Introducing a transdisciplinary curriculum to foster student citizenship: a challenge beyond curricula reform

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Abstract: The article discusses the implementation of new curricula in the Engineering School of the Autonomous Metropolitan University of Mexico City, Campus Azcapotzalco. The curricula aim at fostering student citizenship, and at training transdisciplinary practices. First, the concepts of citizenship and transdisciplinarity are introduced and discussed, with an emphasis on Nicolescu’s concept of transdisciplinarity that emphasises the integration of formal, experiential and direct knowing. The article makes a plea for such integration in curricula so they become like rich ecologies incorporating various ways of knowing. Then, the implementation process is analysed, addressing resistance encountered and changes made, up to the final curricula acceptance. The article concludes that designing transdisciplinary curricula implies the introduction of a new paradigm that: 1) needs to be broadly discussed; 2) involves training of the academic staff; 3) asks seeing curricula in a real systemic way placing each course within the context of the broader whole.

Keywords: citizenship; transdisciplinarity; education; academic curricula development; UAM Mexico City; engineering and basic sciences.


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1 Introduction

Humans are not born citizens, but rather may become them. The process of building citizenship consists of the progressive construction of relationships between human beings and the political realm in which they live, and consist of creating lasting and meaningful relationships among citizens mutually (Isin, 2008). Educational institutions have a major task in building citizenship, from the primary school up to the university. The task is to teach students to see interconnectedness, assume responsibility and respond to emergence and rapid change in adequate ways. This is rather different from teaching fragmented bits of information and knowledge for a world that is supposed to remain unchanged. The academic world, however, is still characterised by an ongoing specialisation that leads to an exponential growth of highly atomised bits and pieces of knowledge (c.f., Mittelstrass, 2000) that thwarts a vision of a more autonomous human being capable of creating his own place in the world (UNDP, 2013).

Multi- and interdisciplinarity are approaches to solve the problem of specialisation and to a large extent they do. The multidisciplinary approach aims to transcend the limits of disciplines by studying an object of a determined discipline using the concepts of other disciplines (Volckmann, 2007). For example, an ancient work of art may be studied not only in the context of art history, but also within the contexts of history of religion, world history, or geometry. Studying problems applying a multidisciplinary perspective enriches our understanding through incorporating the knowledge coming from several disciplines (Nicolescu, 2008). However, it still falls short in teaching students how to be in contact with themselves, how to construct meaningful relationships and how to participate in the political realm, using a combination of their life experiences, knowledge and expertise. Interdisciplinarity has a different goal, and refers to the transfer of methods from one discipline to another. One example is the application of nuclear physics methods in medicine, which has led to the appearance of new cancer treatments (Nicolescu, 2008). Yet, for fostering citizenship interdisciplinarity equally still falls short.

Transdisciplinarity is different as it not only responds to the need to make connections between disciplines and specialisations, but also looks for a connection between scientific knowledge, life experiences, values and lay knowledge. Therefore, it potentially has the capacity to serve as a framework for building citizenship and stimulating social responsibility. That is why the engineering school in the Autonomous Metropolitan University of Mexico City (UAM) started in 2009 with the development of a transversal curriculum for all of its ten bachelor programs that initially was called the ‘transdisciplinary core’ (TC) of the new curricula. The aim was precisely to foster
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In this article, we present and analyse the implementation process of the new curricula in UAM and focus in particular on the question how the concept of transdisciplinarity was addressed. Before going into this analysis, we first present in a more theoretical way the concepts of citizenship and transdisciplinarity.

2 Building citizenship in a globalising world

Citizenship has to do with civil rights and responsibilities and is upheld by political institutions mediated by a judicial system. Generally speaking, the concept of citizenship covers three realms: the civic, the political and the social, while each element is associated with specific institutions. The civic concern is the application of justice and is related to legal institutions; the political is related to political decision-making and related institutions, and the social is related to education and social services and related institutions (Auvachez, 2007). The process of citizen formation involves teaching concepts of membership, rights, participation, and responsibility in social, political, and civil realms. Until now, the concept of citizenship is closely related to the nation-state and its central institutions (Isin, 2008).

