



An experience on the application of transdisciplinarity in an undergraduate course on "transdisciplinary environmental analysis"

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Abstract

Transdisciplinarity is the highest level of integration among disciplines and it represents the construction of a whole system without solid frontiers among disciplines. Although highly desirable, currently the practical application of transdisciplinary approaches to education at the university level is scarce. Belonging to different knowledge areas and with different academic backgrounds (Anthropology, Biology, Biochemistry, Nursery, Ecology, Geography, Environmental Education and Law), we have joined our efforts to deal with the challenge of carrying out academic activities within the frame of transdisciplinarity. In this communication, we will present our experience on the application of transdisciplinarity in an undergraduate course open to students from different Faculties and disciplines. The general topic selected for the course was environment. Our choice was based on the assumption that the interdisciplinary nature of environmental studies could contribute to make it easier the transition to actual transdisciplinary approaches. The course accounted for 3 ECTS credits and included both activities in classroom and through a virtual campus resource based on the Moodle platform, as well as a field practice.

1. A brief introduction to transdisciplinarity

The changes from the Bologna Declaration in higher education inform the University activities of adapting their curriculum to the new way of teachings and learning. These changes involve qualifications in terms of learning outcomes, competencies and profile, promoting diversity as an interdisciplinary approach. This paper deals with our experience in applying transdisciplinarity in undergraduate courses. Analysis of the environment and mainly environmental education have been conducted with a transdisciplinarity approach, going beyond the process that nowadays is taking place inside the European Common Higher Education Area.

1.1 From disciplinarity to transdisciplinarity

The progress of Science has been accompanied by an increasing degree of specialization. Specialization causes a compartmentalization in which each discipline has its own professionals, its own language, and its own ways of analysis and validation rules. In parallel to this tendency towards segregation, there is an effort to synthesize and unify disciplines under a functional and interrelated perspective. This has been the case with Ecology, Geography, Theoretical Physics, Health Sciences, and Economy. This new trend breaks the monodisciplinary nature of the different disciplines and integrates both social and natural aspects. Several levels of cooperation or relationship among disciplines can be described [1, 2]:

Multidisciplinarity represents the lowest level of integration. It happens when the solution of a problem requires the information and help provided by several disciplines, without a mutual enrichment.

The second level of integration is represented by pluridisciplinarity, in which an actual cooperation among disciplines does occur in the absence of any actual coordination.



A higher level of integration is interdisciplinarity, which implies a will of commitment to develop a wider frame in which each of the interacting disciplines are modified and each begin to depend clearly ones on the others. Three different levels of interdisciplinarity can be distinguished: a) An application level. For instance, the transfer of nuclear physics methods to medicine has given rise to new cancer treatments. b) An epistemological level. For instance, the transfer of methods from formal logics to law has produced interesting new analysis of law epistemology. c) A level of emergence of new disciplines. For instance, the transfer of methods from mathematics to physics gave rise to mathematical physics; that of informatics to arts has given rise to net-art, and so on.

The highest level of integration can only be achieved within the framework of *transdisciplinarity*.

1.2 The concept of transdisciplinarity

The first known reference to the term transdisciplinarity can be found in an article on the unity of knowledge written by the Nobel prize in Physics Niels Bohr in 1955. However, the first well documented use of this concept is found in a text written by Jean Piaget for an international symposium on interdisciplinarity held in 1970. Transdisciplinarity is a level of interaction among subjects higher than and different to interdisciplinarity. It represents the construction of a whole system without solid frontiers among disciplines. Therefore, it represents a general systems theory, including operative and regulatory structures and probabilistic systems, linking these different possibilities by means of regulated and defined transformations [3]. The integration occurs within an omnicomprehensive system, pursuing common goals and an idea of epistemological and cultural unification [1, 4]. This task is not outside the goals of University, since according to Esteban Rodríguez-Cairo (from a lecture given at the Faculty of Sciences, University of Málaga, in 1996) "to be a real university person, one has to be transdisciplinary" [cited in 2]. Although transdisciplinarity is not a new discipline or a new hyperdiscipline, disciplinary research can feed it, since both disciplinary and transdisciplinary approaches do not need to antagonize but rather they can be complementary approaches.

2. Why a transdisciplinary environmental analysis?

We are aware that the complexity of global environmental problems requires transdisciplinary approaches with interaction of natural and social sciences. The disciplinary barriers need to be opened in order to get global analysis and solutions. New technologies can provide the tools for a sustainable development, but they should be integrated in a frame of new values. The relation between human society and the environment must be changed.

2.1 The "Trans" group at the University of Málaga

Trans is an open and unofficial group of researchers and professors at the University of Málaga aiming to make reflections on the implementation of transdisciplinary approaches for higher education. The members of the group are the co-authors of this communication. We belong to different knowledge areas and have different academic backgrounds (Anthropology, Biology, Biochemistry, Nursery, Ecology, Geography, Environmental Education and Law). Since the academic season 1994-95, a process of reflection, analysing the transdisciplinary approaches applied to the teaching-learning related to the environment at the university was started. Since then, we have carried out several Educative Innovation Projects giving rise to a solid production in terms of communications to congresses, publication of books and articles [2, 5, 6] and implantation of undergraduate courses with a transdisciplinary approach.

