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Decolonizing the training of engineers and scientists: the case of the Faculty of Physical Sciences and Mathematics at Universidad de Chile

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Abstract

Given current global crises, there is a need to move beyond the anthropocentric, reductionist and short-term vision of the world, imposed through the hegemony of Western culture. Are we still in time to change the prevailing hegemonic vision of the world and better address global crises and their local impacts? What is the role of intercultural higher education in this challenging task? We conceive this type of education for the training of future decision-makers, as well as scientists and technicians who must respond to current and future challenges in society. Therefore, we evaluate the contribution of the Indigenous Peoples Program (PPI) of the Faculty of Physical and Mathematical Sciences (FCFM) at Universidad de Chile (UCH). We conclude that the PPI opens up possibilities for intercultural training in the FCFM, which can contribute to changing the professional and scientific performance of its graduates, opening their minds to other cultures, worldviews, values and paradigms.

1. Introduction

From the birth of Chile as a republic in the 19th century to the present, the educational projects that have characterized the country have been homogenizing in nature. In its origins, the goal was to build the nation-state, while today the objective has been to be a competitive nation in the global, neoliberal world. In this regard, Chile is not an exception in Latin America, where the tendency to emulate what happens in so-called 'first world' countries has prevailed. Indeed, as early as the 16th century, a homogeneous education was promoted in Europe in order to build a national identity in the nascent nation-states, which was replicated by the European colonizers when they reached American lands.

In the same way, in more recent times, the growing neoliberalism and globalization, led by the United States of America and Great Britain, imposed in Latin America a new type of education. This education focused no longer on the collective objective of 'nation building', but on the objective of 'investing in human capital' for future, private profitability, where meritocracy – measured with standards similar to those of the 'developed world' – plays a fundamental role (Brunet-Icart & Moral-Martín, 2017).

While in the first type of education, the state educational institutions played an essential role, in the second type, private schools and universities assume an increasingly prominent role. However, in both cases, large sectors of the population have been marginalized, either because their peripheral relation to the system did not allow them to access education institutions under the same conditions as the rest of the population (Pinedo, 2011), or because topics relevant to their interest were not included in training programs.

Thus, in Chile, indigenous populations have seen their language, customs, worldview, techniques and forms of organization disappear, by adopting what the dominant culture has transmitted to them for centuries through education. Indeed, as indicated by Chica and Marín (2016), for Latin America in general, ancestral knowledge has been relegated to a secondary position, in favour of the dominant logic of the West.

When studying the case of the Mapuche ethnic group in Chile, Rodríguez-Garcés, Padilla-Fuentes and Suazo-Ruiz (2020:86) point out that:

in an educational system that privileges characteristics of status, class and ethnicity, Mapuche students face a double vulnerability. On the one hand, they must be integrated into a centralized and monocultural curriculum, where respect for indigenous values and knowledge is rhetorical and anecdotal; on the other hand, they must fight to discontinue historical gaps in the accumulation of human and cultural capital, where their families usually do not have the necessary resources to support school activities or to be part of an educational community of which they do not feel part.

In this way, indigenous peoples in Chile were left out of the educational system or were positioned in a disadvantageous way within it. Other conditions of marginality have intersected with their ethnic and racial positioning, leading to systemic, intersectional discrimination within the national educational system.

Indeed, the interests, culture and worldview of indigenous peoples were not considered important to the construction of the Latin American nation-state; on the contrary, they were far removed from the European ideals against which the republics were constituted. In the same way, at present, indigenous local interests, often opposed to global economic interests, are seen as an obstacle to the successful and competitive insertion of Latin American economies into international trade.

This situation has been exacerbated by the internationalization of higher education. This process was initiated in Europe by the Erasmus Program, created in 1987 for the exchange of students and professors from that continent. This was reinforced by the Bologna Declaration, signed in 1999 by several European countries to standardize curricula and facilitate the exchange to which the aforementioned program had given rise (De Wit & Hunter, 2015). These actions were emulated in the following years by countries in different parts of the world, including Chile, where several universities signed in 2003, the Declaration of Valparaíso to “initiate curricular changes that seek greater tuning with the model proposed by the Bologna Declaration” (Muga & Bruce, 2005: 171). This further reinforced the homogenization of curricula and the increased use of performance measurement metrics for the teaching-learning processes. This became more evident through the accreditation of undergraduate programs, postgraduate programs and higher education institutions in Chile; processes definitively institutionalized with the Higher Education Quality Assurance Law No. 20,129 and the consequent creation of the National Accreditation Commission in 2006.

Thus, two centuries of Western hegemonic culture in Latin America makes us wonder if, in addition to the unethical nature of discrimination itself, the current situation is desirable for those who, regardless of their ethnic origin, currently inhabit the American lands. The atomized and hierarchical conception of the Western world, with an absolute dominance of western man over nature, is opposed to a holistic and spiritual vision of the world, where relations of respect and reciprocity prevail, as in the case of indigenous peoples. This seems to have led us to the edge of an abyss: climate change, pandemics, inequities and violence. Are we in time to reverse this situation? Does training, particularly intercultural higher education, open up possibilities for a solution in this regard? In this paper, we investigate the experience of the Faculty of Physical and Mathematical Sciences (FCFM) at the Universidad de Chile (UCH).

