Interdisciplinary Environmental Review

Volume VII, Number 1, 2005

Interdisciplinary Environmental Association

Evaluating Interdisciplinary Teaching and Research in Developing Countries[1]

Ileana Espejel, Claudia Leyva, Evarista Arellano, Guillermo Arámburo, Roberto Martínez, José Luis Fermán, Concepción Arredondo, and Cecilia López
Sciences School, Universidad Autónoma de Baja California

ABSTRACT

Postgraduate programs in ecosystems management, conservation biology, or sustainable development attempt to understand environmental issues from an interdisciplinary approach. We list the main problems and solutions dealing with the evaluation of interdisciplinary work. The evaluation processes are attached to more funding and higher salaries; therefore evaluation is an important issue. Our diagnosis showed that teachers and researchers are suffering an "over evaluation," using identical indicators coming from disciplinary areas and designed in developed countries. To prepare a national proposal, we brought together most coordinators of postgraduate programs for the development of interdisciplinary products and actions so these may be properly evaluated.

1. THE INTERDISCIPLINARY WORK

Several papers have been published about this controversial issue of interdisciplinary experiences for research and teaching (Allen-Meares, 1998; Bauer, 1990; Bruhn, 2000; Covich, 2000; Collins, 2002; Golde and Gallagher, 1999; Heckhausen H , 1985; Jones et al., 1999; Klein, 2003, 2004) but little has been said about evaluation and how this may constrict creativity (Bauman, 2003), especially in developing countries where science administrators imitate evaluation formulas rather than create their own independent ones.

1. J. Ruis Careaga and B. Ortiz Espejel collaborated partially to the ideas expressed in this paper. We are grateful to all the participants (coordinators of master in sciences programs) that attended the symposium on which this paper is based. Thanks to Dr. Ellis Glazier for editing the English-language text.

What Is Interdisciplinary Capacity Building?

The key point in the definition of "interdisciplinary" is the type of collaboration between the members of a faculty (Wear, 1999; Sperber, 2004), so the actions in teaching, learning, research, or problem-solving that several disciplines integrate generate sufficient, substantial, and well-sustained results to permit a new way of addressing environmental and natural-resource management problems (Bronstein, 2002; Collins, 2002; Gilbert, 1998). Presently, capacity building for sustainable development has arisen as a major necessity in the world, and in developing countries is a priority (Ceccon and Cetto, 2003). Sustainable development is a matter of interdisciplinary action.

We found that evaluators confuse interdisciplinary work as superficial in scientific research. They also think that team work is easier. It is undeniable that excellence in the natural sciences requires a specialization that allows understanding questions on the edge of knowledge and the ability to employ complex methodologies and operate sophisticated equipment.

Nonetheless, thematic teaching and research strategies are insufficient to solve or even explain the complex problems that are formulated in areas such as natural-resource management, conservation biology, sustainable development, and biotechnology. It is not about easing the tension between specialization vs. generalization that for so long has concerned the scientific world, but to refocus the discipline, or pluridisciplinarity (multidisciplinarity, interdisciplinarity, transdisciplinarity) that needs to coexist in the university's world in a less individual environment, but that allows individuality, cooperation, and tolerance among colleagues (Bradbleer, 1999; Hargreaves, 1997; Klein, 2004; Latas, 1995; Lawrence and Després, 2004; Sperber, 2004).

For Bronstein (2002), the interdisciplinary collaboration implies first to develop trust to interact among professionals, so that it spreads an interdependence as a result of sharing and by being accompanied in their goals and tasks. Second, it should create new activities based on actions of collaboration. Third, it requires flexibility to deliberate, which includes the ability to reach productive commitments despite disagreements and the altering of each collaborator's role in the function of agreements as participant, or as a leader. Fourth, it requires taking responsibility for the complete process to reach common goals, and last, but most important, it requests reflection and feedback about one's own actions and those of the collaborators.

In summary, the research, teaching, and service work in the interdisciplinary field could evaluate:

1. Knowledge of the disciplines related to the investigation topic (conceptual, material, and methodological): ecology, geography, anthropology, economy, and agronomy.
2. Integration of disciplines (construction of interdisciplinary experiences).
3. Design and integration of interdisciplinary methods.

