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ECOLOGICAL ETHICS: TOWARDS AN EDUCATION OF TECHNO-DIVERSITY

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ABSTRACT
The sustainable development is a big challenge for the end of the century due to earth evolution linked with anthropic activities: climate change, resources depletion, health stakes and related problems will change the way we live. Engineering design activities will have to evolve to address in a different way human's needs and also new kinds of needs. The ability to change design practices will depend on the way to think the relationship between human and nature. Ethics has a specific place for that. The proposed paper deals with ecological ethics and discuss the way it can be addressed concerning technology and the way it can be taught in terms of pedagogical methods.
A first part discusses the concept of ecological ethics and proposes to avoid environmental ethics but develop an ethics of the environment. This position enables to defend to transfer the biodiversity characteristic to techno-diversity one in order to ensure adaptation and resilience, future will require for being able to keep health, comfort levels within environmental constraints. The requirement of a pragmatic approach of ethics and ecology is highlighted to be able to face and be conscious of diversity of situations. Then, a discussion on pedagogy of ecological ethics is done and shows how the link must be built with society, into pedagogical activities.

Keywords: Ecological ethics, techno-diversity, pedagogy, engineering design, technology

1 INTRODUCTION
Educators and institutions have been creating, selecting, modifying, and adapting their methods and tools to fulfil their students' needs since education began. Such process is different from institution to institution and even from educator to educator as the geopolitical context poses the limits and opportunities in very specific temporal scales. The current (and growing) global unsustainability crisis has been forcing educators, for at least the last fifty years, to rethink their pedagogical strategies to transfer their knowledge on the causes, consequences, and actions to take to overcome such crisis.
At the core of the unsustainability crisis lies a dualistic mode of thinking of the world we have inherited from past educational systems: this is the divide between humans and nature. Othering nature has turned into the instrumentalization of the natural resources to fulfil the human needs and wants. Such utilitarian perspective has already created not only physical changes to the geological spheres of the Earth, but also has created more unsustainable societies. A reflection about such division was presenting the early 1970's which allowed a change in society, and as the ecological movement grew, the reflection on environmentally sustainable values finally reached the classrooms.
Since then, ethical questions regarding our role as technologists of planet Earth have raised and have been addressed from diverse perspectives. This article describes the transition from environmental ethics to ecological ethics in a context of technology education, that is the transition from a utilitarian perspective of nature to an integrative perspective where the human-nature divide ceases to exist. We describe such transition and root for the implementation of an ecological ethics-based pedagogy to face the unsustainability challenges we face today and those we will face in the future. Using an integrative literature review we will guide the reader through essential concepts, such as "milieu" and "techno-diversity", to understand the importance of an ecological ethics-based education.
This paper is to be taken as starting point to generate a new method of learning, teaching, and practicing ecological ethics in the context of technology education, in especially of engineering design education. Taking technology education as our subject of study, this article starts presenting the method

we are using to discuss the necessary distinction between environmental ethics and ecological ethics, to later move to describe the relationship between ecological ethics and technology. The last part of the article comprehends a discussion on pedagogy of ecological ethics and its link with society and into pedagogical activities.

2 METHODOLOGIES

This article discusses the intersection of technology education and ecological ethics contributing to an integrative literature review on the conceptual and practical developments of the concept of "techno-diversity". A critical analysis is performed contrasting the ontological and epistemological positions of the most relevant English-speaking and French-speaking authors on the subject. The combination of both corpus of knowledge allows to reconcile both approaches in order to propose new perspectives on the pedagogical methods to learn, teach and practice ecological ethics in and outside the classrooms of technological higher education. The aim of this integrative review is to assess, criticize and synthesize the literature on the chosen topic with the intention to propose a new theoretical framework for learning, teaching and practicing ecological ethics in the context of technology education [1].

This paper aims at describing the initial results of several discussions among a multidisciplinary (from philosophy to mechanical engineering and computing sciences) and multigenerational (from doctoral students to well established professors and heads of university departments) team of researchers. The challenge of co-constructing this article (as it has been thought and written using multiple perspectives) demonstrates by itself the importance of generating common methods and frameworks to reflect and discuss on the "milieu" (concept developed below) from where this specific knowledge is produced.

