INTERDISCIPLINARY AND SYSTEMIC APPROACHES IN AGRICULTURAL PRACTICES: BRIDGING THE GAP BETWEEN UNIVERSITY AND PROFESSIONAL INTERVENTION

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Abstract

University tradition is deeply rooted in the academic discipline. The hegemony of discipline is so great that it is almost impossible to conceive a broader field of interconnected ideas in knowledge organization. The academic discipline is based mainly on the idea of narrowness of focus, boundary definition, etc. and in its development we may trace back the same Darwinian urge towards differentiation and specialization. At the same time, Faculty identity has developed around this Cartesian view of knowledge, and academics have vested interests in specialization since they are rewarded for the degree of specialization achieved. Yet academic management is becoming aware of the need to assess the appropriate boundaries for disciplinary teaching, learning, and institutional organization in view of the demands of a highly complex world. Society is demanding from the professionals trained in universities a much more integrated view of reality, and better skills to transfer knowledge and solve problems from the real world. This is the case of Argentine university agricultural programs, which are dramatically receiving the impact of local and global changes which urge the Academia to be more responsive, more effective, and more oriented to experiential learning. Our basic assumption was that interdisciplinarity and systemic teaching approaches in the agricultural studies is a way to bridge the gap between the demands for quick and effective professional interventions on one hand, and disciplinary learning processes on the other. This study was carried out to explore the faculty's perceptions about interdisciplinary/systemic approaches in university programs. To this effect, we decided to organize a two-day meeting with teachers from different agricultural and veterinarian colleges across Argentina. Some of the activities included simulated interdisciplinary/systemic activities in workshops. The specific objectives were to (i) find out faculty members´ previous ideas about the relationships of their disciplinary "territories" with others, (b) see if such ideas were rigidly structured and unlikely to be challenged during the workshop sessions, (b) analyze teachers´ interactions and productions in interdisciplinary teams to state difficulties in implementing the approaches, and (c) get the participants´ insight about their strengths and weaknesses.
Some results were analyzed and main conclusions were drawn from the participants' inputs and productions.

Key words: interdisciplinarity, systemic teaching approaches, agricultural programs

Introduction

University tradition is deeply rooted in the academic discipline. The hegemony of discipline is so great that it is almost impossible to conceive a broader field of interconnected ideas in knowledge organization, at least from the XVIII Century on. The Cartesian model of thinking has permeated the Academia in such a way that it is difficult to imagine a different university

scenario. Discipline brought about specialization, which gave a huge push to knowledge development and, in turn, gave rise to the structure of chairs and departments.
The academic discipline is based mainly on the idea of narrowness of focus, boundary definition, etc. and in its development we may trace back the same Darwinian urge towards differentiation and specialization.
At the same time, Faculty identity has developed around this Cartesian view of knowledge and academics have vested interests in specialization since they are rewarded for the degree of specialization achieved and struggle for getting resources for their departments and chairs. F.G. Bailey has described university as the culture of a community in which different tribes live together (1977) and Tony Becher (1985) has illustrated this situation with the metaphor of "academic tribes and territories". According to the author, it is natural to think of academics, knowledge and its properties in terms of tribes and landscape, field and frontiers, pioneering, exploration, false traits, charts and landmarks, etc. Besides it is possible to set neighboring areas of knowledge and lesser measures of shared ground across disciplines. He points out that academic tribes develop *patriotic* feelings within a discipline and that deviations from the common, cultural norms may be penalized (even punished) by expulsion.
Yet academic management is becoming aware of the need to assess the appropriate boundaries for disciplinary teaching, learning, and institutional organization in view of the demands of a highly complex world. Reality does not show itself in a Cartesian way. Reality is a whole that young professionals will have to deal with upon graduation. Then, they will be called upon with the complex and ever-changing problems and environments.
As Rothblatt (1985) pointed out, there is an inevitable conflict between academic interest and secular concerns, mainly originating in two sets of pressures: the first consists of outside demands and the second derives form the internal constitution of science, from its cultural or value systems, and from the academic institution that scientists themselves have built or cooperated in building in order to maximize the conditions under which their work is performed.
Higher education in the modern word is inescapably bound into its host society (Barnett 1988). Parallel to the organization of expert knowledge in disciplines, society is demanding from the professionals trained in universities a much more integrated view of reality, and better skills to transfer knowledge and solve problems from the real world. This is the case of Argentine university agricultural programs. These programs are dramatically receiving the impact of local and global changes, which urge the Academia to be more responsive, more effective, and more oriented to experiential learning. These demands reshape the profile of agronomists (Bocchicchio, 2000; Plencovich *et al*., 2000; Vilella *et al*. 1999), and challenge the way the academics conceive knowledge organization, teaching and learning processes.
The challenge that professional training in agricultural sciences is undergoing is formidable. The productivity paradigm has to articulate with a strong commitment to environmental issues, having quality improvement and community development as a goal. The pace of time requires proactive professionals, flexible, versatile, creative, responsive, and able to promote participatory actions and leadership. To favor these skills, the university teachers will have to envisage learning and teaching processes in a different way. The dilemma student-now/professional agronomist-tomorrow should be set aside. New teaching methodologies should be taken into account and students' responsibility should be enhanced. Undoubtedly, these strategies demand from the faculty some characteristics that go beyond epistemological considerations, and are deeply ingrained in a framework of axiological and pedagogical values. The training of professional agronomists requires the generation of values, attitudes, and habits that shape an *invisible curriculum,* which permeates the university daily life (Fraschina, 2001).

