who could narrate the realities and traditions of the local life. Through this interaction, a functional bond between the community, students, and the research team was established. Members of both the parish and the town council were enthusiastic about the project, since this would greatly promote the municipality in terms of sustainable development, recovery of cultural memory and conservation of biodiversity.



Figure 5. Vernacular architecture with avocado orchards at Finca Mariana y Marcos Tochimilco. Source: Antonio Zepeda Pérez (Arch.), (2019).

3.4. Observations Regarding “Barefoot” Implementation Strategies in Tochimilco

Working with students applying a critical perspective on local issues with “a simple, focused intervention (that) can create new energy, demonstrating the possibilities of a space in a way that motivates others to engage with their community. It can even contribute to the planning process” [41]. Without understanding the local context, the role of inhabitants, the key stakeholders, and the essence of place, no contemporary environmental intervention will overcome the challenges of the sustainable development of the Mexican rural world.

As it is shown in the Figure 6 in the context of “barefoot” landscape work in Tochimilco, based on expansive learning principles and community based projects, students learned collaborative design and work through contextual studies by a total immersion in the community. Thus, this work coincide with Marques et al. [39] that designers “must design with the goal of encouraging different and memorable experiences for all individuals, communities, organizations, and cultures that are deeply linked to the surrounding environment” (p. 12). The way of involving a group of students with professionals, technicians, and local community was part of a critical process that lead architectural and planning students to discover, analyze, and assume complexity between socio-spatial reality and project needs that are based for a good regenerative process [2]. This is not only a simple method, but an educational need focused on local perspective or “new localism” developed by Katz and Novak [42] who state that the local inclusion is multidimensional rather than a simple problem-solving process requiring “new norms of growth, governance, and finance” (p. 17). In addition, this locally focused practice should be aligned with a critical view for, “evaluating attitude towards reality, a questioning rather than acceptance of the world as it is [. . .] it leads to a position not only necessarily critical in the sense of negative criticism, but also critically exposing the positive possibilities of change, implying positions on what is wrong and needing change, but also on what is desirable and needs to be built on and fostered” ([43] p. 24).

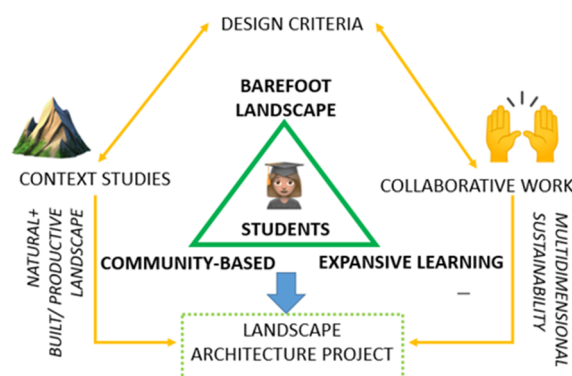


Figure 6. Framework for “barefoot” landscape for architecture students. Source: elaborated by M. Schumacher (2020).

4. Results and Discussion

For Mexican land policies, every community with more than 2500 inhabitants is considered urban [44], no matter if it still has agricultural activities or a strong rural identity. Thus, the presence of productive agricultural activities in a locality with more than 2500 inhabitants such as Tochimilco, makes of it a grey area in terms of protection policies of rural traditions and conservation of cultural and natural landscapes. When losing the status of a rural community, these localities are exposed to food-security policies based on industrialized, large agriculture, GMOs production, and finally, abandonment of the rural population.

Tochimilco’s rural landscape juxtaposed with its categorization as an “urban settlement” creates a complex reality regarding the recognition and protection of its tangible and intangible environmental values and the co-existence between its population, its rural identity, and the natural context surrounding it. As the basis for the further discussion justified by the results of the project described above, we would like to present the following statements.