This integrative literature review comprehends four steps: 1) the definition of the structure of the literature review, 2) the literature review itself, 3) a synthesis and a critical analysis of the literature found, and 4) a proposal to further develop the learning, teaching, and practicing of the knowledge learned from the results of the literature review.

For performing the literature review, articles in English and French language are taken into account. A preliminary identification of the main sources has been developed, from which we start to extract the keywords to look for on the different databases. The keyword analysis is particularly complex as similar concepts are expressed with different (non-translatable) words into the other chosen language (e.g.: "milieu", "environment", "technique" ...). Consequently, we put the emphasis on generating an integrative literature review rather than a systematic literature review. The initial keywords being used for such task are "ecological ethics", "technology" and "pedagogy", the three of them translatable into French and English without losing its conceptual meaning. We are exploring those concepts in the following sections, starting with a discussion to show how to move from an environmental ethics perspective to an ecological ethics one.

3 LITERATURE REVIEW

3.1. Environmental ethics

Since the pioneering article "Is There a Need for a New, an Environmental, Ethic?" by Richard Routley in 1973, the subject of study of Environmental Ethics has been growing in the English-speaking world [2]. More academic publications, conferences and scientific journals are being proposed to study the conceptual framework and its application to diverse areas of study. For those last fifty years, environmental ethics scholars developed the idea of intrinsic value of the environment in order to reconcile the divide human-nature to move towards more sustainable pathways.

The idea was to move from an anthropocentric perspective towards one that would grant intrinsic value to natural entities. In its search for intrinsic value (vs. instrumental value), environmental ethics were led to essentialise nature and extract the human from it, thus reinforcing (or at least maintaining) the divide human-nature they initially wanted to reconcile.

The Wilderness movement, a conservation practice born in North America that sees nature as an entity that should be left undisturbed and intact in order to be preserved, is an example of such efforts. Today, even the advocates of *wilderness* have now come to question this notion and mode of protection as typically dualistic, Western and macho [3]. As Philippe Descola explained in the introductory lecture to an IUCN (International Union for Conservation of Nature) meeting, the export of Western models of nature protection (*wilderness* type) and Western modes of recreation has been to the detriment of local populations as well as their environment [4].

At the same time, across the Atlantic, due to geographical and historical reasons, the same notion of wilderness did not make sense. In France there is no such thing as “paysage sans paysan” (countryside without countrymen), the landscapes are neither shaped only by natural forces nor human ones, the “paysages” are the result of the combination of both forces [5]. The dualism human-nature is less strong and tends to form a type of reflection where it is possible to talk about ecology without ever talking about “Nature” or even “environment”; instead, concepts like “culture” and “milieu” are at the centre of the ecological reflection in France. In the next section we will return to expand on the concept of “milieu” and its relationship with the ecological thinking.

It is important to remember that our argument is that the drawback of environmental ethics is not that it looks for the intrinsic value of nature, is that it advocates for a dualistic vision that puts naturalism against humanism. Such position validates the Great Divide between Nature and Culture, creating with it a separation between natural sciences and human sciences (from Serge Moscovici to Bruno Latour [6, 7, 8]) in the education systems. Based on this statement, in the next section we introduce the concept of “milieu” which is central to understand our position on ecological ethics.

3.2. Ecological ethics and technology

As written by Petit and Guillaume [8], Hicham-Stéphane Afeissa [9] divided the philosophy of ecology in two components: ecology of technology (focus on the study of the way the relations of human beings to their environment have been reshaped by technology - Anders, Jaspers, Arendt, Jonas) and ecology of nature (questioning the value to give to nature and ecological and ethical communities -Leopold, Lynn White Jr., Naess, Callicott).

“This divide, Afeissa rightly highlights, is a central distinction to understand the French tradition, which is clearly situated on the former side. In his study of the French tradition of political ecology illustrated by Jacques Ellul, Bertrand de Jouvenel, René Dumont, Serge Moscovici, André Gorz, Cornelius Castoriadis, and Felix Guattari, Kerry Whiteside points that the French debate on ecology is not framed as a strong divide between eco-centric and anthropocentric approaches; it is rather formulated as a critique of the invasion of the techno-sciences in our daily lives [10]. Despite the variety of their respective approaches, none of the French political ecology philosophers separates the question of ecology from the question of technology.” [5]. On this statement, Petit warns however that it would be misleading to conclude that an ecology “without nature” would mean an ecology “for technology”; it rather means first and foremost that “Nature” and “technology” articulate each other to shape a “milieu”.