We carry out a preliminary evaluation of the Indigenous Peoples Program (PPI) of the aforementioned faculty, by investigating its contribution to intercultural higher education in STEM education. This is based on qualitative methodologies, considering that we seek to know how participants in the PPI initiatives perceive and experience these initiatives; that is, how they interpret and signify these initiatives, for which the qualitative approach is suggested as the most pertinent (Hernández, Fernández & Baptista, 2014).

In what follows, we will first present a conceptual framework within which to situate the subsequent analysis in terms of the intercultural training that the program sought to promote. Second, we will detail our objectives and methodology, and then – thirdly – discuss the intercultural training experience of the FCFM through the different initiatives promoted by the PPI.

2. Intercultural training

According to the Dictionary of the Royal Spanish Academy¹, ‘training’ refers to the action and effect of acquiring intellectual, moral or professional preparation, while the term ‘intercultural’ is defined as concerning the relationship between cultures. It follows that ‘intercultural training’ is what prepares a person to interact with and across different cultures. However, beyond these apparently simple formal definitions, intercultural training, both in its conception and in its application, appears to be something much more complex and polysemic. In particular, the notion of ‘intercultural’ has been used in different ways and, in the Latin American context, it is used to refer to that which is ‘indigenous’. Likewise, it has been used with different objectives, either for vindication by some indigenous communities, or by Latin American States to incorporate these communities into their political-economic logic.

Santana (2015) refers to this issue in depth, starting with a quote from a Mapuche person: “Interculturality was achieved by us, the peoples, but now it is the discourse of the State” (Diez & Novaro, 2009 in Santana, 2015:100). Santana (2015) argues that interculturality should not only be understood as regarding indigenous matters. This is because nation-states should not use this concept to justify the participation of indigenous communities in public policies, and indigenous peoples should not see themselves as ‘intercultural’ within their own national population. In fact, in such cases, “interculturality becomes functional to the operating logic of the State, to the global policies of capitalism, and to the multilateral development organizations...” (Santana, 2015:100). Tubino (2011, in Santana, 2015: 100) discusses the difference between functional interculturalism and critical interculturalism:

Functional interculturalism seeks to promote intercultural dialogue without touching the causes of cultural and social injustice, critical interculturalism seeks to suppress them. For intercultural dialogue to be an event, it must be contextualized.

As Walsh (2009: n.p.) points out, interculturality – from a critical perspective – addresses the structural-colonial-racial matrix in which it develops. This matrix imposes a:

...racialized and hierarchical power, with whites and ‘whitewashed’ at the top, and indigenous and afro-descendant peoples at the bottom. From this position, interculturality is understood as a tool, as a process and project that is built from the people -and as a demand for subalternity-, in contrast to the functional one, which is exercised from above. It underpins and requires the transformation of structures, institutions and social relations, and the construction of different conditions of being, thinking, knowing, learning, feeling and living.

The contrast of these two types of ‘interculturalism’ takes us back to an old discussion in education. Simply put, what does the education system do? Does it reproduce or transform inequalities (Brunet-Icart & Moral-Martín, 2017)? In the intercultural field, we could ask ourselves: what does intercultural education do? Does it introduce indigenous students to the logic of formation of ‘human capital’ to reproduce the current world order, homogenizing their identities with the dominant culture? Or, does

¹ <https://dle.rae.es/> Accessed 27 March 2021.

it allow them to re-value their identities and cultures, empower themselves and combine knowledge for the benefit of the interests of their peoples? Undoubtedly, both options co-exist (Santana, 2015), but our preference is to get out of the fatalism of reproduction brought about by an immovable structure and promote the capacity for social action. As Fernández-Enguita (2011, in Brunet-Icart and Moral-Martín, 2017: 43) points out, “attention to social structure must be combined with attention to social action. Institutions constitute a *sui generis*² reality, different from the individuals that compose them, but they only come to life through them, which offers them the opportunity to mediate their purposes and effects”. It is within the framework of this commitment that the experience of the PPI arises, which is referred to in the following pages.

Certainly, the challenge is not insignificant, since as Castro-Gómez (2007; following Lander, 2000) points out, on the one hand, the modern Latin American university reproduces and reinforces the hegemonic perspectives of the North, so that knowledge is colonized and, consequently, it is fragmented into disciplines and structured into faculties. It is from this structure that knowledge is controlled; that is, it is defined which knowledge is legitimate and which is not (Castro-Gómez, 2007). On the other hand, following the ideas of Lyotard (1990) in Castro-Gómez (2007), the latter author points out that the postmodern university is no longer at the service of the State, but of transnational companies. In fact, “knowledge that is hegemonic is no longer produced by the university under the guidance of the State, but is produced by the market under the guidance of itself. As it is, the university ceases to be the control nucleus of knowledge...” (Castro-Gómez 2007: 299). In this way, both the modern and postmodern characteristics of the Latin American university make it difficult to decolonize it.