The construction of citizenship, however, is dynamic and must respond to ever-new developments (Jenson, 2007). In the actual globalising world, the concept of citizenship must be adapted to the new configurations in development. Actually, established borders between nations, economies and cultures are changing while considerable segments of people move from one country to another (OCHA, 2013; UNHCR, 2013). This affects the nature of citizenship as well as its required forms of training and education. Migrants take their culture, religion and spirituality with them, thus contributing to societies that become more inter- and transcultural. The new world emerging in this process is interconnected in new forms that are ordered in ways that can best be described by Edgar Morin’s characterisation of complexity: paradoxical instead of organised through one guiding principle, dialogical instead of guided by one dominant logic and cyclical instead of guided by linear developments (Luengo, 2009; Morin, 1992; Morin et al., 2002). Or it can be described in the words of Bourdieu (1990) when he mentioned a life that does not anymore “constitute a whole, a coherent group which may and should be perceived as a unitary expression of a subjective and objective interaction”. A world consistent with the notions of Morin and Bourdieu is rooted in systemic notions of complexity and calls for citizenship that is global and intercultural, rather than national and mono-cultural. It involves teaching the ability of self-reflection and the capacity to continuously position oneself in a world of differences and diversity, of taking responsibility and commitment to collaborate in emerging teams rather than to meet the needs of fixed institutions.

3 Transdisciplinarity as a hybrid way of knowledge production

Transdisciplinary education potentially offers various possibilities for teaching contemporary forms of citizenship. Transdisciplinarity is about seeing interconnectedness
and building bridges among diverse cultures and disciplines. Even though a generally accepted definition of transdisciplinarity does not exist (Lawrence and Després, 2004.), the idea of combining disciplinary knowledge with non-disciplinary (non-scientific, non-academic) ways of knowing is common in all definitions of transdisciplinarity (Cicovacki, 2004). Two key interpretations or approaches can be distinguished:

- An approach that focuses on solving real life problems in participation and collaboration between academic and non-academic partners, such as the private sector, governments and NGO’s (Gibbons et al., 1994). For science, this involves a shift away from studying ‘problems formulated within the academic world’ towards finding answers for problems formulated outside of academia (Gibbons and Novotny, 2001).

- An approach that focuses on hybrid ways of knowledge production, complementing scientific knowing with knowing from outside of science such as lay knowledge, intuition or art. Within this approach two main orientations can be found. The first focus is on teambuilding and on capacities needed for working in transdisciplinary groups (Thompson-Klein, 2008; Stokols et al., 2008). This approach is applied in professional teams made up of academics and non-academics, each having complementary knowledge needed to solve a problem. A well-known example is found in medical care where nurses, technicians and medical experts work together to solve problems of particular patients (Kessel and Rosenfield, 2008). A second orientation focuses more in particular on restoring unity of knowing within individuals and groups. The approach, first laid out in the manifest of transdisciplinarity (Nicolescu, 2002) is based on a theoretical framework that has an ontological as well as an epistemological part (Nicolescu, 2008; Dieleman, 2013, 2015).

The UAM engineering school, and more in particular a team of research professors assigned with a review of the existing and development of new curricula, took Nicolescu’s approach of transdisciplinarity as the frame of reference. They made this choice as Nicolescu’s approach fits best to the expressed need to teach the ability of self-reflection and train students in applying various sources of knowledge in integrated ways. Because of that, it is important to briefly highlight some of the ontological assumptions of this approach as they have played a role in the acceptance of – and resistance to – the new curriculum within UAM. Central in Nicolescu’s approach is a critique on science – and the scientific worldview – for its claim that it can generate explanations and create solutions in all spheres of reality. He bases that criticism on the insights of contemporary physics and quantum physics in particular. Quantum physics shows that not all of reality functions according to the laws and basic concepts of classical science (like causality, gravity or the speed of light), as quantum entities behave in ways that cannot be explained by these laws and basic concepts. Nicolescu introduces the concept of levels of reality where each level works according to specific laws and basic concepts and where science can only be applied on one specific level of reality, mainly the level that deals with substance. Other levels, such as those of emotions, intuition, spirituality or symbolism should be understood using other-than-scientific ‘organs of perception’. Equally, and in contrast to what Galileo Galilei taught us while he established the axioms of classical science, matter is not only substance but should be seen as the complexus ‘substance-energy-space-time-information’. Nature is at once...
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Material as well as information as it is at once sensuous and consciousness. According to Nicolescu (2012, p.16), this is an obvious fact for all physicist of today and has major consequences for the way we need to look at the axioms of classical science as defined by Galilei, and has major consequences for the ways to know matter, nature and reality as a whole. Knowing the world involves using the complete potential of ways of knowing – on various levels of reality – that exists in between, among and beyond the scientific disciplines (hence: transdisciplinarity). It invites – in fact encourages, legitimises or even obliges – us to work with the whole human being accepting all forms of knowing and corresponding methods of generating knowledge as being equal and complementary: scientific, experiential and direct knowing using analysis, descriptions, emotions, intuition, symbols, metaphors, rituals and more.

