Aprendizagem colaborativa, transdisciplinaridade e gestão socioambiental na Amazônia: abordagens para a construção de conhecimento entre academia e sociedade

Collaborative learning, transdisciplinarity and social-environmental management in the Amazon: approaches to knowledge production between academia and society

El aprendizaje colaborativo, la transdisciplinariedad y la gestión socioambiental en la Amazonía: enfoques para la construcción del conocimiento entre la academia y la sociedad

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Resumo

Este artigo apresenta uma reflexão sobre duas experiências de formação de líderes para a gestão socioambiental colaborativa na Amazônia como contribuição à geração de abordagens para o fortalecimento da pós-graduação na construção de caminhos para o desenvolvimento sustentável. As abordagens inter e transdisciplinar aplicadas foram adaptadas de programas de pós-graduação e formação de lideranças da Universidade da Flórida. Essa abordagem, ainda em construção, tem como objetivo integrar teorias e métodos de sistemas socioecológicos complexos com conceitos e experiências de gestão participativa, bem como elementos da aprendizagem colaborativa e experiencial na educação de adultos. As lições aprendidas apontam para oportunidades e desafios na construção conjunta de conhecimento entre academia e sociedade como paradigma inovador de educação para a sustentabilidade na Amazônia, integrando perspectivas e conhecimentos de diferentes atores sociais.

Palavras-chave: Pós-Graduação na Amazônia. Aprendizagem Colaborativa. Sistemas Socioecológicos Complexos. Pesquisa Participativa. Desenvolvimento Sustentável. Transdisciplinaridade.

Abstract

This article focuses on two experiences involving leader training for collaborative social-environmental management in the Amazon seeking to create approaches to strengthen postgraduate education in its construction of paths to sustainable development. The interdisciplinary and transdisciplinary approaches used were adapted from postgraduate and leadership training programmes offered by the University of Florida. The approach, still under construction, aims at integrating complex social-ecological systems theories and methods with participatory management concepts and experiences, and also elements of collaborative and experiential learning in adult education. Lessons learned point to opportunities and challenges in the joint construction of knowledge by academia and society as an innovative paradigm of

education for sustainability in the Amazon, integrating the perspectives and knowledge of different social actors.

Keywords: Postgraduate Education in the Amazon. Collaborative Learning. Complex Social-Ecological Systems. Participatory Research. Sustainable Development. Transdisciplinarity.

Resumen

Este artículo presenta una reflexión sobre dos experiencias de formación de líderes para la gestión socioambiental colaborativa en la Amazonía como una contribución a la generación de enfoques para el fortalecimiento del posgrado en la construcción de caminos hacia el desarrollo sostenible. Los enfoques inter y transdisciplinario aplicados son una adaptación de los programas de posgrado y formación de liderazgos en la Universidad de Florida. Este enfoque, todavía en construcción, busca integrar teorías y métodos de sistemas socio-ecológicos complejos con los conceptos y las experiencias de gestión participativa, así como elementos de aprendizaje colaborativo y experiencial en la educación de adultos. Las lecciones aprendidas apuntan a oportunidades y desafíos para la construcción conjunta de conocimiento entre la academia y la sociedad como paradigma innovador de la educación para la sostenibilidad en la Amazonía, integrando perspectivas y conocimientos de diferentes actores sociales.

Palabras clave: Educación de Posgrado en la Amazonía. Aprendizaje Colaborativo. Sistemas Socio-Ecológicos Complejos. Investigación Participativa. Desarrollo Sostenible. Transdisciplinariedad.

Introduction

In the past 20 years, from the first United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 to the Rio+20 Conference in 2012, there have been profound changes in the production and transmission of scientific knowledge towards

sustainable development. Transformations in science and higher education are not isolated from transformations in society, its means of communication and paradigms of development. The very concept of sustainable development has been the target of transformations and subject to criticism and reviews. However, the emphasis on interdisciplinarity as a tool for the shared analysis and resolution of environmental problems, for the quality of life of future generations and the integration of multiscale social, ecological and economic dimensions (from local to global level and vice-versa) has been maintained along this path (BRAZIL, 2012). This paper presents a contribution to the construction of interdisciplinary and transdisciplinary approaches to adult education, aimed at training leaders for collaborative social-environmental management in the Amazon.