However, in the face of the aforementioned situation, new paradigms emerge within the academy (Capra, 1998; Capra & Luisi, 2014; Castro-Gómez, 2007), which promote complex systemic thinking and transdisciplinarity, which in turn promotes the interrelation of disciplines and the integration of knowledge. This allows, in turn, the ‘dialogue of knowledge’ expressed by Castro-Gómez (2007: 303), who argues that “while the first consequence of the paradigm of complex thinking would be the transdisciplinary flexibility of knowledge, the second would be the transculturation of knowledge”.

3. Questions and Objectives

Faced with the current global crises, which have put humanity as well as many other species at risk, there is a need to move beyond the anthropocentric, reductionist and short-term vision of the world imposed by Western hegemonic culture (Capra, 1998; Capra & Luisi, 2014). As stated above, we wonder if we still have time to overcome this hegemonic worldview and better address global crises and their local impacts, before the risk mentioned above turns into an irreversible disaster. In this challenging task, we specifically wonder about the role of training, particularly intercultural higher education. In this regard, we think that it is of utmost importance that this type of education should be conceived for the training of future decision makers, as well as scientists and technicians who must respond to current and future challenges of society, both on a global and local scale. For this reason,

² of its/his/her/their own kind, in a class by itself, therefore ‘unique’.

it is important to ask these questions within a faculty where engineers and scientists are trained who, as such, will have an enormous responsibility towards society.

Thus, a little over a year after the creation of the PPI, we set out to conduct a preliminary evaluation of the contribution of this program to intercultural higher education. Firstly, we analyse the subprograms developed within the PPI in terms of their contribution to interculturality, especially in relation to the development of an intercultural community and the re-evaluation of indigenous knowledge and identity. Secondly, we seek to identify the potential of this program to promote a higher education that offers a turning point to address the great challenges of today's world, by contributing to the critical thinking of students, and exposing them to the visions and values of indigenous cultures.

4. Methodology

The methodology used prioritizes qualitative research techniques, insomuch as it is about delving into a case study, rather than reaching general universal conclusions. It is not a question then of quantifying, but of “qualifying and describing the social phenomenon based on determining features, as they are perceived by the elements themselves that are within the studied situation” (Bernal Torres, 2006:57). For this, literature was reviewed and a theoretical framework was developed in order to contextualize the case study within a larger framework.

The instruments used to collect information were open-ended questionnaires, which were answered by participants in the PPI subprograms. These questionnaires included ‘teaching surveys’ that the UCH uses for all its students, and which contain open-ended questions allowing students to freely expand on the evaluated courses. Analysis of the information collected was carried out using content analysis techniques, in order to properly identify, systematize and interpret the relevant elements for the investigation (Andréu-Abela, 2002). These instruments were prepared and completed in Spanish, and responses were translated into English for this article.

The detail of the methodology used for the evaluation of each subprogram is explained later, in the section corresponding to the subprogram in question. There, reference will be made to the type of instrument used, its application and the number of responses received, as well as the topics addressed. However, the emphasis will be on qualitative analysis, and some of the representative responses from the various comments received from participants in the PPI initiatives are quoted.

5. The experience of the Faculty of Physical and Mathematical Sciences (FCFM) at UCH

5.1. Background

The study presented here has been conducted at the UCH. The UCH is an institution of higher education organized into faculties, and these in turn are organized into departments. However, more and more interdisciplinary centers and programs are emerging. The FCFM has twelve departments and ten ‘Centers’, in addition to a transdisciplinary teaching area (Transversal Studies in Humanities

for Engineering and Sciences, ETHICS), and the PPI. Likewise, although the UCH is immersed in a neoliberal economy, promoted for almost half a century by successive national governments, it is the largest public university in the country, and still values its role of service to society.

The FCFM, which has defined its mission as “the generation, development, integration and communication of knowledge in basic sciences, engineering, earth sciences, economics and management” (FCFM, 2021: 1), encompasses a community of students, professors and staff members with diverse origins, backgrounds and interests. Thus, over time, the community has organized around the common interests of some groups, recently highlighting a growing movement that emerged from a number of indigenous professors and students, which was gradually adding members of the community, both indigenous and non-indigenous, including a significant number of FCFM staff members. A particularly important milestone in this regard was the murder of Camilo Catrillanca, a Mapuche community member who was killed in a Chilean police attack in November 2018, which provoked outrage among members of the community (Bonney, 2018). After this event, the Dean pledged support for the formalization of indigenous representation, which resulted in the approval of the PPI in 2019 (FCFM, 2019).