Nicolescu makes a plea for the development of a transdisciplinary hermeneutics that integrates various forms of knowing but he does not provide a model or guide for working with such transdisciplinary hermeneutics. Others, like Doucet and Janssens (2011) pay more explicit attention to transdisciplinary ways of knowing and talk about hybrid forms of knowledge production complementing scientific knowing with creativity, aesthetics, ideology, politics and more. They do not make the explicit references to ontology as Nicolescu is doing but their proposal has noticeable similarities and can be seen as complementary to the work of Nicolescu. Thompson-Klein (2004, 2008, 2013), well known for her work on comparing various forms of multi-, inter- and transdisciplinarity, sees this orientation of seeing knowledge production as a hybrid endeavour, as one of the more recent and promising approaches in transdisciplinarity. Already in 2001, Nowotny et al. (2001) made a plea for this kind of transdisciplinary as it validates lay perspective and alternative knowledges (like indigenous or spiritual knowing) and breaks with the traditional view that only academic knowledge is real expertise and validated knowledge. Dieleman (2015) elaborates on the concept of transdisciplinary hermeneutics as a form of hybrid knowing in an article where he equally introduces the concept of ‘ecology of knowing’, a concept used in the next part of this article.

4 Teaching transdisciplinarity based on four forms of knowing

Before entering into the implementation process of the new curriculum at UAM, it is important to present a framework for hybrid knowledge production as it enables us to evaluate the design and implementation process of the new curriculum in UAM.

Such a framework for hybrid knowledge production and teaching transdisciplinary knowing can be created using three basic levels of reality and corresponding organs of perception: the level of formal knowledge, of experiential knowing and of direct knowing. These three levels together form a comprehensive whole and offer the possibility to create ecologies of knowing where each form of knowing nourishes the other thus creating a rich and diverse ecosystem of knowing. Creating such ecologies of knowing through the merging of the previous three mentioned forms may be considered as a fourth and highest form of knowing as it integrates the partial forms of knowing allows us to know beyond the parts in a real transdisciplinary way (Dieleman, 2015).

Formal knowledge consists of ‘codified’ knowledge found in books, articles, documents and databases. It contains knowledge in the form of what Nicolescu (2006)
calls “representations, descriptions, images or mathematical formalizations” and what Russel (1912) labelled as ‘knowledge by description’. It is indirect and mediated by concepts, theories and believes. Traditionally, this form of knowledge has taken a central place in university curricula and is often simply referred to as ‘knowledge’, thus distinguishing it from other key competencies as ‘skills’ and ‘attitude’ (and sometimes ‘aptitude’). It lies at the heart of the disciplinary – and equally multi/interdisciplinary – world of mental processes of knowing where analytical intelligence plays a major role and where knowledge is seen as objective or intersubjective, existing independent from the knowing subject. Teaching formal knowledge is realised through the traditional teaching forms applied in almost any university.

Experiential knowing is quite different as it is personal and therefore subjective, comparable to what Russel (1912) characterised as ‘knowledge by acquaintance’. Here, the subject has a much more direct and unmediated access to what is known. Experiential knowing does not refer to any specific category of knowledge but rather to particular processes of knowing, and more in particular to the ability to know as the result of using all life experiences that are stored in our mental maps. Instead of using analytical intelligence it is based on incorporated intelligence, seen as the accumulation of action-based experience over time. And instead of relying on logic, it is more oriented to the use of associative or lateral thinking, the capacity to compare entities (experiences) that do not necessarily have a logical connection. Experiential knowing should not be confused with tacit or embedded knowledge. Both are forms of know-how that may emerge out of processes of experiential knowing, and often they do, but they are certainly not the same.