The concept of “milieu” has implications different from the concept of Environment. There are two main distinctions: 1) rather than positioning on the outside, “milieu” lies between the inside and the outside”; 2) rather than referring to a shared objective experience, “milieu” refers to the unique experience of a living organism in a place. If the environment is an absolute concept, the milieu is a relative concept. If the environment refers to an external nature, the milieu designates a physical-bio-socio-technical complex. In the next section we will develop the relationship between technology and milieu.

3.3. Philosophy of the technical milieu

“The term “technical milieu” does not separate technology and life, nor the technologies of matter from the technologies of living organisms; nor the ethics of the living from industrial politics; nor the philosophy of the environment from the philosophy of technology.” [5]

At the core of Simondon’s ecological philosophy lies the following sentence: “learn to consider our techniques as our own children” [11]. This sentence, echoed the thought of the readers of Bernard Stiegler, who knew how to add a little bit more of complexity by adding the concept of “technique” to it, and also to the readers of Donna Haraway [12] who claimed herself: "Make kin, not babies!"; “both groups of intellectuals can be considered as ecologists as they helped deploying the technological responsibility we need to develop the understanding of the dynamics of society and the consequences of its actions” [5].

In France, there is a tradition of ecology of the “technical milieu”, represented by authors that go from Gilbert Simondon [13] to Bernard Stiegler [14]. Contrary to environmental ethics, the ethics of the “technical milieu” digs into the politics of life, the politics of “milieu” aligns there with ecological ethics as a critique of the political economy (in this case, that of Bernard Stiegler leads to the contributory

economy and/or the commons). The concept of "milieu" appears as a bridge between the philosophy of technology and the philosophy of nature and positions itself as a way to reflect on the ecological ethics and its political implications. Such form of thinking political ecology has given space for rethinking what we learn and how we learn what we learn. We can follow the example of Geography, that was a pioneer, and the first to understand that there was no political ecology possible without radical pedagogy [15]. In the next section we will develop the role of pedagogy (alternative pedagogy) as a strategy towards an ecological ethics perspective for technical education.

4 THE ROLE OF PEDAGOGY

We cannot go into the history of alternative pedagogies without thinking of the role of the ecological movements in the decade of 1970. Multiple educational reforms were happening simultaneously around the globe transforming our societies. Ivan Illich is a great example of such effort, proposing along Alexander Lenger the "Radical Humanism" [16]. Such a trend openly criticized the society of consumption recently brought by the emerging neoliberal economy in Europe and North America. They were one of the first ones proposing a commitment to reconsider the ways of living, producing and consuming in order to make modern societies compatible with the limited number of natural resources available. Today, such ideas find even more weight into the sustainability studies thanks to the emergence of the Planetary Boundaries and the Doughnut Economics, using interdisciplinary scientific frameworks.

An example of a new pedagogical strategy towards ecological ethics, can be found in Italy in the decade of 1970's. Global Tools, a multidisciplinary experimental programme of design education, founded in 1973 was seeking to invent a *new school without students to teach*, a school based on the re-appropriation of simple technologies [17]. We could call this a "school of the environment", its pedagogy was based on the self-reflection of the future designers with their surrounding environment, to further think on the impact of the materials and type of architecture to the social and ecological surroundings. What Ugo de La Pietra, one of the founders of Global Tools, called "reappropriation of the environment" is in fact a mix between eco-social and territorial design and the school of bioregionalism, that of Peter Berg or Alberto Magnaghi [18], a school which applies a "pedagogy of the milieu" in the tradition of Célestin Freinet [19].