The history of the indigenous movement within the faculty dates back to at least 2014 through recurrent academic and student practices. These include the following:

- Professional internships in Mapuche³ communities of the Araucanía Region, developed jointly by Departments of Electrical Engineering of the UCH and Universidad de la Frontera (UFRO)⁴.
- Thesis work on issues affecting the Mapuche communities in conjunction with the Faculty of Agronomic Sciences at the UCH and the Faculty of Engineering at the UFRO.
- Applied research projects in non-conventional renewable energies for Mapuche communities.
- Transversal training courses on indigenous issues, offered by the FCFM Humanities faculty.
- Workshops on Mapuzugun, the Mapuche language, organized by the Chillkatufe UChile Mew⁵ student group, with strong participation from FCFM students.
- Seminars, round tables and open lectures related to these topics.
- Public events, such as Wiñol Tripantu (indigenous New Year) and the international day of Indigenous Women, among other activities.

As noted above, in late 2018, the challenge arose to further systematize indigenous activities within the faculty, from which the idea of a formal program began to be developed, which called on those people who were already working on these issues, as well as others who felt challenged to do so. Thus, in May 2019, the Faculty Council approved the PPI, which proposed to systematically consider the

³ Mapuche means “people of the land”.

⁴ UFRO was created after the 1981 higher education reform, promoted by the then military dictatorship of Chile, which stripped Chilean public universities of their regional headquarters to create autonomous entities at the regional level. The UFRO arises from two regional headquarters, one from the UCH and the other from the Universidad Técnica del Estado. It is located in the Araucanía Region, where 33% of the population is recognized as Mapuche, according to the 2017 census (INE, 2018).

⁵ The Chillkatufe Uchile Mew group, established in 2015, was formed with the aim of bringing together a group of students who would work on Mapuche issues at the university level. It focused on different activities of a cultural and political nature, for the dissemination and strengthening of Mapuche cultural spaces, knowledge and practices at the UCH.

different dimensions of interculturality in the training of engineering and science students, as well as in the daily life of the university campus.

One of the first tasks of the PPI was to collaborate on the development of the Indigenous Policy of the UCH, which was approved in October 2019 by the University Senate, and entered into force in June 2020. It should be noted that this is the only university in Chile that has a policy of recognition and integration of indigenous culture and knowledge for the training of students and university life (UCH, 2019). This policy is an especially important milestone, as it provides institutional support from the hierarchy within the university environment. The PPI aimed to make the principles of this policy a reality.

In this way, the program received financial support from the faculty, with the political backing of the university. Thus, in 2020, special quotas were introduced to receive indigenous students entering the first year of the FCFM. Likewise, tutorships were implemented to build community, meet the newly enrolled students and support them in their new student life. Furthermore, indigenous community linkages were developed with the support of local institutions, and mechanisms were designed to attract students and professors to the development of undergraduate or postgraduate thesis work in the context of indigenous communities.

In addition, workshops were developed on topics of indigenous interest which, due to the COVID-19 pandemic, were carried out virtually and with high participation from outside the university. These included: workshops on the Mapuzugun language, political ecology and geological processes in the Mapuche worldview, and anthropology for approaching indigenous communities.

In summary, the PPI is constituted as a comprehensive and cross-cutting initiative, which covers four areas (see Figure 1) that aim to strengthen intercultural training, namely:

- Training courses in indigenous languages, politics and cultures of the multiple nations that (co)exist in Chile.
- Fieldwork with indigenous communities, through community professional internships.
- Thesis work to address challenges with indigenous communities.
- Dissemination and extension of the recognition of cultural and ethnic diversity in our faculty.

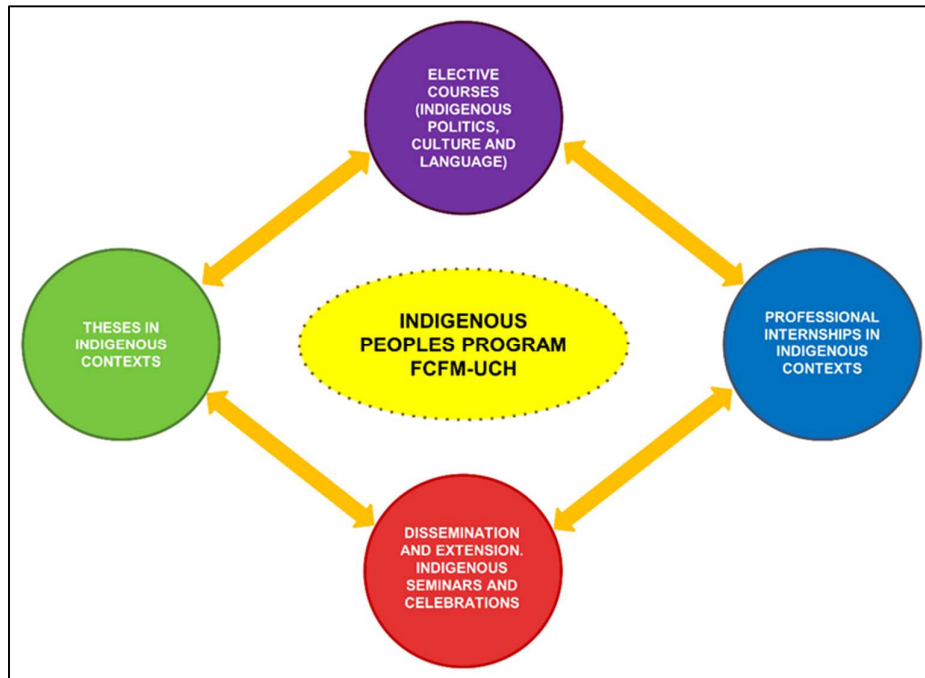


Figure 1: Areas of action within the PPI and their relationship (source: Authors).