In higher education, the prospect of sustainable development presumes a knowledge transformation process that is opposed to scientific rationality based on reductionist and fragmented models and encourages the construction of interdisciplinary and integrative knowledge. Interdisciplinarity can be understood as a form of knowledge that integrates disciplinary perspectives as a way of finding convergence and dialogue between theoretical frameworks and science methods without fragmentation of the phenomenon (FERNANDES; SAMPAIO, 2008). For Piaget (1972), interdisciplinarity consists of the mutual exchange of various disciplines, with mutual enrichment as a result. Japiassú (1976) qualifies interdisciplinarity by the intensity of exchanges among experts and by the degree to which disciplines are integrated in a common project. Sharing information and perspectives becomes something necessary in this process, in which there is no moving forward without dialogue between researchers and disciplinary approaches.

In Brazil's postgraduate education, interdisciplinarity emerges driven by the need to interconnect practical knowledge while widening technical-scientific cooperation. In 2008, Capes redefined its Multidisciplinary Area created in 1999 and renamed it Interdisciplinary Area (CAInter). The existence of CAInter spurred the proposition of courses with an interdisciplinary vision, following the global trend of increasing the number of research groups and academic programmes addressing

complex issues that require interdisciplinary philosophy and practices (BRAZIL, 2012).

By the end of 1980, the epistemological paradigm of transdisciplinarity was more strongly established in the academic world, covering forms of knowledge that were beyond western science and theoretical-methodological disciplinary borders (FREITAS; MORIN; NICOLESCU, 1994). The transdisciplinarity approach is still relatively new and contested in academic circles. For some, it is a way of building integrative knowledge that goes beyond western science disciplines, requiring dialogue, exchange and the integration of academic knowledge and the knowledge systems of non-academic participants (TRESS; TRESS; FRY, 2005). Other authors construe transdisciplinarity as a philosophy used to understand the world that enables the transcendence of disciplines, whose connections would be situated within a whole system with no fixed borders (PIAGET, 1972; NICOLESCU, 2008).

In the past twenty years, despite the proliferation of NGOs, policies and research projects aimed at participatory sustainable development and focused on the local scale while at the same time involving interdisciplinary and transdisciplinary knowledge construction processes, the synthesis and feedback of lessons learned and the implications of these experiences for the practice of higher education in Brazil still require effort and specific resources. The relevance of these experiences in terms of understanding the interdisciplinary and transdisciplinary building process, the paths of socially constructed knowledge, and the possible insertion of alternative education and research models in formal education needs to be synthesised and socialised (BRAZIL, 2012).

This paper presents a reflection on two leadership training courses for collaborative management in the Amazon. These experiences are at the interface of participatory and sustainable development concepts and practices; of a systems, interdisciplinary and transdisciplinary approach to the understanding of environment-society inter-relations; and of collaborative learning in adult education. These initiatives were developed through international cooperation and partnerships with higher education institutions in the Amazon region, as well as with other

institutions. By analysing and reflecting upon these experiences, we aim to contribute to the generation of innovative proposals for formal and informal education in the Amazon Region, integrating academy and society in the construction of multicultural, inclusive and shared development.

Background and analysis units

The Amazon Conservation Leadership Initiative - ACLI programme funded by the Gordon & Betty Moore Foundation is part of the Tropical Conservation and Development Programme of the University of Florida (TCD)[1]. The TCD aims to strengthen university education for tropical conservation and development and is based on joint action of academia and conservation professionals; on the integration between social and biological sciences; and on the integration of theory and practice (KAINER et al., 2006).