Teaching this form of knowing can be realised in so-called ‘spaces of imagination and experimentation’ (Schön, 1983; Dieleman, 2013). Such spaces are organised around specific problems to be solved, but their aim is not to solve the problem in an arrow sense but to ‘engaging in the situation’ (Schön, 1983). This means connecting with the situation in multiple ways: emotionally, using all our senses, seeing the aesthetics and deficiencies in aesthetics of a situation, analysing its functionality and deficiencies in this respect and imagining alternatives taking all mentioned aspects in consideration. This offers the opportunity to escape the strict methodological rules science obliges us to work with, and allows us to connect as complete human beings with a problem or situation (Nicolescu, 2009).

It constitutes a major challenge for (traditional) educational institutions and their teachers, precisely because it is personal and methodologically open (Ertas, 2012). Yet, even though it is really challenging, it is important to teach this form of knowing/doing as it is an appropriate way to learn to see and experience connections and connectivity, and to engage in our work not only through the mind but as complete human beings. Experiential knowing is realised through that what Schön (1983) called ‘reflective action’ that is like engaging in a double dialogue, one with the situation to, and one with our inner self and more in particular with our mental map where all previous life experiences are stored in the form of a variety of images. Schön (1983) sometimes substituted the term ‘reflective action’ with ‘artful doing’ and indeed it looks like the way artists engage in a double dialogue when they create a work of art. It implies engaging in a situation in all possible forms incorporating all possible ways of knowing including symbolic and imaginative knowing, and invites students (and teachers) to rediscover the artist, artisan or craftsman inside of them.
The third category, direct knowing, refers to a form of knowing that cannot be understood in terms of the mind or incorporated intelligence as accumulated experience over time. It is insight that presents itself ‘just like that’ in ‘a flash’, while it is not based on conscientious and deliberate processes of thinking or calculating. Intuitive knowing is probably the best-known form of knowing that comes from within, during moments of revelation in which certain knowing presents itself. It is ‘in’-sight that we often get when we try ‘not to think’ and we ‘clear our mind’ instead of engaging inconscientious processes of thinking.

In various disciplines, such as economics or business administration, the importance of intuitive and direct knowing is widely recognised. Herbert Simon, who received a Nobel Price in economics for his work on bounded rationality, paid extensive attention to the importance of intuition in decision-making and developed a line of research on the use of intuition and heuristics that is relevant until today. Daniel Kahneman, a psychologist by training and equally a Nobel Laureate in economics, devoted his academic career to the difference between on the one hand intuitive and emotional thinking (that he calls fast thinking), and on the other hand deliberative and logical thinking (slow thinking). Kahneman explains how evasive intuitive thinking is and showed the importance of being aware of the great impact of intuition on our behaviour in all kinds of professional settings. Because of that, it is important to teach how to be aware and use direct knowing like intuition in our professional lives.

Teaching the importance of direct knowing, and especially how to be aware of it and use it, can be realised through various techniques that stimulate contact with our inner self. It involves practices such as meditation, yoga or martial arts, as well as practicing various artistic activities like creative writing, painting, dancing or acting, and may include mere physical activities as walking, hiking or running. These somatic exercises enable us to (re)-discover ourselves and to(re)-connect our body, mind and emotions.

In the end, and this is an important notion in the context of curriculum development, the real added value of distinguishing these forms of knowledge and knowing lies in the integrated application of them in specific situations or contexts (Nicolescu, 2011). It is here where personal ecologies of knowing are created that allow us to have a real rich and transdisciplinary understanding of the world. The creation of such personal ecologies of knowing (Dieleman, 2012) is considered to be the fourth form of knowledge generation. This can be realised on an individual – intra-personal – level and on a group – inter-personal – level, and both forms need specific mechanisms to realise the creation of such ecologies of knowing. On the individual level, the best way to integrate the three forms is in the spaces of imagination and experimentation previously mentioned. Such spaces first of all allow us to realise experiential knowing on various levels of reality, but offer all the possibilities to integrate the experiential knowing thus gained with formal knowledge and direct knowing. On the group level, the challenge is similar to the one of interdisciplinarity as it deals with integrating knowledge distributed among various team members that each possesses a part of the insights. Both the individual and the group level needs to be addressed in transdisciplinary curriculum design.
5 Introducing transdisciplinary education in the UAM-A engineering school

The Autonomous Metropolitan University (UAM) is one of Mexico’s largest and most significant public universities. Founded in 1974 to satisfy the higher educational needs of Mexico’s increasingly expanding capital, the UAM serves approximately 52,000 students, with 3,006 professors on five campuses, four of which are within Mexico City; a new campus is outside the capital. The UAM offers 72 bachelors programs, 54 masters, and 35 doctoral programs, coordinated by 15 academic divisions, three per campus (see: http://www.uam.mx).