4. A permanent epistemological surveillance (to understand the processes of knowledge and their relationship to the environmental field).
5. The construction of a new knowledge, environmental knowledge (to reformulate traditional disciplinary questions).
6. The problems of knowledge construction as a function of their sociopolitical relevancy.
7. The consideration of spatial and temporal scales as two axes of the interdisciplinary analysis of the natural-resource management.
8. The connections between academia, government, and society in the resolution of social-environmental conflicts (both regional and local) and to make this an activity of generation or application of innovative knowledge.
9. Capacity of social-environmental intervention.
10. Ability to work in an interdisciplinary team.

Examples of Available Training in Mexico

1. Natural Resources, where specialists are trained and prepared for evaluation and managing of a) physical resources: soil and water; b) biotical resources: flora and fauna; c) ecosystem and landscape resources: basin and coastal areas; and d) human health: plague and disease.
2. Rural Development equally prepares specialists that have the objective of guiding the development of rural communities and cattle and gatherer regions, according to the sustainable alternatives of the existing natural resources in each region.
3. Regional Planning trains specialists for urban and for rural planning through development, territorial, and ecological planning.
4. Environment and Health. This area works on establishing the relationship between the ecological conditions of an area and how these can affect the population's health. The specialists are versed in pollution monitoring and quality of the environment topics, which are always related to a complex health problem.
5. Environmental Technology. In this area, specialists are prepared for the responsibility of watching over and studying how industry affects the environment and then generate biotechnical or environmentally friendly methods.

The actual postgraduate programs and the groups of investigators have a human capital of specialists that are all linked around a natural, social, and political environment. As a team (students and teachers) they study a certain region in an integrated way and try to answer all the variants of a system. For instance:

Despite wildlife or nature-oriented studies, the development of a region cannot be achieved if the social problems are not approached (it is necessary for interdisciplinary studies in developing countries that people improve their general situation, i.e., the team has to present economic alternatives or ideas for health care along with the conservation of nature or other biological or environmental

aim). The interdisciplinary team of students and teachers has to keep in mind during the teaching-research process the sustainable use of natural resources to avoid the exhaustion of the soils, forests, and water reservoirs, besides the protection of endangered species. Proposals must recommend technology considered to be "healthier," as well as best technology that, besides monetary gain, also considers sustainability.

The difference between interdisciplinary and disciplinary postgraduate programs is that a disciplinary program is only able to study part of a system and to answer a specific question without being able to link to a whole system or other systems, because it cannot embrace the whole universe of a local, regional, or national problem as interdisciplinary teaching-research does. Disciplinary postgraduate programs use teaching and learning traditional tools whereas interdisciplinary programs work in developing the necessary tools to study each of the problems to be studied and how they are related.

II. THE INTERDISCIPLINARY WORK AND ITS PRODUCTS

Academic work that is interdisciplinary, as a productive activity and social practice, generates, to a certain extent, intangible evidence. Nevertheless, the works that are produced, besides being varied as for length, depth, and audience, have high levels of applicability and consumption because they obey social claims and solve problems outlined from a socioeconomic or sociopolitical dimension, more than just "scientific curiosity," which is also valid.

Among the products of interdisciplinary work are:

1. Proposals for management plans (in protected areas, in wildlife management units, in cities, in green areas, in basins, municipalities, and towns).
2. Proposals of territorial and ecological planning.
3. Environmental impact assessment studies.
4. Environmental risk studies.
5. Environmental education programs.
6. Analysis of active ruling and innovation proposals.
7. Proposals for programs of alternative rural development.
8. Plans for urban development, population centers, and suburban areas.
9. Manuals to combat plague and disease.
10. Instruction manuals and biopesticide techniques for the use of organic fertilizers.
11. Translation and interpretation textbooks.

The materials generated are:

1. Technical reports, consultant reports and evaluations, diverse data that is published in pamphlets, bulletins, videos, and CDs.