In December 2007, ACLI organised a workshop in Manaus on The State of the Art of Amazon Region Postgraduate Programmes Related to Biodiversity Conservation and Sustainable Development. In this workshop, the coordinators of post-graduate programmes from 14 universities, researchers from the University of Florida and other actors in the Brazilian Amazon acknowledged the existence of constraints to the ability of PPGs (Postgraduate Programmes) to meet the challenges of biodiversity conservation and sustainable development, in terms of both knowledge production and vocational training (ACLI, 2008). One of the recommendations of this meeting was to ensure that PPGs address the interdisciplinary theme of biodiversity conservation and sustainable development in the Amazon in greater depth, highlighting partnerships between universities, other institutions and social actors.

The leadership training course held in Alta Floresta, MT in 2009 was a follow-up to this process. A group was formed after the course, consisting of persons interested in learning and working collaboratively in the study and management of Amazon landscapes. The CNPq research

[1] ACLI: http://www.sfrc.ufl.edu/ACLI/; TCD: www.tcd.ufl.edu.

group on Water, Forest and People was thus created, followed by the development of a second course, made official as a Specialisation Course with a two-year duration.

The units of analysis examined in this paper are the two leadership training courses for environmental management in the Amazon held in Mato Grosso. The first was an informal training experience and is called Alta Floresta Course along the paper. The second is the formal Specialisation Course and is called Cotriguacu Course. The focus of analysis is the process of interdisciplinary and transdisciplinary knowledge construction through collaborative learning between groups of participants and between these and groups of social actors of the Amazon region.

1) Informal leadership training course (Alta Floresta Course)

The course – Developing Collaborative Strategies for Environmental Management in the Brazilian Amazon – was conducted by the University of Florida in Alta Floresta in July 2009 and lasted 14 days. It included 19 participants from seven Amazon universities (the Federal Universities of Acre, Amapa, Amazonas, Pará, Rondonia and Tocantins, and the State University of Mato Grosso), including three postgraduate programme coordinators. The multidisciplinary and multi-institutional focus was enhanced by the inclusion of representatives from the state government, the private sector, the Kaiabi indigenous people and NGOs as course attendees. The course's objective was to equip participants to face environmental management-related challenges in the Amazon and to understand the diversity of land uses, social actors and public policies represented in the study area.

2) Non-degree postgraduate course (Cotriguacu Course)

The specialisation course – Collaborative Management of Social-Ecological Complex Systems in the Brazilian Amazon – was a follow-up to the Alta Floresta Course and was delivered through a partnership between the University of Florida and the State University of Mato

Grosso (Unemat), with the support of the Cotriguacu Municipal Government, the Mato Grosso State Secretariat for the Environment (Sema- MT) and the Life Centre Institute (ICV). The course focused on the Cotriguacu region of Mato Grosso and lasted for two years (from 2010 to 2012), consisting of four face-to-face modules lasting an average of 10 days, in addition to activities between modules. The 23 participants represented different subject areas, institutions and management experiences in the Amazon. A research project entitled Developing a Collaborative Social-Environmental Management Model in a Programme of Payment for Environmental Services in the State of Mato Grosso was conducted together with the course with funding from the Research Support Foundation of the State of Mato Grosso (Fapemat).