2.2 The environment as a transverse and transdisciplinary concept

Our activity has been focused on environment. The selection of this topic was based on the complexity of the concept and on the confluence of aspects related to both natural and human environment. In fact, the idea of environment has evolved from a first identification of the concept with the natural context towards a more comprehensive view, which considers that the environment is the result of both physical and human forces and processes. As a result, many new interrelationships between the man and the environment arise. To a full understanding of this complex and comprehensive concept



of environment, it is necessary to turn to causes and explanations that go beyond the limits of natural laws and enter the social, psychological, and cultural fields, as well as human constructions, as Economy and Politics. Therefore, the environment is an especially rich and interesting topic to be treated from a transdisciplinary viewpoint.

3. Our previous experience in the use of transdisciplinary approaches in higher education

A first Educative Innovation Project (entitled "*Reflection and transdisciplinary action on the environment*") was developed in the period 1995-97, aiming to create a forum for the discussion and critical reflection on environmental topics. Product of these discussions and reflections, a compulsory need to carry out a survey to know the position of the students at the University of Málaga was detected. The survey, its results and their critical discussion were included in a monography [5].

3.1 The survey on the position of the students at the University of Málaga concerning environment

A first aim of the survey was to know the relationship of the students at the University of Málaga with the environment, with a triple approach: 1st Their degree of knowledge of the environment and environmental problems. 2nd Their opinions and theoretical attitudes related to the environment. 3rd Their level of compromise with the environment: their effective attitude in their daily activity. A second aim of the survey was to get insight on the influence of graduate studies on the environmental formation of the studentship. To reach this goal, the results obtained with students in the first and in the last course of graduate studies were compared. The sample space covered a total of 1049 students from a population of 21852 students. The results of the survey [6] reinforced and confirmed the need of a transdisciplinary approach to the problem.

4. Our "Transdisciplinary Environmental Analysis" course

Based on our previous experience with the survey on environment, a pilot course was designed under the educational concept of investigation in action and its methodological proposal of the self-reflective spiral (planning-action-observation-reflection). The course improved our practice and helped –in a next step- for the challenge of designing the program and contents of a new graduate transdisciplinary course. Our efforts in this direction yielded the pilot course "*Water: source of life*", carried out in January, 2000. Although limited in its scopes, the experience was highly positive for all the participants. In particular, the Transdisciplinary Group had the first real opportunity to test this didactic approach as a group.

4.1 Educative Innovation Projects supporting the development of the course

During the academic period 2002-03, *Trans* group worked in the project entitled "*Transdisciplinary didactic strategies for the study of the environment: possibilities and limitations*", where strategies to apply transdisciplinary methodologies were discussed. In 2003-2004, the innovative project "*Design and Experimentation of the program of a course on the Transdisciplinary Analysis of Environment*" was conducted. Finally, since 2004 we have been able to develop and to offer in three different editions the *Transdisciplinary Environmental Analysis* course, as a higher education undergraduate course open to students from different academic backgrounds.

4.2 Structure of the course

The course was designed to cover 3 ECTS credits, including group work in university classrooms, distance work through a virtual campus and a practical work during a journey outside the campus. The time schedule of the group activities of the course comprised 8 sessions of 3 hours each and an additional day's journey to contact the human and natural environment. A transdisciplinary approach was applied, with an integrated and interrelated view of the physicochemical, geological, biological, biomedical, economical, juridical, socio-cultural and educative aspects of the environment. The contents were grouped in 8 thematic units carried out as short workshops, all of them continuously



interconnected: 1) Introduction to transdisciplinarity and to the course. By means of the elaboration of a conceptual map based on the previous ideas on the subject of study brought by the students, barriers and compartments in between disciplines began to break up, fitting the basis for the transdisciplinary approach used along the course. 2) Climate Change. 3) Residues. 4) Environmental Risks. 5) Environment and New Technologies. 6) Environment, Health and Culture. 7) Urban Environment. 8) Environment and Development. For the day's journey, professors and students moved along the line of coast from Málaga to a near town (Rincón de la Victoria) with stops at several observation points to watch the *continuum* natural-human environment and to detect the impact of human action. Afterwards, experiences and experiments were shared for the rest of the day in the Natural Park "Mounts of Málaga". Finally, students filled a test along with a report on their practical activities and an anonymous survey to evaluate the course. The experience was really good with an overwhelming majority of extremely positive evaluations of the course among the enrolled students, who emphasized the completely interactive nature of the course with continuous exchanges among students and professors.

4.3 Current and future prospects

In conclusion, we are a group involved in the awareness of environmental preservation, as well as reaching a great level of quality in education. A transdisciplinary approach able to integrate the new lines and the new challenges that our society demands was conducted. Currently, the group is developing a guide for the application of transdisciplinarity to higher education. The aim is to offer some expert or master course based on this approach in the near future.

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