4.1. First Statement: Architectural Education in Mexico Should Promote Environmental and Landscape Awareness among the Students in Order to Promote Multidimensional Sustainability, Especially When Working in Landscapes with Tangible or Intangible Natural, Cultural, or Historical Values

Without understanding the special human–nature environmental relationalities, no contemporary planning project will overcome the challenges between human–nature awareness of existing landscape values and economic interests in which “ [. . .] the paradigms on peri-urbanization where the market forces guide urban growth, development plans are short-term political visions and exclusive land policies segregate and disperse the social fabric” ([11] p. 170). The interaction between different actors giving form to the human environment make possible the creation of conscious and congruent projects sensible to the importance of the signifying elements that shape the human–nature territory [42]. For the architectural education, interventions in this kind of environments are an opportunity to trigger projects based on the “barefoot” methods adopting local vernacular knowledge as the framework for the project development. In this way students learn to understand connections and dependencies between nature and local culture, between urban settlements and complex ecosystems, and the landscape as a physical manifestation of tangible and intangible values.

4.2. Second Statement: In the Case of Mexico, Expansive Learning Model and Co-Configuration Strategies Involving Local Rural Communities as “Partner of Place” Opens up a Way to More Sensitized Planning and Design Solutions Regarding Multidimensional Environmental and Landscape Values

The expansive learning strategies can be associated with ideas of “New localism” and its critical perspective corresponding to different social design practices in the framework

of “regenerative design” and social urbanism, two methods that fit Mexico’s complex reality and Latin American cultural development [2]. In this framework, adding the role of designer as an important agent of change, regenerative design shares the idea that living systems have the capacity to co-evolve to new levels of diversity, complexity, creativity, and life. Co-configuration work in Expansive learning practice apply also the concept of Mang and Haggard [2] of “partners of place” as the framework for different regenerative principles leading to a strategic alliance between stakeholders and participants.

4.3. Third Statement: “New Localism” and “Partners of Place” Framework Applied through Expansive Learning Inspired by Critical Realism (Cr) in Architectural Education, Promotes Critical Attitude of Top-Down Public Policy Informed by Economic and Real Estate Interests Triggering the Destruction of Valuable Natural, Cultural, or Historical Landscapes in Mexican Rural Communities and Their Landscapes

Contemporary planning frequently emphasizes economic and technological efficiency ignoring the human condition, and narratives and meanings attached to it. For it, nature and landscape are considered as resources to nurture the economic and technological development, the stance that has contributed to the current ecological crisis of the planet. “Barefoot” strategies related to experiential learning, “New localism” and “partnership of place” reveal us a different path to follow in order to have a regenerative, transdisciplinary bottom-up understanding of the social, economic, and environmental context; to achieve a real, locally sensible, and conceptually wide sustainability as a vehicle to attend socio-human and culture-nature conditions in rural areas of Mexico [2,3]. The rupture with the utilitarian stance of landscape and community planning means for future professionals awareness to understand the impact and long-term consequences of architectural–urban development on a multi-dimensional human–nature environments.

We would like to present the following recommendations regarding Expansive learning and community based co-configuration work in the context of architectural education in Mexico, in the area of landscape conservation, community planning and rural–urban design:

- (1) Considering the vast nature–culture and human–nature values of Mexican landscapes, the architectural education in Mexico should sensitize students to be able to read and understand them in terms of a sustainable relationship between culture, traditions, and sustainable development. Indeed, certainly also the landscape architecture programs with this same focus should be more widely offered by public and private universities.
- (2) For the future landscape planning practices, it is important to consider training in the recognition of the bio-cultural essence of place, and of landscape narratives and vulnerabilities as part of the contents of architectural course plans and regenerative projects.
- (3) The adoption of methods such as expansive learning are favorable for connecting students, educational institutions, researchers, and local communities to carry out “barefoot” projects as key strategies to trigger professional awareness. Introduction of architectural students to the concept of landscape in Mexican rural areas should be based on an integral view including aspects from the bio-cultural landscape factors and ecological variants to urban image and semiotics to promote the idea of the need of holistic projects that harmoniously connect the landscape and conservation of biodiversity to the local culture and traditional knowledge about the use of natural resources reinforced by the recovery of memories and experiences about the harmonious coexistence with the nature. This opens up a possibility for a more sustainable development for rural communities of Mexico such as Tochimilco.

Through research and educational projects the promotion of the conservation of local agricultural traditions and ways of using arable land, water resources, and natural environment should be carried out, based on the sustainable coexistence between the human and the non-human, between the community, the landscape, the climate, the water, and the biodiversity.