Theoretical-methodological approach

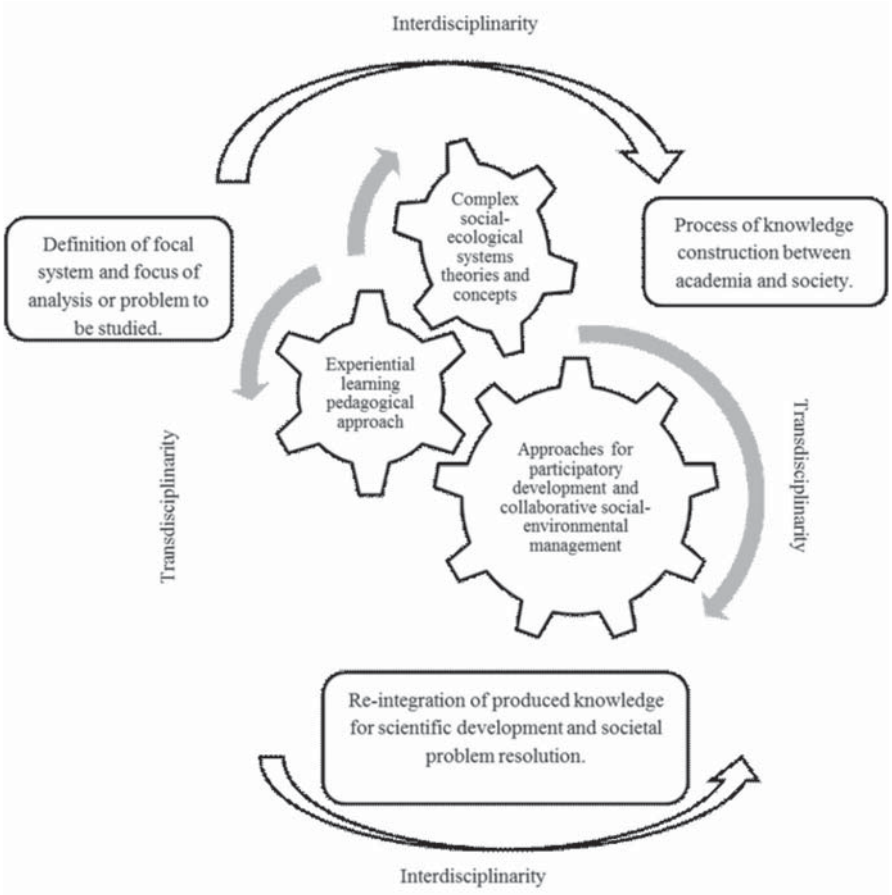
In their book "The new production of knowledge," Gibbons et al. (1994) described the emergence of a different form of scientific knowledge production, different from conventional academic production, which they called mode 2 knowledge production as opposed to mode 1 or conventional science. Among the paradigms that underpin the transformation of knowledge production advocated by the authors are the application context, transdisciplinarity, the heterogeneity of places and audiences involved, reflexivity, social responsibility and the unique quality control of this production.

In 1960s Brazil, Paulo Freire regarded the dialogue between knowledge and collaborative learning as the path of education for freedom, and he preached the construction of knowledge between science and society as a political-social practice. Freire emphasised the value of local knowledge, the construction of knowledge based on the subjects' reality, and breaking the distinction between researcher and object of research for a form of collaborative learning between teacher and student, researcher and researched, and ultimately, science and society (FREIRE, 1967; 1970; 1985). In his reflections and educational practices, Freire already had elements for a form of multi-epistemological knowledge construction that transcended academic boundaries.

With the convergence of crises in education and the conventional top-down development model, participatory approaches to development have arisen more strongly from the 1980s onwards, using mode 2 knowledge production precepts (CHAMBERS, 1994). Knowledge is not transferred from teacher to student or from expert to social actor; it is produced with a collaborative learning process that integrates theoretical frameworks and practical knowledge targeted to the resolution of problems. Although many approaches, criticisms and perceptions about participatory development exist, one of the precepts of this approach is the focus on the right to participation and on collaborative learning, leading to the empowerment of local communities to make autonomous decisions (Ibidem).

The changes in education, research and extension reified at the first Rio 92 meeting coincided with political openness in Brazil, the beginning of the ecological crisis and awareness, the crisis in disciplinary scientific knowledge, the crisis in the capitalist model of development and finally, with the crisis in the scientific colonialism of western science (SANTOS, 2009). In this scenario of transformation, transdisciplinarity emerged as a proposal for the construction of knowledge that transcended academic disciplines and allowed the incorporation of a plurality of academic and non-academic epistemologies in the analysis of a common problem.

It is important to consider that understanding transdisciplinarity as a form of construction of knowledge or epistemological paradigm does not necessarily teach us how this plural and multidimensional knowledge can be constructed. Hence, it is important to seek pedagogical elements and philosophical principles to qualify, synthesise and share transdisciplinary experiences. In the case of the two courses discussed in this paper (Alta Floresta and Cotriguacu), experiments were carried out to reconcile systemic interdisciplinary approaches with elements of collaborative and experiential learning in adult education, integrating research principles and participatory development. The theoretical-methodological approach used in both courses is summarised in Figure 1. According to this approach, the knowledge produced in the transdisciplinary process must be reintegrated, both for scientific development and for the resolution of society's problems.