5.2. Evaluation of the Indigenous Peoples Program (PPI)

When evaluating the PPI (comprising the four areas defined above in Figure 1), the following activities were considered:

- Tutorships for first-year indigenous students.
- Workshops on topics of indigenous interest.
- Courses on topics of indigenous interest.
- Professional internships in indigenous communities.
- Thesis work in indigenous communities.

As already explained, these experiences were qualitatively evaluated, through open-ended questionnaires that captured the opinion of participants, namely, university students but also the general public, in the case of the workshops. For now, it has not yet been possible to survey the communities with which we have worked in the professional internships or in the thesis work. Both of these are very important, but the context of the pandemic has made this kind of study difficult. As such, this remains intended future research.

5.2.1. Tutorship for first-year indigenous students

This activity was provided to all first-year, indigenous students in the faculty, which represent 32% of the total first year student cohort (22 of 68). At the end of the semester, a questionnaire was sent to these 22 students, and responses were received from 55% of them (12), of whom 75% of the respondents were from the Mapuche people and 25% from the Aymara people.

Based on the responses received, we can affirm that the tutorship achieved the desired objectives, which are: to support the insertion of indigenous students in the university community, to promote their educational experience, learn from their indigenous knowledge that comes from the territories, and foster their connection with university, artistic and / or cultural spaces from an inclusive perspective and appreciation of diversity. Indeed, the support and inclusion in student life is reflected in the statements of the students, who indicated that the tutors “are very inclusive and the tutors were very concerned”. In addition, the tutorship was very important in the context of the pandemic and the virtual classes: “the concern and support that they show towards us, served a lot to feel more comfortable in the online university environment”.

The most important elements collected regarding the opinions of the students, pertained to their encounters with identity and the concept of community. The first element is reflected in the participants’ interest in aspects of indigenous identity through participation in the workshops carried out by the PPI. In particular, their interest in learning the indigenous language is observed in the following statement: “the workshops were the best, in my opinion they should do a third basic course of Mapuzugun”. The second element is related to the sense of community characteristic of indigenous cultures in Latin America: “I liked that it is run in a concept of small groups with their own leader, it makes it more comfortable and gives more confidence”. This is a paradigm shift with respect to the Western vision, where the hierarchical and individualistic perspective predominates.

These elements open up the possibility of addressing, from an intercultural perspective, the insertion of students in the university world, through incorporation of relevant aspects of their own identity as part of the university’s training program, which allows for recognition of their culture and better adaptation to the university environment. This, together with academic aid, makes it possible to reduce the characteristic disadvantages of young people from rural backgrounds and/or indigenous peoples, as reflected in the following opinion: “I loved it, the support and dedication of the tutors were always there. Without the tutorship I would not have been able to get through this semester”. In other words, personalized academic support was considered key to enhancing adaptation to university life.

5.2.2. Workshops on topics of indigenous interest

For the following analysis, the evaluation – through open-ended questionnaires – of two workshops is considered: ‘Political Ecology’ and ‘Influences of Geological Processes in the Mapuche Worldview’, both given during the first semester of 2020.

5.2.2.1. Political Ecology

The interest in giving this workshop arose from the innumerable environmental conflicts that have developed throughout the history of Chile, but especially in recent decades, in the territories of indigenous peoples. The workshop considered the critical perspective of political ecology as especially adequate to understand such conflicts and provide tools to address them. Thus, as an objective, the workshop program proposed “to know the main concepts and scope of political ecology, an interdisciplinary framework dedicated to the study and approach of conflict around access and control of natural and common goods, by different socio-political agents”. Likewise, the workshop sought “to

apply these concepts to different areas in society and the economy in which environmental and territorial conflicts occur, and to analyse real cases”.

This workshop was attended by 87 people, including FCFM students and the public, 46 of them (53%) completing the evaluation survey. The workshop was delivered in 6 sessions of 90 minutes each.

Among the most valued aspects of this workshop, we highlight its critical examination of current developments and the alternative paradigms offered. In this regard, one participant stated that the content “without a doubt have contributed... a critical look at the development of technologies and ‘progress’”. This opinion is especially relevant in the context of the FCFM, in which it is important that its students and graduates, through a critical perspective on their profession, aim for a more comprehensive and conscious contribution to society, especially with regard to indigenous peoples.