2. Articles in multiple Ibero-American magazines, Internet pages, and international magazines whose diffusion and local impact cannot be compared with those of the disciplinary areas.
3. Books with reports of long-term investigations, with methodological proposals, and didactic materials (although their diffusion is not widespread).

These materials could be translated into publications, but few of them are of international interest. The linking with productive and the more unprotected sectors, as well as with the local, state, and federal agencies that use our products as an input for the processes of decision-making, administration, and rule making, is fundamental, but often is not of international interest. Also, the integrated results are not understood and accepted in the traditional scientific journals because there is a lack of editorial ability for the understanding and reception of interdisciplinary works. Journal reviewers' answers, if positive, demand splitting of the results and then all the richness in ideas that was generated with the interdisciplinary thought is lost.

III. THE EVALUATION OF THE WORK AND INTERDISCIPLINARY POSTGRADUATE PROGRAMS

As understood, the evaluation process is an instrument for feedback and development. It is well-known in Mexico that the evaluation process is used as a measure of control, but we want to think that it is a matter of supporting a self-planning process. A praiseworthy process, as evaluation is, has been perverted when it is tied to salary improvement and institutional financing. We believe that if we put together the discussion of both aspects, we will be able to advance and enhance positive proposals.

When reviewing the evaluation process, we found four approach levels; the types, uses, purposes, and the mechanics of these processes. The first has to do with evaluation types applied to teachers and researchers and postgraduate programs. These can be internal. They are as simple as the reports of activities that are presented to the directors of the academic institutions, and the sort of informal questionnaires used by students in the postgraduate programs at the end of a course. They could also be more complex as in the evaluation of thesis projects, internal research projects, and the evaluations to reward academic performance in our institutions. The evaluation is also external, as the certification processes practiced by the Secretary of Public Education, the National Council of Science and Technology (CONACyT, 2002), and the National Association of Universities and Institutions of higher education that occasionally make different evaluation programs individually or combined.

A second level is the uses that are given to the results of the evaluation. One use can be tracking the quality of the academic work for the assignment of financial resources, the possibility of scholarships for the students, and support for

research projects that depends on the postgraduate program evaluation. This is circularly connected in having an important impact on the formation of human resources as well as on the professors' income.

A third level refers to the purposes of the evaluation processes; to promote investigation policies (regional, national, or international) and to develop academic actions (teamwork, collaboration, linking, diffusion) or to highlight specific lines of investigation (urban development, rural development, forest resources, water resources).

All the above would have to be reflected in a final and complicated aspect, the mechanics of the evaluation. These mechanics involve the instruments, approaches, indicators, and scales used to assign points and periodicity, the pertinence of the evaluation, and the people designated as determiners who have their own respective fields of discipline and their, not always evident, epistemic orientations that are the basis of the evaluative methodology used.

IV. FROM THE EVALUATION OF THE INTERDISCIPLINARY WORK TO THE INTERDISCIPLINARY EVALUATION OF THE WORK

What is evaluated from the interdisciplinary work? Which criteria, indicators, and factors could better reflect the interdisciplinary work? How should the committees that evaluate the interdisciplinary work be integrated?

In Mexico there is only one "multidisciplinary committee" to evaluate projects, mostly formed by members of excellent quality coming from several disciplines but with no experience in interdisciplinary work and training. To date, it is not known how this group was formed nor what were the criteria for project evaluations. In our experience, we concede that evaluations of interdisciplinary projects (research or teaching) are unique situations that need special criteria and an experienced interdisciplinary-trained team of evaluators. In summary, the whole process of evaluation itself needs to be reevaluated (Ceccon and Cetto, 2003; Klein, 2003; Sperber, 2004; Wear, 1999).

The Criteria for the Evaluation of Postgraduate Programs of Interdisciplinary Orientation

There is a national institutional program for the strengthening of postgraduate programs (CONACYT, 2002). Recently, it considered the evaluation of postgraduate programs with professional orientation (applied science) apart from those oriented to research (basic science) as it is well-described in other plans of other countries (The Research Council of Norway, 2001; McNeill et al., 2001).