The Division of Basic Sciences and Engineering at the Azcapotzalco Campus (DCBI-A) is located to the north of Mexico City and attends to 7,000 students within ten bachelors and five graduate programs. Its curricula include engineering-oriented disciplines approved by the Accrediting Council of Engineering Education in Mexico. Since its foundation in the 1970s, the UAM strove to construct an interdisciplinary curriculum, and the task of the professor-researcher was to unify teaching and research within an organisational structure that propitiates planned inter-campus resource use. Three stages were set out for all ten undergraduate plans of study:

- a common core in which students are presented with a multidisciplinary course program
- an academic core in which students study their principle discipline of study,
- areas of concentration consisting of specialisations with a strong interdisciplinary focus.

In 2009, the administration decided that, despite efforts and advances, the bachelors programs were not sufficiently updated in an integral manner. There was a need to adjust the curricular structure in order to centre the learning process on the students and to incorporate the concept of transdisciplinarity as the basis for a new educational model (Sordo-Zabay and Soto, 2012). The administration set out to change the educational operating policies so it could meet the objectives of more flexibility in the technologies (ITCs), sustainability, holistic training, ease of student transfer and use of information and communication technology.

In 2010, an exhaustive review of the curricula was realised by a commission of research-professors of the three divisions within the Azcapotzalco Campus (Basic Sciences and Engineering, Social Sciences and Humanities, and Sciences and Design Arts). The Coordinator of Psychological Support was invited to join the commission in order to explicitly address students’ needs and difficulties. The methodology the commission developed was as following. It first organised one general meeting in each of the three divisions, inviting all professors. A second meeting was organised in each division with professors who expressed interest in being part of the development of the new curricula, and with them the conceptual and pedagogical aspects of the proposed transdisciplinary program was extensively discussed. The subsequent step was to invite the professors to redesign their own courses (and/or propose new ones taking the elements of transdisciplinarity in consideration). In this process, professors were advised and trained in various aspects of the new approach and more in particular in the formulation of measurable learning goals that can be evaluated at the end of a course. In
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In this way, the new programs for the five branches mentioned in Figure 1 were developed. This procedure resulted in various moments of intense reflection, debate, and discussion, with professors involved in the writing of the new curricula, and with the academic community at large. Synthesising all the input thus gathered, the commission drew up a proposal for a new structure of the curriculum for all of the ten bachelors programs (Sordo-Zabay and Soto, 2012).

The proposal included the creation of a TC consisting of obligatory and optional courses related to social sciences, humanities, arts, and other areas that promote students’ holistic development (Cid-Reborido et al., 2012). This core has five different branches: citizen development, insertion in the labour market, arts and humanities, cultural studies and languages (see Figure 1). All of the courses were having some, direct or indirect, link with citizen development, while the branch of citizen development is totally dedicated to citizenship. Moreover, the five branches with their 29 courses form a base for the development of a teaching program fostering hybrid knowledge generation using multiple forms of knowing.

Figure 1  TC with its branches and optional courses (see online version for colours)