Along the same lines, we can highlight the gratitude that the course professor received for “contributing to reflection on building a society under new paradigms, where society develops while respecting the limits of nature”. Finally, it is important that these issues are not only for indigenous peoples, but for the population in general, given that – as we stated earlier – western hegemonic culture affects all of us who inhabit American lands. This situation is revealed in the following comment: “for me it was an attribute that the course was given from the PPI, but in reality, the topics discussed are of direct effect on indigenous and non-indigenous communities”.

5.2.2.2. Influences of Geological Processes in the Mapuche Worldview

This workshop arose from an undergraduate thesis in Geology, developed by a Mapuche student, who agreed to share his knowledge through this workshop, with the intention of showing how natural phenomena (geological and meteorological) have influenced the worldview, way of life and cultural perceptions of the territory of the Mapuche people. The workshop was attended by 166 people, including both the internal and external community of the FCFM, of which 65 responded to the evaluation survey (39%). The workshop was developed in 4 sessions of 90 minutes each.

In relation to this workshop, it was appreciated that “we can learn, first hand, more of this rich worldview, in the special way that our brothers and sisters have of connecting with nature and in community”. It also attracted attention to how scientific knowledge could converge with the knowledge of the Mapuche people. Thus, it was noted that this workshop “contributes to new questions about the explanation and interpretation of events from the Mapuche world, contributes to scientific interest and Mapuche kimün [knowledge]”. Another person emphasized the contribution that this type of knowledge may make to the disciplines within the faculty: “these ‘divergent’ presentations are very useful to inform about a future where perhaps different edges in engineering and science are combined”. Another participant points out how important it is to have academic training, but at the same time continue to be connected to their origins, expressing the view that this workshop showed the Mapuche young “a way of being in the academy, but never leaving aside the tuwün [origin]”.

5.2.3. Courses on topics of indigenous interest

Evaluation of two types of courses is presented below: one directly related to indigenous issues and an engineering course that incorporates indigenous themes. The first course was on 'First American Nations', while the second was 'Introduction to Sustainable Systems in Engineering'. Evaluation of these courses was carried out on the basis of the teaching surveys that the students complete at the end of each semester. In particular, the open-ended questions included in the survey were analysed, where those who participate in the course can express themselves in their own words.

5.2.3.1. First American Nations

Since the second semester of 2016, the course 'First American Nations' has been taught, alternating each semester between the versions 'Mapuche Culture and Politics' and 'Andean Societies'. For the purposes of this study, all the teacher surveys received were reviewed, from the second semester of 2016 to the first semester of 2020 (382 surveys), with 95% responses received from a total population of 402 students.

The objective of the course is that students reflect on and understand how the 'indigenous subject' is constructed from certain paradigms. This approach to the course has been interesting for the students, which is reflected in the following opinion: "the topics covered are really interesting, [such as] the contrast between Inca history and how our perceptions of it are related to current postmodernity". It is important to highlight how this course allows students to acquire a conceptual and methodological tool to apply it to reality and the social context: "it has helped me to think in a more reflective and critical way, making me question the paradigms that have affected our society". In this way, they have access to different perspectives regarding indigenous issues, which allows them to elaborate their own opinion, as indicated in the following comment: "I really liked being able to know a different point of view on the conflict with the Mapuche people".

It is also interesting to note how this course impacts the students, as reflected in the comments at the end of the semester:

I feel that my way of seeing life changed, especially, considering other truths and that science is not everything. They train us as 'squares' in the common plan [in reference to the first stage of the studies] and it is difficult to put it aside to understand that there are other paradigms [...] And it also helps me to understand the reality in different societies (non-state, non-accumulation), something that I had not questioned, very useful for my life.

In this context, another comment points out that: "I feel that the impact this course had on me is tremendous; it was truly a subject that contributed to my instruction".

5.2.3.2. Introduction to Sustainable Systems in Engineering

This elective course in Chemical Engineering and Engineering in Biotechnology aims for:

The student to integrate the ecological and evolutionary bases that sustain human life and the environmental, social and economic implications of ancestral and modern human activities, to support an analysis of current engineering. The course seeks to develop a critical view of the sustainability of modern human activities and investigates initiatives that seek to provide a comprehensive response to environmental, social and economic problems.

This course includes a unit on 'Indigenous Peoples', the objective of which is to bring students closer to the main local cultures and their way of life, emphasizing their way of meeting basic needs, namely: food, water, housing and shelter. In this way, students have a basis for comparison to analyse modern processes that meet basic needs in the country.

In this course, 14 students from Chemical and Biotechnology Engineering participated, and all of them answered the teacher survey. From this, it is clear that the students received the unit on 'Indigenous Peoples' very well, as revealed by the comments collected. As such, the importance of knowing more about indigenous peoples, and how this can contribute to training is highlighted. In this context, it was noted that:

I believe it was one of the lessons I enjoyed the most [...] While I was studying, I was constantly impressed by their lifestyle and how they have managed to maintain it over the years. For this [...] I totally believe that it was a contribution to my training.