This was useful to support programs forming human resources at the postgraduate level that our country needs. A program can involve both approaches; basic disciplinary research-oriented or applied interdisciplinary problem-solving

focused. We propose unifying both approaches to form a mixed postgraduate program, supporting the teaching needs for natural-resource management, conservation biology, and sustainable development. Besides the above-mentioned, it would be necessary to consider the incorporation of qualitative items.

1. The level of cohesion of the investigations produced: This refers to the analysis of those observational data to decide if the researches produced are conceived as independent works or as an organized conjunction, so that all the works maintain interdependence nexuses to a collective program.
2. The destination of the investigative product refers to the analysis of those observational data that help decide that the investigations produced go to decision-making nuclei in the own organization or to less-favored groups in society.
3. The teaching of the interdisciplinary research issues and the formation of investigators. This refers to the analysis of those observational data allowing the formation of investigators to be mixed for curricular designs in the classroom, or alongside investigators, professionals, and experienced workers together with local communities.
4. The control of the methods and operations refers to the analysis of those observational data that allow the determination if the approaches of evaluation for research are only of internal methodological character (design or evaluation of interdisciplinary investigation methods) that are located in connection with the types of social demand and with requirements of organizational efficiency.
5. Organizational structure refers to the analysis of those observational data allowing the determination if the investigation is organized around the interdisciplinary curriculum and learning by doing or hands-on teaching.

Criteria for the Evaluation of Research, Teaching, and Interdisciplinary Service

The evaluation criteria are known in several application forms for fellowships, projects, etc., at the national-scale evaluation systems (researchers and teachers separately but using similar indicators and criteria) and in different application forms for performance fellowships for each university and research center. They are relatively similar although the decision factors apparently differ.

However the specific values and weights are not available to the interested parties so that it is impossible to refer proposals or improve criteria in this respect. It is known that there is discussion about the possible standardization of the indicators. Therefore, in the workshop we could only work on the available data but we proposed our particular evaluation necessities for the interdisciplinary teaching work.

V. CONCLUSIONS

The workshop gathered together about 60% of the interdisciplinary postgraduate programs of the whole country. We found that socially oriented programs did not relate to natural-resource management; therefore we did not use them this time. However, this is not different from other countries (Muller-Rommel and Meyer, 2001). Nevertheless, there was consensus in creating interdisciplinary evaluation committees (Freudenburg and Gramling, 2002). The group will work on the design of a "certification mechanism" intended for interdisciplinary teams, where experience counts more than publication in international journals and academic degrees. Our results will be presented to the national authorities to evaluate national problem-solving research and teaching in the interdisciplinary fields. We will work on ideas to publish our own academic journal because most of the international high-impact journals do not understand the main goals of interdisciplinary local research (Bauman, 2003), especially of this research in underdeveloped countries (Ceccon and Cetto, 2003). We have to start an association to communicate research and teaching experiences in symposia and workshops as in many other countries to join efforts worldwide.

REFERENCES

Allen-Meares, P., "The Interdisciplinarity Movement." *Journal of Social Work Education.* Vol. 34, No. 1, 1998, pp. 1–2.

Bauer, H. H., "Barriers Against Interdisciplinarity. Implication for Studies of Science, Technology, and Society." *Science, Technology and Human Values.* Vol. 15, No 1. 1990, pp. 105–120.

Bauman, H., "Publish and Perish. The Impact of Citation Indexing on the Development of New Fields of Environmental Research." *Journal of Industrial Ecology.* Vol. 6, Nos. 3–4, 2003, pp. 13–26.

Bradbleer, J., "Barriers to Interdisciplinary Discourses and Student Learning." *Journal of Geography in Higher Education.* Vol. 23, Issue 3, 1999, pp. 381.

Bronstein, L. R., "Index for Interdisciplinary Collaboration." *Social Work Research.* Vol. 26, No. 2, 2002, pp. 113–123.

Bruhn J. C., "Interdisciplinary Research. A Philosophy, Art Form, Artifact or Antidote." *Integrative Physiological and Behaviour Science.* Vol. 35. No. 1, 2000, pp. 58–67.