Source: Sordo-Zabay and Soto (2012)
<table>
<thead>
<tr>
<th>Objectives</th>
<th>Teaching methods</th>
<th>Grading methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human rights</strong></td>
<td>• Workshop</td>
<td>• Two evaluations 40%</td>
</tr>
<tr>
<td>• Identify the importance of human rights in protecting citizens’ life and integrity.</td>
<td>• Presentation in conference</td>
<td>• Group presentation in student conference 40%</td>
</tr>
<tr>
<td>• Describe the Mexican and international institutional framework for human rights protection.</td>
<td>• Use of virtual classroom</td>
<td>• Group presentation 20%</td>
</tr>
<tr>
<td>• Analyse in writing a case of human rights violation and intervention by NGOs and/or other institutions.</td>
<td>• Students, with professor support, review and analyse at least one technical, scientific, or outreach text written in English.</td>
<td></td>
</tr>
<tr>
<td>• Prepare an oral and written defence of one’s own ethical position on human rights in Mexico, including proposals for citizen intervention.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>World economics</strong></td>
<td>• Presentation by professor and seminar with active student participation</td>
<td>• Summaries of readings 10%</td>
</tr>
<tr>
<td>• Identify main economic theories that explain contemporary development of the global economy and their effects on the Mexican economy.</td>
<td>• Students, with professor support, review and analyse at least one technical, scientific, or outreach text written in English.</td>
<td>• Three evaluations 60%</td>
</tr>
<tr>
<td>• Explain the world economic structure and its agents or institutions.</td>
<td></td>
<td>• Final evaluation 30%</td>
</tr>
<tr>
<td>• Identify the situation of the Mexican economy and society as affected by global agents and institutions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ethics and values</strong></td>
<td>• Dialogue and reflection</td>
<td>• Reading of book and essay 40%</td>
</tr>
<tr>
<td>• Identify the values and ethics related to personal and professional decision-making.</td>
<td>• Case studies to reflect, question, and engage in dialogue on an individual and group basis.</td>
<td>• Group essay 40%</td>
</tr>
<tr>
<td>• Revision and analysis of at least one English text</td>
<td>• Review of two films as homework 10%</td>
<td>• Participation 10%</td>
</tr>
<tr>
<td><strong>Organisational social responsibility</strong></td>
<td>• Use of virtual classroom</td>
<td>• Review of two films as homework 10%</td>
</tr>
<tr>
<td>• Establish the relationship between ethics and business management.</td>
<td>• Individual class presentations</td>
<td></td>
</tr>
<tr>
<td>• Determine the limits of action for social responsibility.</td>
<td>• Group discussions and dialogues</td>
<td></td>
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<tr>
<td>• Differentiate the application of business’ social responsibility in European, Latin American, and Mexican contexts.</td>
<td>• Group conclusions on each topic</td>
<td></td>
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<tr>
<td>• Individual essay and report</td>
<td>• Summaries of readings</td>
<td></td>
</tr>
<tr>
<td>• Summaries of readings</td>
<td>• Presentation in conference</td>
<td></td>
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<tr>
<td>• Final group project (five members)</td>
<td>• Final group project</td>
<td></td>
</tr>
<tr>
<td>• Revision and analysis of at least one English text</td>
<td>• Make up work not allowed</td>
<td></td>
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</tbody>
</table>

Table 1: Didactic elements of the four currently offered courses of the citizen development branch.
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The human rights course invites students to draw up an oral and written defence of their own ethical position regarding human rights in Mexico, and possible ways of citizen intervention (see Table 1). In this way, an explicit link with the students’ mental map is encouraged thus stimulating experiential knowing. The ethics and values course identifies the values and ethics related to personal and professional decision-making. Its teaching methods are largely based on dialogue and reflection on both individual as well as group basis, again aiming at stimulating the use of the mental map. The languages branch includes, next to learning a second language (mainly English), various courses aiming at the creative capacities of the students, such as a course in creative writing and a course including the use of symbolic logic. It equally has a course on oral expression stimulating skills in relationship with exploring one’s self.

On the level of formal knowledge explicit attention is paid to citizenship in a globalising world. The world economics course explains the world economic structure and its main institutions, and explores the situation of the Mexican economy and society as affected by global agents and institutions. The course on organisational social responsibility equally pays attention to global relationships and differentiates between the concepts and application of social responsibility in the European, Latin American and Mexican context. Finally, the level of direct knowing is addressed through the arts and humanities courses that stimulate students to work with other than analytical skills and to explore the world through artistic expressions and actions in the workshops for drawing, photography and theatre. This offers the students the possibility to work on various levels of reality, including the imaginary, creative, symbolic and embodied forms of knowing.

No plan was developed however to integrate the various forms of knowing in an ecology of knowing or system where each course is in some way interacting with the others, creating emergent properties and generating feedback and feed-forward loops between the elements (courses) of the system. The five branches of the TC together may be seen in this way, but during the design process in UAM it was not.

6 Resistance to, changes in and implementation of the new curriculum

After completing the proposal, it was presented in its final form to the academic community in a number of sessions for all sectors of the community: students, professors and the administrative staff. Even though various professors had been involved in the design of the proposal, the TC received quite some criticism and resistance, especially from the side of the professors that did not participate in the design process. The critique can be divided in four areas:

1. the content of proposed changes
2. the implementation process
3. the context
4. the way the program was developed and proposed.