Note: The interdisciplinary and transdisciplinary knowledge construction process occurs with the integration of participatory development and research theories and methods, experiential learning in adult education and a complex social-ecological systems approach.

Figure 1.Theoretical-methodological approach adopted in the leadership training courses for collaborative management of social-ecological systems in the Amazon.

Methods and tools for the analysis of complex social-ecological systems were used in both experiences, adapted from a resilience evaluation manual developed by a group of scientists called Resilience Alliance[2]. The group, an interdisciplinary theoretical body for the integrated study of the relationship between ecological and social systems, developed the social-ecological systems approach (GUNDERSON and HOLLING, 2002). Both courses used elements of resilience assessment as a theoretical framework to conduct assessments and research exercises, by participants among themselves and between them and regional

[2] www.resalliance.org/index.Php/resilience_assessment.

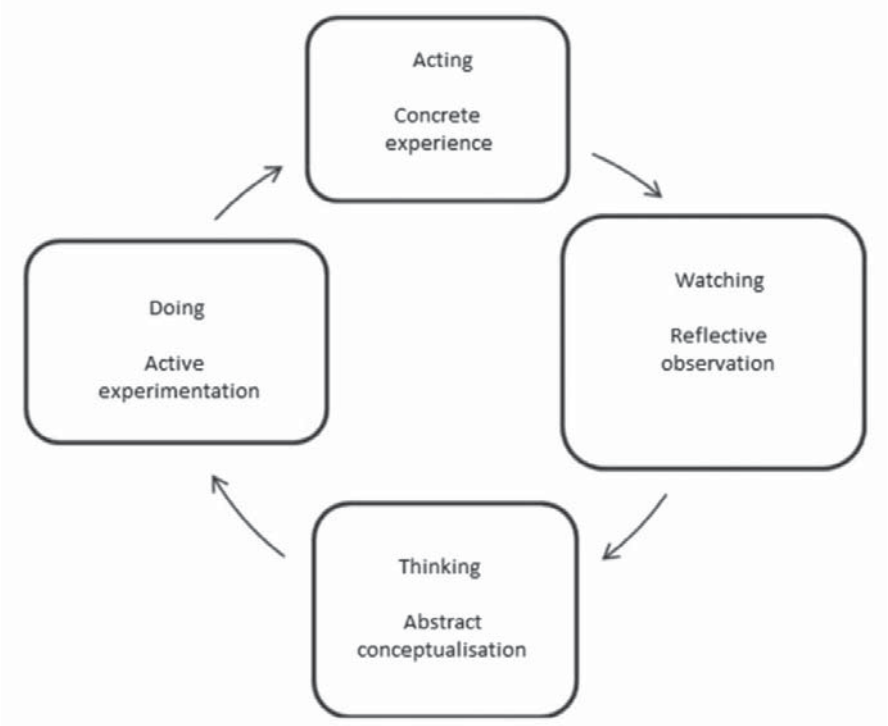
social actors. As an example, an initial step in the implementation of this methodology involves an analysis of the system's history in order to identify factors of change, leading to the understanding of how the system organises itself and reacts to disturbances. Resilience can be translated as the ability of a system to absorb disturbances and reorganise itself in the face of change, keeping functions, structure and mechanisms that are essential to its existence (WALKER et al., 2004). The concept of resilience has been advocated as a paradigm for sustainability for recognizing the dynamic and interactive aspects of social-ecological systems, their cycles, reorganizations, scales, interactions and emerging properties (FOLKE et al., 2002).