Along the same lines, another student said that:

Something that I had not internalized is the heritage and learning that we can have from our native peoples [...] I realized how undervalued these peoples and their knowledge are so that, in many cases, they themselves have had to put them aside to try to adapt and survive at the current rate, due to the effects we cause on an environment that is common to everyone. With the research I realized how little they had taught me about these people and their way of doing things, and I think it is something that should be taught since we are children, [...] with full capacity to open our minds to other ways of doing things.

Also, from a training point of view, especially highlighting the contribution that knowledge of indigenous peoples can make to engineering, it was argued that:

Another important learning was the study of indigenous peoples because, in general, not enough is taught [...], less in engineering, when in fact we could learn a lot about the relationship with nature, the management of resources and beliefs. It is important to recognize and learn from our past, to support ourselves and be inspired by solutions that have existed for more than thousands of years, instead of trying to create new things that are not in line with our environment.

In this regard, another student talked about the importance of recovering this knowledge:

It seems super important to me to know the cultures that precede us, to contrast the differences in the lifestyles and values of each one. It was in these lectures that I really reflected on how indigenous peoples [...] learned to use their environment to complete their needs and that is something that we have been losing. I think it's extremely important to recover it.

Likewise, from the field of engineering, the relevance of deeply understanding the way of life and worldview of these peoples is highlighted, so as to keep it present in professional decisions that may be made in the future, as expressed in the following comment:

One of the main contributions that I was able to identify [...] was being able to know and reflect on the worldview of indigenous peoples, since it allowed me to value their way of life and deepen my respect for their culture. I consider the above important, first, because there are various aspects of their way of life that can be incorporated into ours, especially at a spiritual and consciousness level, which represent an improvement in our relationship with nature and its flows. And second, because in the future as an engineer there is the possibility that my decisions affect this type of life, then knowing and evaluating them will allow me to take them into account when deciding on the development of the projects in which I embark.

5.2.4. Professional internships in indigenous communities

The objective of these internships is the integration of students into an indigenous community, with the interest of knowing their reality, opportunities and problems, and by listening to the community. Also, in conjunction with the community members and from their own professional training, the internships aim to analyse possible alternatives to address the problems identified, considering the aspects that are relevant for the community. Thus, students acquire community learning within cultural diversity.

During January and February 2020, eleven social internships were carried out with field visits to indigenous communities of the Araucanía region (southern Chile), and the Arica and Parinacota region (northern Chile), where students from Engineering, Electrical Engineering, Industrial Engineering and Geology participated. A questionnaire was developed to find out the opinion of these students after having completed their internship. Of those who answered the questionnaire (9 of 11), 33% declared that they felt they belonged to an indigenous group, specifically the Mapuche, and the remaining 67% indicated that they did not belong to indigenous peoples, which suggests that interest in indigenous issues is not exclusive to those who belong to these peoples.

In relation to the intercultural contribution of professional internships, one student points out: “the possibility of being able to know first hand the culture and way of life of the Mapuche people was (and continues to be) very enriching, both culturally and intellectually”. While regarding the relationship with the communities, another student states: “I liked the close relationship with people from both the academic world and the community members. In [...] the visit to the José Paineicura Hueñalihuen Mapuche community, [...] a pleasant welcome by the local people was sensed”. Regarding the learning obtained, one student points out:

The social internship was an opportunity to apply what is known, a fact that allowed us to criticize our teaching system. It also fostered the learning of new knowledge [...] Last, [...] it allowed us to get to know new sectors of Chile and new people/cultures, which allow for personal enrichment.

Another student refers to the impact it had on their personal training:

From the internship I really liked the possibility that it gives of being able to know an indigenous community, interact with people, become aware of the peoples, realize their needs and the risks they run. Being able to participate in the community's own ceremonies is also a very enriching experience for life.

This allows training of professionals with an awareness of the reality of indigenous peoples in some localities of the country, which also enriches their own participation in the customs of the community. Along the same lines, a student stated that they “[liked] the opportunities to know other realities and generate greater awareness with the indigenous communities and territories; I believe that it is important that we be conscious professionals with those who inhabit our environment”. In this regard, community internships open up the possibility of a new type of training for students, in which relationships of respect and reciprocity through this experience with indigenous communities provide learning and a vision of work, as well as a relationship with the environment different from that offered by western hegemonic culture.

5.2.5. Thesis work in the context of indigenous communities

The development of thesis work in indigenous communities is based on ‘Community-Based Learning’, by means of which the competencies that the student receives from their specialty in the relevant engineering or science area intermingle with knowledge of the community in which it is applied. In this way, at the time of writing this article, three undergraduate theses and two Master's theses were being carried out. These address topics ranging from food production from algae, energy-water management systems, use of irrigation water, to computational tools for learning Mapuzugun.

Clearly, community work motivates students and their interest. Furthermore, for some students, it is one of the first experiences of its kind in their program. This is reflected in comments like “the fact of facilitating direct work with communities allows to trace a path to think and develop engineering, which is tremendously valuable”; “being able to experience working with communities allows us to find a different dimension of work that is very rewarding”; “it feels that the thesis can have a benefit that improves people's lives. [...] There is experience in the development of something that can be used in a context and that is not something that only exists in a theoretical world”; and “it contributes, because there are no other instances like these in the career”.