We will address all these three aspects in the following evaluation, aiming to show an interesting configuration of critique among the four areas.

The first type or area of critique addressed the content of the program, and addressed in particular the interpretation of transdisciplinarity as developed by Nicolescu. His view
on transdisciplinarity, with the notions of levels of reality and the relative importance of science in knowing the whole of reality, provoked strong reactions. Accepting the proposal for the new TC implied an implicit way, the acceptance of this rather fundamental paradigm shift regarding science. Many professors expressed sincere objections to this even though they were not necessarily against the epistemological principle of hybrid knowledge production.

The second area or type of critique was equally strong and addressed the pretentious nature of the new curriculum. It proposes new courses throughout the whole of all the undergraduate studies. On top of that, it proposes the implementation of new teaching methods of which some were alien to the standard practices of the professors. This was especially true for the courses outside of the realm of formal knowledge such as the arts related courses and those introducing new teaching methods as problem-based learning and the use of case studies. Various professors looked at the realisation of this ambitious plan as unrealistic given the limited availability of human and material resources on campus.

The third type of critique, context-based, was not explicitly expressed during the meetings, but proved to be very important. It had to do with leaving the comfort-zone that most of the teaching staff was accustomed to. Transdisciplinarity obliges us to work outside of the mere cognitive and analytical, and outside of clearly defined project descriptions safely away from emotions, intuition and societal or political discussions. Most academics choose to work in academia because they feel comfortable with their work. They do not want to work outside of the mere analytical with fundamentally different schemes of knowledge production and may – intuitively – feel that they would not be able to do that. Expressing incapacity however is not a part of the culture in most universities, as in UAM, so this aspect is usually hidden even though it is a powerful reason to not accept transdisciplinarity. The resistance to the new curriculum was stronger as a comprehensive vision behind the proposed curriculum was missing. This made it more difficult to explain why certain courses (like for instance, creative writing or theatre) needed to have such an important place in the new curricula.

It must be said that the critique has its merit. Changing towards a transdisciplinary way of working indeed implies a shift in the appreciation of science as a system of knowledge generating, teaching, creating solutions for problems and eventually: truth. Introducing transdisciplinary curricula is more than ‘changing curricula’ as it implies a shift in the way of seeing the essence of a university as an institution of knowledge production and teaching. This aspect should not be underestimated and must be discussed at length with all involved sectors of a university or schools before decisions on curricula reform are taken. Equally, such a reform indeed does have a major impact on the teaching staff. The key to successful educational reforms always will be found in the collaboration of the main responsible actors of education, the teaching staff. This is even more important in reforms to transdisciplinary ways of working as the impact on the teachers is more profound. Transforming people however – and one may want to add: especially professors – is a process that requires attention and effort over longer periods of time. As Muhar et al. (2013) concluded after analysing their transdisciplinary doctoral programs, it is necessary to provide training for teachers and supervisors on principles and practices of transdisciplinarity, in the form of formal training arrangements as well as in the form of creating an informal culture that stimulates transdisciplinarity. Curricula reform towards transdisciplinary curricula in the end implies a cultural shift that by nature is a long term process.
The fourth and final type of critique concerns the process in which the new curricula were developed and proposed. Critique on this process was rather absent. The UAM has a long tradition of working with committees of professors that together develop proposals for change, and most persons involved in this particular process were accustomed with that tradition. The many meetings in which all were invited to participate were regarded as a positive aspect of this particular process. Yet, the engineering school lacks a culture of evaluating proposals on a conceptual or paradigmatic level, and professors usually evaluate them with the question in mind: what does it mean for me? This lack of conceptual/paradigmatic orientation affected the process of the development of the TC. The committee did not explicitly addressed the paradigmatic aspects of Nicolescu’s approach to transdisciplinarity, and failed to show the relevance of Nicolescu’s approach in the context of the need to foster citizenship. From the side of the academic community, critique was expressed but not really on a conceptual/paradigmatic level.

Illustrative for this is that the commission decided to respond to the critique by changing the name ‘TC’ into ‘multi- and interdisciplinary core’, thus taking away resistance that was provoked by the word ‘trans’ and especially the interpretation of transdisciplinarity by Nicolescu. But in doing so, they did not change the content of the proposal. What was changed was that various optional courses proposed by individual professors were added even though these were outside of the domain of transdisciplinarity and did not contribute much to the overall goal of fostering student citizenship through transdisciplinary education.