Interdisciplinarity and systemic teaching methodologies are powerful tools towards learning processes that articulate theoretical issues with complex and realistic problems (Morin, 1996; Plencovich *et al*., 2000b; Wassermann, 1994).
However, we know from experiences gathered within our college- Facultad de Agronomía, Universidad de Buenos Aires (FAUBA)- that interdisciplinarity is better said than done. It is difficult for teachers to shift from a disciplinary paradigm to an interdisciplinary one, even if faculty is convinced about their benefits (Plencovich *et al*., 1998, 1999, 2000). Anyway it was difficult for us to assess the extent and nature of difficulties these practices implied. So we decided to have a deeper view of the epistemological, teaching, and even administrative problems these approaches may pose on teachers. To do so, we conducted an exploratory study. Our basic assumption was that interdisciplinarity and systemic teaching approaches in the agricultural studies is a way to bridge the gap between the demands for quick and effective professional interventions on one hand, and disciplinary learning processes on the other. The study was carried out to explore the faculty's perceptions about interdisciplinary/systemic approaches in university programs. To this effect, we decided to organize a two-day meeting with teachers from different agricultural and veterinarian colleges across Argentina. Some of the activities included simulated interdisciplinary/systemic activities in workshops. The specific objectives were to (i) find out faculty members´ previous ideas about the relationships of their disciplinary "territories" with others, (b) see if such ideas were rigidly structured and unlikely to be challenged during the workshop sessions, (b) analyze teachers´ interactions and productions in interdisciplinary teams to state difficulties in implementing the approaches, and (c) get the participants´ insight about these methodologies strengths and weaknesses.
We noticed that it could be useful to continue with this sort of meetings in order to train teachers in integrated teaching organization, but the pace should be slower. We strongly recommend courses on participatory teaching skills.

The systemic and interdisciplinary meeting

A two-day meeting with conferences and workshops was organized at the FAUBA on July 5-6, 2001.
The Secretary of Academic Affairs of the FAUBA, who was assisted by an interdisciplinary group made of academics from different sciences, organized the meeting.[1] Forty-three teachers from different agricultural and veterinary colleges attended the meeting. They were experts in the following disciplines: Botany, Agricultural Biochemistry (2 participants), Rural Administration, Beef Cattle, Industrial Crops (3), Ecology, Agricultural Climatology (3), Edaphology, Plant Pathology, Agricultural Economics, Infectious Diseases, Forage Management (3), Floriculture, Fruit Crop Production (3), Ecological Cattle Raising, Soil Management and Conservation (2), Microbiology (2), Soil Microbiology, Pedagogy, Grain Production, Beef Production, Ovine Production, General Chemistry (7), Organic Chemistry, Plant Health, and Agricultural Zoology. The call for enrollment was nationwide and the presence of teams of teachers and academic managers from different universities was encouraged, since we believe that only teams, not individuals, may introduce sustainable changes in institutions.
A *dossier* was compiled with articles and reference books from different authors, and was handed in before the meeting to assure that participants had a common ground about the "state of arts" of systemic and interdisciplinary approaches.
Four workshops were organized, interspersed with conferences, and other activities.

[1] The authors of this paper.

The following sections describe the activities in detail and sate how they were used as a research component for this study.