The pedagogy used in the courses is based on experiential learning theory and practice adapted to adult education, integrated with training for collaborative leadership (O'LEARY; BLOMGREN; CHOI, 2010). Some leadership training methods were adapted from the Natural Resources Leadership Institute of the University of Florida[3] (NRLI). As opposed to top-down or hierarchical leadership, both courses aimed at training leaders for collaboration, qualifying them to solve complex problems that require interdisciplinary understanding and collaboration among multiple actors. Skills were developed to manage dynamic processes associated with disputes and conflicts in the management of natural resources by social actors having different – and often incompatible – interests, knowledge and management systems. Specific methods were used to provide participants with the opportunity to listen to the perspectives of multiple actors and then reflect as a group on the implications of these visions. The search for closed concepts is not the most important objective to be attained in the education process; rather, we focus on sharing different understandings and experiences involving concepts and problems, generating new ideas and forms of analysis (FREIRE, 1985).

Specific skills in for collaborative leadership training included tools to design facilitation processes for dialogue and group learning, both within the group of participants and between them and social actors of the Alta Floresta and Cotriguacu regions. The participants were thus prepared for teamwork, exercising collaborative leadership in their professional activities by understanding the operation of groups and networks (O'LEARY; BLOMGREN; CHOI, 2010).

[3] http://nrli.ifas.ufl.edu/

The experiential learning theory used in the courses is based on education for freedom and psychology of education approaches developed by educators and theorists such as Paulo Freire in Brazil and David Kolb in the United States. This theoretical and methodological framework is critical of the traditional approach focused on the student-teacher transfer of knowledge, which, according to the authors, limits the ability of students to become independent learners (FREIRE, 1967; KOLB, 1984). The incorporation of Kolb's experiential learning cycle (1984) to the design and development of the courses boosted the students' learning process (Figure 2). The cycle begins by providing concrete experiences that trigger comments and reflections. Learners translate their reflections into abstract concepts and begin to envision implications for new actions. Finally, experimenting and testing new ideas provide concrete experiences that lead the subject into repeating the learning



Note: The cycle comprises four stages, starting with an action or concrete experience, followed by an individual or group reflection, which leads to a conceptualization or theoretical review of the theme under analysis and finally, to the application of experiential learning, which is again experienced in future actions.

Figure 2. Kolb's experiential learning cycle (1984)

In the experiential learning approach, participants are encouraged to reconstruct their own experience, so that learning is seen as a process and not as a result or product. Disagreements, differences and conflicts become catalysts in the learning process as participants expose themselves to ways of thinking, feeling, reflecting and acting (KOLB; KOLB, 2005).

To enable the construction of interdisciplinary and transdisciplinary knowledge, we used group learning dynamics and tools such as interviews and field visits with local social actors, lectures by specialists, mixed panels (in round table format) with social actors contributing different forms of knowledge and perspectives, scenario exercises, a show of experiences, and facilitated discussion of readings and films. Tools and methods such as monitoring groups, facilitated dialogue and individual and group reflection were used to ensure meta-learning and to boost exchanges between disciplinary knowledge and the knowledge of local actors. Monitoring Groups were formed by participants to recall the activities of the previous day or period, as well as to bring important elements about the group's learning dynamics and conduction of activities. These groups were creative in the development of reflection activities and processes (which also help to break the ice and unwind the group) and these were documented in a booklet containing a collection of dynamics from the Cotriguacu Course (ATHAYDE; BARTELS; BUSCHBACHER, 2011).

The approach used at the Alta Floresta Course for the participation of social actors and inclusion of their perspectives in understanding the region's social-environmental system began with a technical lecture on economic sectors, regional panoramas and/or public policies. Then, field visits were made and interviews were conducted, providing better knowledge of the diversity of local actors and the conditions in which they live. Finally, discussion panels fostered dialogue with and between actors, and represented several productive sectors and points of view. At the end of the course, participants showed to social actors their own analyses and models for understanding reality.

The assessment process was developed in such a way as to provide continued reflection on learning at the individual level and as a group,

using individual reflection texts and formal assessments after and between each face-to-face phase. Participants were encouraged to keep a learning journal to record major points learned during face-to-face phases.