With these changes, the new curriculum was accepted in 2013 and is currently in a process of implementation. In 2014, 18 out of the 24 courses are being developed and offered in various stages of all bachelor programs. In the branch of citizen development, this concerns four courses out of the programmed total of 6: ‘human rights’, ‘world economics’, ‘ethics and values’ and ‘organisational social responsibility’. Within the branch of ‘insertion to the labour market’, 2 out of the 5 programmed courses are currently offered: ‘Tools for the business person’ as well as ‘labour insertion’. Within the branch of arts and humanities, all four courses are developed: ‘art history’, ‘drawing workshop’, ‘photography workshop’ and ‘theatre workshop’. The language branch offers 4 of the 5 programmed courses, only missing the course: ‘reasoning and symbolic language’. Cultural studies finally are fully operational and offer all of the programmed courses.

The process is on its way but, as mentioned before, the results in the long run depend on the willingness and capacities of the teaching staff to collaborate and adapt themselves to new teaching methods and principles. In Mexico, the concept of ‘Libertad de Cátedra’ or the liberty of the chair a professor holds is very important and cannot be limited for any reason. The curricula reform therefore must be seen as a long term process including – in this particular case – ongoing dialogues on the concepts of transdisciplinarity and citizenship as well as ongoing dialogues on the way the new curricula are realising the teaching objectives. It looks to be inevitable to add to the introduction of the new curricula a system of continuous reflection and improvement addressing the concept of transdisciplinarity on a conceptual and paradigmatic level, the coherence of the curricula as a dynamic system and the capacities and willingness of the teaching staff to contribute to the curricula and the underlying teaching objectives.
7 Conclusions and recommendations

In this article, we revised the design and implementation process of a new transdisciplinary curriculum in the UAM Engineering School in Mexico City. The curriculum was designed to contribute to citizenship, self-reflection, seeing connectivity and being able to work in emerging teams taking responsibility and showing creativity. We first presented the concept of citizenship and then discussed transdisciplinarity. We conceptualised transdisciplinarity as a form of hybrid knowledge production integrating complementary forms of knowledge, noticeably formal knowledge, experiential knowing and direct knowing. We then presented and analysed the design and implementation process, leading to the following conclusions and recommendations, which go beyond the specific experiences in UAM and have relevance for (transdisciplinary) curricula reform in all universities.

First, when transdisciplinarity is seen as the integration of scientific research with forms of knowledge generation outside of science (lay perspectives, indigenous knowledge, experiential knowing, direct knowing, art or more) it is important to develop one’s own vision on transdisciplinarity before starting the design and implementation process of new curricula. These curricula should be seen as heterogeneous yet comprehensive systems and as living and dynamic ecologies where each form of knowing nourishes the other. It is recommendable to use certain tools and methodologies that are capable of assessing the contribution of the total of a curriculum to the formulated teaching objectives set out, tools that currently exist in the field of sustainability. In UAM, this was not realised and it did complicate both the design as well as the implementation process of the new curriculum.

Secondly, when transdisciplinarity is seen as mentioned above, teaching transdisciplinary ways of knowing implies rather fundamental changes in the use of teaching methods and principles, and seriously affects the teacher-student relationships. It asks for extensive training of the teaching staff and the creation of an informal culture that stimulates transdisciplinarity. Thirdly, transdisciplinarity, in any of its interpretations, emphasises the relative importance of science and involves a paradigm shift that will not be immediately or easily acceptable for the academic community that is supposed to work with the new curricula. The concept of transdisciplinarity (and its various interpretations) should be discussed at length with involved sectors and actors before decisions on curricula reform are taken.

We like to finish with the following hypothesis concerning the introduction of transdisciplinary curricula in universities. The hypothesis is that it involves a challenge in two distinct ways. First, it asks for the development of curricula as heterogeneous yet comprehensive ecologies of knowing beyond the mere aggregation of courses around certain areas of study. Secondly, it proposes a challenge beyond the mere introduction of new curricula, especially when this affects the culture of the university and the ontological and epistemological fundamentals on which it is constructed. Further research is needed to verify or falsify this hypothesis.
Introducing a transdisciplinary curriculum to foster student citizenship

References