Meeting Agenda

The meeting comprised the following activities:
A.INITIAL DIAGRAM:
Participants had to fill an *initial diagram* about the relative position their discipline had with respect to others (see Figure 1).
B.CONFERENCES:
Several *conferences* on main issues, such as systemic approaches, multidisciplinary, disciplinary, interdisciplinary models in universities, challenges teaching poses to interdisciplinarity, the coordinator's role in interdisciplinary teaching approaches, and the idea of an *invisible curriculum*. After each conference, participants had time to ask lecturers questions and make comments.
C.PRESENTATIONS ABOUT EXPERIENCES:
Some FAUBA teaching team *presentations* about their experience concerning systemic and interdisciplinary projects. There were six fifteen-minute presentations, which mainly focused on the pros and cons of these kinds of activities. After a three-presentation block, there was time to ask lecturers questions and make comments.
D. WORKSHOPS
Four *workshops,* in which participants had to simulate the actual work of an interdisciplinary team from a constructivist perspective. After each workshop, there was a plenary session where all groups shared experiences. The plenary concluded with a general discussion.

Activity aims as regards this study:

A.INITIAL DIAGRAM
As we mentioned before, at the beginning of the meeting, before the workshops, participants were asked to fill in the diagram below, according to the following instructions:

Please, write in circle 1 the name of your discipline, and in the other circles the name of other disciplines that are closely related (circle 2), and more remotely related to your discipline (circle 3).

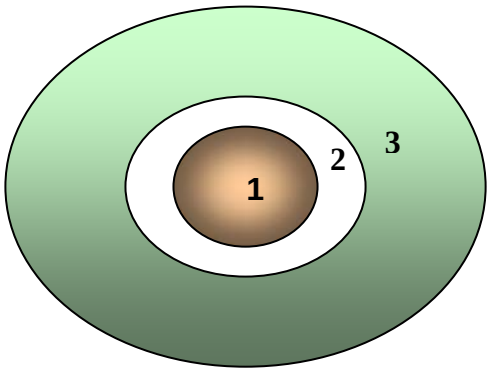

Figure 1: Diagram to assess the perception that participants have about the relative position of their disciplines as regards other fields of knowledge

The purpose of this activity was to search for the epistemological relationships teachers found among their disciplines and others before the meeting, and see their development. The activity would also give us evidence whether their beliefs about such relationships were primarily positivist or constructivist ones.

B. CONFERENCES

The conferences aim was to reinforce some main concepts already presented in the *dossier*, and provide a common ground for discussion.

C.PRESENTATIONS

Their purpose was to introduce participants into interdisciplinarity as a possible, though difficult, teaching practice and together with the other activities elicit their comments about its pros and cons.

The time provided for participants´ questions and comments at the end of each conference and after the presentations had the purpose of giving them the possibility of stating their views about the approaches and the meeting.

D. WORKSHOPS

The main purpose of the workshops was *inter alia* to collect information about the way teachers interacted when negotiating, the difficulties they had in constructing a common unit- giving in or supporting the inclusion of themes, etc. - the epistemological obstacles they had to overcome in order to do so, the change of attitudes they underwent, etc. and the insights they got about this kind of approach**.** Not all the workshop aims were accomplished due to the lack of time (see page 10).

Participants were assigned to groups at random on the first day. From then on, they did not change groups. Eight groups were formed with about 5 members each. We played the role of non-participant observers in all groups, helped by assistants.

Workshops outcomes- interactions, comments, reactions, productions- provided the main source to collect information about teachers´ perception on interdisciplinarity, and the nature of its main drawbacks and advantages.

Workshop activities:

Workshop 1

In small groups, participants had to follow these instructions:

Instructions

From the list of contents attached, please

(i) Select contents to build a unit of knowledge which can be taught from a **systemic** and/ or **interdisciplinary** approach,

(ii) Add some other contents that may give autonomy to the unit,

(iii) State previous knowledge (or disciplines) students should know,

(iv) Propose chairs/departments that may be in charge of dealing with this unit,

(v) Select the target students for this unit (undergraduate, graduate students) and curriculum courses (program, year),

(vi) Give reason why this systemic /interdisciplinary approach may favor learning processes,

(vii) Write the unit on a transparency for presentation on the plenary session.

The list of contents handed in comprised thirty-three items related to different agronomic sciences, ranging from hard scientific contents to soft ones.

Participants had to negotiate content selection, unit focus, etc.