In this way, these first experiences of thesis work have proved to be satisfactory, and are beginning to have the multiplier effect that was expected. Indeed, the number of students and professors interested in participating in this activity has increased and thus meets the aspirations of one of the participating students that is reflected in the following comment: “in this sense, I think the only suggestion I can make is to find a way to grow in order to expand to more students and communities”.

6. Conclusions and Discussion

The PPI, as an instance of intercultural training and spread, is a pioneer within UCH. Despite the recent implementation of most of its subprograms, we have sought to perform a qualitative evaluation of some of these subprograms. This study gives us a first impression of what has been the short journey of the PPI, with some indication in terms of its capacity to include a population historically marginalized from formal education and its capacity to offer training that is complementary to Western approaches. This complementary training seeks to address the challenges left by the domination of a hegemonic culture, one that violated nature and the peoples who lived in harmony with it, leaving behind environmental disasters, material poverty, cultural loss and spiritual emptiness.

In terms of inclusion, not only were special quotas adopted for students from different indigenous peoples, but also a subprogram of tutorship for first-year indigenous students was organized. The beneficiaries expressed feeling welcomed by the tutors (students of higher years) and effectively overcame possible academic gaps, since they had access to a supportive community and were able to reconnect with the identity of their native peoples.

Regarding training directly related to indigenous issues, the critical thinking of students was encouraged, and they were able to question the paradigms of Western culture through workshops and courses, and value those closer to their own cultures of origin. At the same time, they were able to appreciate how ancient wisdom could converge with scientific knowledge. In this way, they understood that opting for academic training does not imply forgetting their own origins but that, on the contrary, they can be revalued. Likewise, for the non-indigenous students, the training delivered through these programs allowed them to learn more deeply about the cultures of the native peoples and to respect them.

On a more professional level, students who were in advanced courses, or were completing professional internships, or their thesis work, especially valued the learning that could be obtained through knowledge of indigenous peoples. This allowed for understanding of the need for a relationship of respect with nature and among themselves, and the importance of recovering this wisdom for “more upright and humanistic” engineering and science, and “more conscious” professionals, who can make decisions more consistent with the reality of indigenous communities and their territories. In this way, the wisdom of these peoples is seen as a contribution to the respective professions, which benefits their performance in indigenous contexts, but also constitutes a contribution in other areas.

In accordance with the above, we can see that the PPI opens up avenues for intercultural training in the FCFM, which can contribute to changing the professional and scientific performance of its graduates. Indeed, through the PPI, they can open their minds to other cultures, worldviews, values and paradigms, in order to use their capacities to contribute to the construction of a more harmonious and respectful world for indigenous peoples and their environment. Certainly, this depends on the ability of these experiences to be maintained over time, strengthened and replicated, not only in the FCFM, but also in other university faculties and other higher education centers in the country and across the global South. In this regard, the approval and enforcement of the Indigenous Policy at UCH

is good news, as well as the announcement that there will be indigenous quotas in all its faculties as of the year 2021.

However, political will is required to maintain the program, and there needs to be an understanding that investing in an initiative like this is part of the medium and long-term solution to the crises that currently afflict society. We think that we still have time to train professionals and scientists that are more committed and prepared to tackle these challenges, but this requires strong institutional commitment.

Such commitment – in our case study – has been adequate for a first phase of the PPI. However, if we are to move towards decolonization of FCFM education, greater effort is necessary. To what extent do current curricula respond to the accreditation requirements of external Western agencies, and to what extent to the cultures that inhabit the different territories of the country? What are the spaces for intercultural training that escape rigid curriculum aimed at efficiently training ‘internationally-qualified’ professionals? How can we promote transdisciplinary and intercultural approaches more systematically and effectively, in an institution still predominantly organized by disciplines? Is there political will to support centers, programs and teaching areas that break with disciplinary schemes? Is there willingness to transform structures that make critical interculturalism possible, with new ways of relating to and knowing the world?

We leave these questions open simply to show the path that still remains regarding intercultural training and decolonization of curriculum and, indeed, to achieve a turning point in addressing the great challenges of today’s world. Critical thinking, the contribution to a systemic and intercultural vision, as well as internalization of the values of indigenous cultures over those belonging to an exhausted western culture, cannot be an experience for a few. On the contrary, such experience should be sustained by the political will of an institution and its authorities, to reach a critical mass that is capable of producing the changes that the world requires, both on a global and local scale. State universities that promote public interest should position themselves at the forefront of these changes and challenge the interests of westernized and commercialized education. In this regard, we highlight a university policy that has already been entered into force at UCH to advance the incorporation of indigenous peoples, their cultures and their languages, and we celebrate that the FCFM has approved the creation of the PPI, whose financing was assured for two years. But this remains only a beginning.

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