5. Conclusions

In the Mexican architectural education, on one hand landscape is still frequently understood as a passive and static background for human activities. On the other hand, public policies and private planning privileged appropriation of rural lands and natural landscapes in the benefit of real estate development. Other issues such as commodification of traditional communities and experiential tourism is putting in danger localities like Tochimilco. In this context, the architectural education should adopt a more sensitized stance in understanding cultural and natural landscapes as providers of resources necessary for the human life, called ecosystem services [13–15], but in a co-responsibility framework, the human being is also responsible for preserving good conditions landscape's environment. This leads us to reconsider new approaches to teaching, learning and assessment in architectural practices to enhance learning skills in the framework of critical realism (CR), collaboration [36], regenerative development [2], and co-configuration [34] to prepare new generations of architects with the necessary competencies to understand and revalue the relationalities between culture, nature, and everyday practices in Mexican rural communities. The co-configuration tools permit them then to develop multidimensional and environmentally sensitized solutions to guarantee a more sustainable future for rural communities and their landscapes. The implementation of expansive learning and co-configuration practices in Tochimilco helped us to answer the research questions of this paper, as depicted below:

(I) What is the role of the architectural student when working with barefoot practices? Mexican rural communities are facing transformation processes and changes produced by the clash between complex networks of local cultural and social performativity, natural conditions, and external economic and political demands. Thus, future architects and urban planners should have a bio-cultural understanding of the environment as the origin for the human experiences of interaction with the landscape and of the relationship between human communities and their context as means of production of meaning. During their studies, architectural students should develop the necessary competences to be able to carry out professional practices sensitized to Mexican realities in which local people have a strong participation [2] promoting strategies based on the principle of “partnership of place”. Thus, the traditional planning system for natural and cultural landscape areas in Mexico can be critically analyzed, revised, and contested through visualizing the results and damages current planning policies have caused by the implementation of linear planning strategies without feedback loops [3]. When feedback and collaboration strategies are implemented, students as future professionals are able to recognize the vulnerability and local wisdom of indigenous and rural communities [39] as well as recognize their particular conditions and values as a framework for multidimensional sustainable design proposals.

(II) How expansive learning helps to sensitize students to vulnerable landscapes? In this project, the environment of the community has mainly been observed and studied from two stances: as a natural and a productive (rural) landscape. The two of them preserve human–nature and nature–culture values as the framework for a complex Socio-Ecological System of landscape (SES), potentially facing external economic and political pressures for their exploitation in the near future. However, observing the current expansion of urban development to rural areas, it may not be farfetched to consider that communities such as Tochimilco might be facing situations similar to other communities and villages neighboring growing metropolitan areas such as that of the city of Puebla. The existing urban development schemes have followed the patterns of traditional management of economic activities, combining the introduction of technologies and an intensive extraction of natural resources such as water. For many communities, these pressures on the use of natural resources have led to the deterioration of local landscape transforming it almost totally ([15] p. 45).

In Tochimilco, there is no planned management of forest resources and agriculture is practiced according to ancestral guidelines such as the rotation in the use of arable land in order to conserve the natural productivity of soil (p. 46). Tochimilco's weak planning mechanisms [45] and the general lack of political interest on different governmental levels

regarding the protection of vulnerable land uses, biodiversity, and landscapes, make the promotion of multidimensional environmental awareness among local and governmental stakeholders and planning and design professionals urgent. Thus, projects as the one presented in this paper, aims at promoting the multidimensional understanding of the traditional Mexican rural world in terms of a Socio-Ecological System of landscape (SES) among future professionals in architecture and urban planning, sensitizing them of the human–nature and nature–culture relationships between the human community and the landscape it occupies.

(III) What should architectural education do in order to promote landscape and environmental awareness among new generations of professionals? The “adoption” of a vulnerable landscape and its community is fundamental to integrate students to a holistic environmental learning process in which the “barefoot” bottom-up planning and design strategies on the Expansive learning basis are applied to conceptualization–designing processes. These projects give an opportunity to create and maintain a long term relationship between students, researchers, and the community in order study the local landscapes, to create new, locally sensible design and planning solutions, to measure the possible impact of their implementation, to have feedback and to trigger multidisciplinary and collaborative research work to benefit rural communities. Consequently, the understanding of different organizational levels—from the local to the regional—by students is fundamental to evaluate strategic partnerships among stakeholders because it integrates “society units, and the community in general to have a collective responsibility at local and territorial scale” ([13] p. 156).

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