Groups were given fifteen minutes each for presentation on the plenary session.

Workshop Two

Instructions

(a) In small groups, discuss the following issues:

(i) Mention a problem related with the agricultural sector to teach the unit you have worked out in Workshop One. State the problem.

(ii) What student activities would you plan to give support to the systemic/interdisciplinary analysis of the unit?

(b) Fill in the transparency to be presented on the plenary session.

Workshop Three

Instructions

(a) Give examples of teaching practices, which do NOT favor the systemic and/or interdisciplinary approach, in some of the following aspects:

(i) Teaching methodologies used by the teaching team,

(ii) Bibliography selection and organization,

(iii) Students' assignments,

(iv) Evaluation,

(v) Other.

(b) Select at least three and propose modifications to make them favor the systemic and/or interdisciplinary approach.

(c)What demands systemic and/or interdisciplinary approaches pose on the teaching team?

(d) Work out a brief report about the group discussion to be presented in the plenary session.

Workshop Four

Instructions

(a)What strengths or weaknesses are implied in the proposed approach? Analyze them from the coordination standpoint, as well as from the intra-institutional, academic, and administrative aspects. Present a report in the plenary session.

(b)Work out a brief report about the group discussion to be presented on the plenary.

Teachers perceptions and trends observed throughout the meeting

Initial diagram

The following table shows some of the relationships among disciplines established by the participants (see Fig.1).

Industrial Crops teachers were the ones that stated more discipline connections. We present only one case here (case 6), with 12 counts in circle 2, and 11 in circle 3.

The Soil Management and Conservation teacher was the one that stated less: 4 in circle 2, and 2 in circle 3 (Case 25); followed by Ecology, 4 in circle 2 and 4 in circle 3 (Case 9).

It is remarkable that Ecology- a transdiciplinary science-was one of the least prolific subjects, as regards interconnections with other disciplines, according to the teacher's view.

On the other hand, sixty-two percent of the participants mentioned Ecology as a discipline related to theirs, 55 % mentioned Physiology, and 42 % mentioned Sociology.

There was no "reciprocity" between some disciplines, although they are "naturally" linked. See Botany (Case 2) and Ecology (Case 9) (Fig. 2).
There was no coincidence among teachers of the same subject as to the relationships they found among disciplines (see cases 6 and 7).
Teachers included in their choices instrumental subjects, such as Statistics.
Only one teacher (see case 9, Table 1) mentioned one subject (Psychology) that was not a component of the curriculum design. Only Chemistry teachers mentioned some "Humanities"- apart from Sociology- such as Epistemology and Sociological Politics, and some cross-disciplines, such as Rural Administration.

Case N°	DISCIPLINE	DISCIPLINES MENTIONED IN CIRCLE 2 Closely connected	DISCIPLINES MENTIONED IN CIRCLE 3 More remotely connected
2	Botany	Ecology, Genetics, Microbiology	Forage Mgmt, Plant Therapeutics, Horticulture, Fruit Crop Production, Oleaginous Plants
6	Industrial Crops	Cereals, Fertilization, Irrigation, Soil Management, Edaphology, Plant Production, Plant Physiology, Ecology, Plant Pathology, Plant Therapeutics, Climatology, Marketing	Mathemathics, Physics, Statistics, Sociology, Rural Admin, Economics, Agricultural Machinery, Botany, Genetics, Microbiology, Biochemistry
8	Industrial Crops	Fertilization, Soil Management, Plant Production, Land Use and Planning,	Botany, Edaphology, Ag. Machinery, Statistics, Ecology, Mathematics, Chemistry, Physiology
9	Ecology	Biology, Edaphology, Climatology, Physics	Psychology, Sociology, Economic Politics, Agric. and Cattle Production
17	Forage Management	Beef cattle, Dairy cattle, Ovine Cattle, Animal Nutrition, Ecology	Health Management, Physiology, Statistics, Biochemistry
18	Forage Management	Climatology, Nutrition, Plant Production, Ecology, Soil Sciences, Animal Production	Forage Production, Animal Physiology, Microbiology, Agricultural Machinery
24	Ecological Cattle Production	Animal Production, Marketing, Plant Production, Forage Management, Economics, Agricultural and Cattle Production Systems	Environmental Pollution, Landfill Management, Decision-making theory, Edaphology, General Systems Theory, Climatology, Hydrology, Residue Recycling
25	Soils Mgmt. and Conservation	Plant production, Edaphology, Agricultural Machinery, Climatology	Animal Nutrition, Botany
37	General Chemistry	Biological Chemistry, Organic Chemistry, Edaphology, Fertilization, Physics, Biology	Economics, Sociology, Political Sociology
39	General Chemistry	Epistemology, Soil Microbiology, Ecology	Rural Admin, Sociology, Economic Politics,