Structure of the courses and lessons learned in Mato Grosso

A group of three coordinators spent four months planning and coordinating the activities for the first course in Alta Floresta. The coordinators' familiarity with the theoretical and methodological approach previously used, as well as their research and work experience in the Amazon, were key elements for the success of the course. But there were barriers in the planning process for the Cotriguacu Course, which was a continuation from Alta Floresta. An attempt was made at participatory planning for the course involving the newly formed Alta Floresta group. However, the planning process was hindered by difficulties regarding distance, time availability, conflicting time schedules and in particular the lack of sufficient clarity about the roles and responsibilities of participants. A first lesson learned was that the planning phase would require much more time, dedication and strategy if it was to be carried out jointly and in a participatory way, possibly avoiding the conflicts that followed. While the Alta Floresta Course was informal and short in duration, the Cotriguacu Course was a formal non-degree specialisation, which hampered the flexibility of activities and imposed some necessary administrative procedures.

In both experiences, the selection of participants took into consideration the representativeness of diverse experiences, disciplinary areas and institutions operating in the Amazon. It was also decided to include representatives of local communities with a variety of backgrounds and experience. Among the Alta Floresta attendees, there was a person from the local forestry sector and a representative of the Kaiabi indigenous people. Four local representatives took part in the Cotriguacu Course: one from the forestry sector, one from the Secretariat of Agriculture, one from Sema-MT and one from the livestock industry. This diversity of

participants fulfilled one of the guiding principles of the approach, which aimed at leveraging the group itself as a learning space for understanding and managing the social diversity represented in the Amazon region.

In Alta Floresta, emphasis was given to analysing public policies relevant to sustainable development in the region, and to how different social actors representing regional socioeconomic sectors participate, understand and affect these policies. The core of the course was an analysis of three land use systems in the region. As the course went on, the study of the sectors became more complex and thorough, complementing the analyses and methodologies used in previous sectors. The course began with the forestry sector by focusing very specifically on the reforestation potential of planting teak (Tectona grandis) to meet the industry's challenge of ensuring an adequate supply of raw material. The agricultural sector was dealt with at a second moment with the examination of a particular state public policy called "Legal MT", which involves the regularisation and licensing of rural properties. The third subsystem focused on the assessment of protected areas in the context of the regional mosaic of different land uses, including public and private conservation units and indigenous lands.

In Cotriguacu, the four face-to-face modules were organised to enable the progressive understanding of the region as a social-ecological system, covering its historical context, economic activities, the environment and the social actors that determine regional landscape dynamics. During these modules, participants developed group projects called demonstration projects, with the purpose of learning and testing the methodology to assess resilience by engaging with groups of local social actors.

In Cotriguacu, different actors interact based on specific systems of land knowledge, use and management. In contrast with the Alta Floresta course, the Cotriguacu course started with a broad question: "How can the region's land management systems and natural resources be kept viable?" This question gave participants ample flexibility and openness to listen to actors about their expectations, difficulties and

goals. However, it also hindered the integration between actors and the existence of a common ground. Participants were divided according to groups of social actors present in the municipality. In addition, a fourth group employed the course's theoretical-methodological approach with riverine communities in Rondonia and Amazonas.

These were the four working groups organised for the Cotriguacu Course:

- Family agriculture, especially rural settlements;
- Middle-sized and major rural producers (forestry production and livestock sectors);
- Indigenous peoples (Rikbaktsa indigenous people); and
- Traditional populations (riverine communities of the Porto Velho region in Rondonia and lower Rio Negro in Amazonas).

These groups remained together until the end of the course. On the one hand, they made it easier to deepen the analysis of that social group, but on the other hand they limited the exchange and interaction among participants. In spite of the efforts to come up with activities to connect and integrate the groups by using the resilience assessment exercise, they remained relatively isolated. The analysis of different social-ecological sub-systems represented by the groups of actors coexisting in the Cotriguacu landscape did not get integrated into the course until its last module, when a scenario exercise was conducted. In the first module, a cross-section water resources group was created and organised according to social-environmental themes instead of by sector or regional actor, as with other groups. It was an interesting experience because it showed the importance of creating variables and cross-cutting themes for analysis to build bridges between disciplines, groups of actors and contrasts in local knowledge.