Ceccon E. and Cetto A. M., "Capacity Building for Sustainable Development: Some Mexican Perspectives." *Int. J. Sustain. Dev. World Ecol.* Vol. 10, 2003, pp. 345–352.

Collins, J. P., "May You Live in Interesting Times: Using Multidisciplinary and Interdisciplinary Programs to Cope with Change in the Life Sciences." *Bioscience.* Vol. 1, 2002, pp. 75–84.

Consejo Nacional de Ciencia y Tecnología (CONACYT), *Manual para la Evaluación de los programas de posgrado.* México, 2002.

Covich A., "Biocomplexity and the Future: The Need to Unite Disciplines." *Bioscience.* Vol. 50, No. 12, 2000, pp. 2–3.

Freudenburg, W. and Gramling R., "Scientific Expertise and Natural Resource Decision: Social Science Perception on Interdisciplinary Scientific Committees." *Social Science Quarterly.* Vol. 83, No. 1, March 2002, pp. 112–136.

Gilbert, L. E., "Disciplinary Breadth and Interdisciplinary Knowledge Production." *Knowledge, Technology and Policy.* Vol. II, Nos. 1, 2, 1998, pp. 4–15.

Golde M. C. and Gallagher H. A., "The Challenges of Conducting Interdisciplinary Research in Traditional Doctoral Programs." *Ecosystems.* Vol. 1, 1999, pp. 281–285.

Hargreaves, A., *Profesorado, cultura y postmodernidad: cambian los tiempos, cambia el profesorado.* (Ediciones Morata España 1997).

Heckhausen H., *Disciplina e Interdisciplinariedad: Problemas de la Enseñanza y de la Investigación en las Universidades.* (ANUIES México, 1985).

Jones C. P., Merritt J. Q. and Palmer C., "Critical Thinking and Interdisciplinarity in Environmental Higher Education: The Case for Epistemological and Values Awareness." *Journal of Geography in Higher Education.* Vol. 23, No. 3., 1999, pp. 349–357.

Klein T. J., "Prospects for Transdisciplinarity." *Futures.* Vol. 36, No. 4, 2004, pp. 515–526.

Klein T. J., "Thinking about Interdisciplinarity: A Primer for Practice." Adapted from *Colorado School of Mines Quarterly.* Vol. 103. No. 1, 2003, pp. 101–114.

Latas R., "Interdisciplinarity in Post-Secondary Education: A Bibliographical Search Presented to Professor Aura Cuevas and Dr. Yuan Yuan." December 4, 1995. http://www.palomar.edu /english /Latas/Grad /id600b.htm

Lawrence J. R. and Després C., "Futures of Transdisciplinarity." *Futures.* Vol. 36, No. 4, 2004, pp. 397–405.

McNeill, D., García-Godos J. and Gjerdåker A., *Interdisciplinary Research on Development and the Environment.* Centre for Development and the Environment University of Oslo Report No. 10. 2001.

Mudroch, V., "The Future of Interdisciplinarity: The Case of Swiss Universities." *Studies in Higher Education.* Vol. 17, No. 1, 1992, pp. 43–55.

Muller-Rommel, F. and Meyer H., "Social Sciences and Environmental Sciences: A State of the Art Review." *Environmental Politics.* Vol. 10, No. 4, Winter 2001, pp. 49–62.

Reiter, M. A., Coggins C. P. and Reiter K. D., "Incorporating Multidisciplinary Environmental Topics into the Curriculum: A Possible Model." In: K. Hickey and D. Kantarelis eds. *The Natural Environment: Interdisciplinary Views.* Proceedings of the 1st International Interdisciplinary Conference on the Environment, Boston MA, 1995, pp. 256–264. IEA, Assumption College, Worcester MA.

Sperber D., 2004. *Rethinking Interdisciplinarity.* www.interdisciplines.org/interdisciplinarity/papers.

Wear, N. D., "Challenges to Interdisciplinary Discourse." *Ecosystems.* Vol. 2, 1999, pp. 299–301.