Table 1: Some combinations presented by participants

Some participants underwent a change of opinion throughout the workshops as regards the connections their disciplines had with other knowledge organizations. One teacher- from the Veterinary School- pointed out: "I never imagined I could share planning teaching practices, and have a dialogue with agronomists and a pedagogical adviser!"
All groups commented after the workshops that they could change the epistemological **maps** (diagram) they had stated before the meeting. From an analysis of the relationships established by the teachers (partially presented in Table 1) and some comments made by participants about this activity after the workshops, we may point out some findings of importance as regards our research:
(a) for this group of teachers, the epistemological relationship among disciplines was a soft concept, one that could be changed and constructed, and not a pre-established, positivist one (

see introduction). This was evidenced by the lack of coincidence of teachers of the same subject when making connections, by the lack of reciprocity among disciplines, by the comments they made about their wish of changing their epistemological maps, etc.
(b) all participants but one reproduced the curriculum design (*halo* effect), and considered relationships from the point of view of requirements for their disciplines.

Workshops

These are some of the participants' productions:

Program: Agronomy
Subject: Agroecosystems
Course: 3/4
UNIT: Productive processes in agroecosystems
Intervening Chairs: Plant Production, Animal Production, Marketing, Rural Administration
Contents: Analytical elements to understand the productive processes in the agroecosystems. Integrated management of Productive Processes. Economic dimension of productive systems. Vertical and cross integration of productive processes.
Requirements: Students should have previous basic concepts about Edaphology, Ecology, Economics, Agricultural Machinery, and Sociology.

Figure 3: Participants´ Work (Workshop 1, Group 2)

Problem situation

A dairy farm has reproductive data that indicate an IPE $\bar{X}$ of 16 months, which seems to contradict an excellent nutritional and health management program that is being implemented.

Intervening subjects: Health Management/Forage Management/ Animal Production/Nutrition

Students´activities: Form and worksheet analysis. Software management in simulated situations. Collection of pasture data. *In situ* surveys to observe working routines.

Figure 4: Participants´ Production (Workshop 2, Group 8)

Comments recorded during the workshop observations:

Interdisciplinarity is time consuming

It took them a long time to negotiate starting points of view, especially during the first workshop. One group had problems of understanding the instructions. It was difficult for them to reach a consensus about the unit focus **first,** and then see in what way their own disciplines might contribute to it. Then they were able to work at a faster pace, but time was scarce and not all the planned activities were carried out. Thus, workshops three and four were not carried out. There was a little confusion around the concepts of disciplines/subjects/cultural practices/content areas, etc. within some groups, which had to be cleared out on the spot by coordinators.
As time went by, participants got enthusiastic at their own production as interdisciplinary teams, but they noticed that it took a long time to plan teaching actions. All groups made

comments that expressed their worry about the impact this kind of work could have on ordinary teaching activities carried out within the department.
We noticed the lack of interactive practices in some participants. This made the sessions longer than expected. However, all group members participated and showed enthusiasm. Apparently, there is very little "team teaching" even within the same chair/department. This is an obstacle to interdisciplinary teaching work.
As they worked, all groups spontaneously reflected on the kind of work they were performing. Once they were able to frame a problem situation (Workshop 2), they found it easier to proceed. They enjoyed presenting their work in plenary sessions, and they wanted copies of the work presented by all the groups.

Teachers comments about interdisciplinary/systemic approaches collected in discussions, exchanges with lecturers, plenary sessions, etc.:

Interdisciplinarity vs. disciplinarity

Participants stated unanimously they were afraid that interdisciplinary teaching practices could produce blanks of knowledge in some disciplines, and superficial pre-scientific analysis. This was a strong issue raised after the conferences. The teachers asked the lecturers questions such as: "Isn't knowledge about a particular discipline resented in interdisciplinary teaching practices?" " How are the blanks in knowledge filled in by students?", "Isn't disciplinary * logics * affected by these holistic approaches?", etc. The impact they had about the possibility of meeting and having a teaching dialogue was so great that they were not able to proceed deeper in a critical assessment of these kinds of approaches, and somewhat got stuck in the dilemma disciplinarity vs. interdisciplinarity.
After the "testimony" of interdisciplinarity experiences presented by the FAUBA faculty, most of the questions posed by the participants gave another turn to the screw of content reduction. They also pointed out that in their view interdisciplinary competence is hardly possible without mastering disciplines. In fact, some teachers claimed that it is essential for students to gain some disciplinary training before being exposed to any program of knowledge integration.