From an institutional point of view, and to limit ourselves to a more recent period, we can say we moved from environmental education (environmental pedagogy [20]), well established in the 1970-80's, to education for sustainable development [21], born in the 1990's and heavily promoted in the early 2000's by the United Nations and its Millenium Development Goals agenda. However, from 2005 onwards the notion of sustainable development started to be strongly questioned by the field of environmental education (among others), in particular by Lucie Sauvé and her colleagues from the University of Quebec in Montreal [22]. In the logic of the pedagogues to whom environmental education lays claim - Rousseau, Dewey, Freinet, Decroly, Ferrer -, it seems natural that it should take up the concepts of institutional pedagogy, as formulated by Fernand Oury, by transposing it from the classroom to the group of citizens in an active process. Citizens who take an initiative in the city in relation to their environment are a group in institutional pedagogy [23]. This group of citizens moves from the world-as-an-object perspective to the world-as-a-project perspective, according to Philippe Meirieu [24], integrating in some way the notion ecological transition.

We recognize that since the 1970s, the slogan has been the same: create an education that does not separate knowledge from life. It would thus be necessary to integrate the existential dimension of the climate crisis and to develop a pedagogy of transition capable of making students reflect on this intimate dimension of the meaning of life[1]. By combining the pedagogy of the environment and Simondon's ecological ethics, we believe we have an operational concept for a new pedagogical framework around the concept of techno-diversity.

5 SYNTHESIS AND PROPOSAL: TOWARDS TECHNO-DIVERSITY

Teaching ecological ethics is thus to teach relations and co-constructions that come from them and allow for evolution. On this account, the teaching of ecological ethics cannot be a specific class, an independent brick added to curricula without being in contradiction with the stated importance to

[1] See the promotion at HVL - Western Norway University of Applied Sciences - of the concept of "Klimadanning", climate education understood as "Bildung".

relations. Teaching ecological ethics in technological curricula means practicing ethics in technology classes. This implies to give primacy to relations between the different teachings, thus, to break down the traditional frontiers that are built between them.

Breaking down the frontier between natural and human sciences: that means to break down the separation between the human acting subject and the natural observed, studied object. To these objects are substituted the figures of individuals (resulting from individuation) and their milieux, co-constructing together. In concrete terms, to nature or environment is substituted biodiversity; indeed, biodiversity is constituted and evolving by the numerous inter-relations of living beings among themselves and with abiotic elements. From human subjects is taken away their characteristic of being an exception in the face of nature. Human beings, with their knowledge and cultures, are to be considered as well from their relations with biodiversity and also with their technical artifacts. They are to be understood as being co-constructed and in co-construction with their milieux, to which biodiversity and their technical actions and productions participate.

Breaking down the frontier between theory and practice: that implies overcoming the dualism between theoretical, universal knowledge and technical skills and know-hows. That means doing technology in the sense that its etymology suggests, as co-construction of knowledge and techniques. Pragmatically speaking, it seems to us that project-based teaching allows for these dynamics of co-construction.

Breaking down the frontier around universities: what is at stake here is the openness and sharing of knowledge and technology not just to academic actors and students but to society and in the opposite way the openness of academic knowledge and practices to other kinds of knowledge, practices, technologies. This perspective encounters approaches of participatory research and research-action.

From this view of technology, we wish to introduce the concept of "techno-diversity" alongside the concept of technology. For the same reason as why we substituted biodiversity to nature, we intend by this suggestion to focus attention on relations among technological systems but as well on relations between biodiversity and technologies, between human cultures and technologies. Once again just as the concept of biodiversity, we understand "techno-diversity" as pointing as well toward the potentials of evolutions, of transformations of technologies, of technological milieux.

From this background of French ecological philosophy and these thoughts, our research aims, through literature review, to investigate existing practices of teaching of ecological ethics in technology curricula in order to lead a distinctive analysis on them and to participate to future, obviously diversified, technological and teaching practices.

6 CONCLUSIONS

This paper contributes to an integrative literature study on ecological ethics and concludes on the importance of breaking down the dichotomy between human and nature, by developing a deeper knowledge of the concept of "milieu", and its relevance on the transition towards techno-diverse societies. It also underlines the requirement for a more integrative and open learning spaces, where society is encouraged to co-construct and design ethical and sustainable technologies. We conclude that the concept of "techno-diversity" opens the room for new perspectives in engineering design education.

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