Interdisciplinarity as a way to facilitate a better professional intervention

After the two first conferences, which dealt with systemic vs. Cartesian approaches to production problems, participants clearly expressed that they agreed on the need to train students in systemic views, but they felt that they did not know teaching methodologies to do so.

Appeal to management involvement

They also emphasized the need to have curriculum "spaces" where interdisciplinary approaches could be attempted. One teacher went further and stated that if college management were not involved in these approaches, they could fail.

Interdisciplinarity training

Teachers called for "more cross-discipline" training, transferable skills, adaptability, and communication skills. They unanimously stated that they needed to be systematically trained in interdisciplinary skills, and insisted that both training and management involvement were needed.
Participants perceived the concept of the *invisible curriculum* as a necessary framework for integrated university activities.

Coordinating interdisciplinary teams

Teachers made the FAUBA teams several questions related to the coordination of activities. They wanted to know in what way they had articulated the different scientific perspectives, since they believed that classes would otherwise be confusing for students.

Conclusions

In this study we learned that in spite of the tremendous impact of disciplinary tradition within the Academia, some teachers find it possible, even desirable to share and establish systemic and interdisciplinary approaches across chairs and departments. This kind of approaches would enable to articulate theory and praxis and could be one effective way to bridge the gap between university training and professional intervention.

The integration of interdisciplinary/systemic activities is a vital academic addition to programs. Not only does it respond to fragmented curricula, but it also gives an answer to the demands of the present times: knowledge synthesis as well as creative and holistic problem solving skills.

From the teachers´ perceptions expressed throughout the meeting and observations collected, we may state that participants' previous perception about the relationships among disciplines was strongly connected with the curriculum design they had in mind (in most cases the one in which their discipline inserted in their actual teaching practice, mainly veterinary and agricultural curriculum designs).

In some cases, teachers from the same discipline conceived relationships with other fields differently, thus showing that such relations are constructed more than established; this would facilitate the establishment of interdisciplinary and systemic policies in colleges, because in one way it would mean that positivist paradigms may be overcome by teachers, who would be open to different epistemological models.

Participants showed themselves as curriculum-dependent, so it may be assumed that they may seek for spaces specifically designed for systemic or interdisciplinary approaches, more than construct them from their own initiative. This appeals directly to college management and organizations, and go beyond chairs and department boundaries.

Teachers were enthusiastic at the possibility of working together, across chairs and departments. However, the idea that they had to give in some contents in view of interdisciplinary learning units seemed to be a drawback.

Interdisciplinary components should be integrated within a discipline-focused program in addition to, but not detrimental to, the base discipline. Interdisciplinary study should be implemented as it relates to the base (major) discipline or field of study. The responses obtained from the workshops strengthen the contention that interdisciplinary activities are time consuming (Plencovich *et al*. 2000b). This fact arises an issue that may be of importance for college management, since teachers participating in them should be rewarded with incentives, or else they would be overwhelmed by the dual track job of assisting two masters at the same time: the department/chair and the interdisciplinary/systemic teaching activities.

According to teachers, interdisciplinary teaching skills are not naturally acquired. They need to be trained in hands-on courses. We noticed that it could be useful to continue with this sort of meetings in order to train teachers in integrated teaching organization, but the pace should be slower. We strongly recommend courses on participatory teaching skills. As participants persistently held, academic management must create first the *niches* within the curriculum designs to have the real possibility of implementing integrated actions. These kinds of activities cannot depend exclusively on the urge for innovations some teaching groups may have. No matter how deeply involved faculty might be in their own beliefs about the beneficial impact of systemic and interdisciplinary approaches; these activities should be

institutionalized in order to be sustainable. Moreover, coordinators having leading pedagogical roles, not merely administrative, should articulate these actions or the approaches could appear confusing and fragmented to students. And above all, these attempts must rely on the cornerstone of the invisible curriculum concept that gives meaning to all pedagogical activities.

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