Applied research projects were developed by participants in-between face-to-face phases. In these projects, participants researched groups of social actors and synthesised their work into individual course completion monographs. Participants conducted research on regional history; environmental perception; public policies for conservation and development in the Amazon; use and management of natural resources; social networks; and productive systems in Cotriguacu. Two

participants conducted research in other regions of the Amazon – forced displacement caused by construction of the Jirau dam in Rondonia and fishing dynamics in the Amazon River (traditional populations group) – and one participant conducted her research on the concept of collaboration as perceived by the group of participants. In order to deepen their theoretical knowledge and follow up these projects, participants held monthly meetings on the internet in-between face-to-face phases, and an internet page was set up to share bibliographical references and other technical documents.

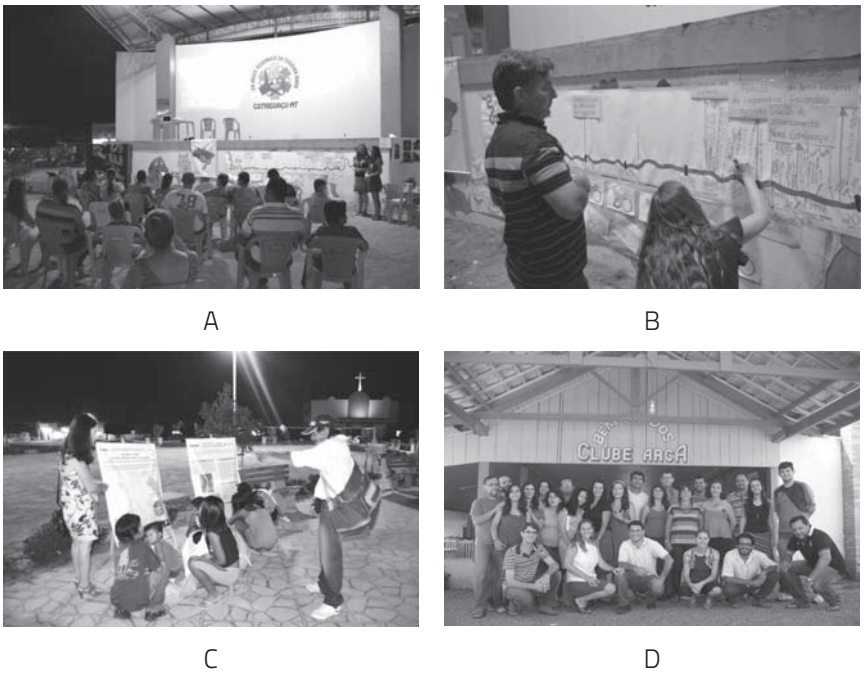
An example of transdisciplinary knowledge brought about by the interaction of participants of the indigenous group with representatives of the Rikbaktsa people was the reflection on the concept of territory. The group realised that according to Rikbaktsa concepts, all areas ancestrally occupied by them are part of their territory, even though they are geographically separated. Therefore, the group's focus of analysis, which had been the Escondido Indigenous Land located in the Cotriguacu municipal area, had to be adjusted to include other Rikbaktsa areas in Mato Grosso. In other words, the Rikbaktsa concept of territory seems to transcend the western disciplinary frontiers of geography and biophysics. The indigenous group's approach of listening and moving closer to the Rikbaktsa without a predetermined theoretical framework or a closed research question was important because it opened their perception to other visions of the world, in this case different from western science.

It is important to emphasise that the engagement of actors during both courses was an exercise to demonstrate the method. In a real participatory research situation, the participation of actors in planning and executing the research would take place in greater depth and within a time horizon appropriate to the specific characteristics of the actors and the research objectives or the process in question.

Products and feedback of results to the local population

In both experiences, there were events for the submission and feedback of results to the local population. In these events, participants organised

themselves into groups and created playful activities to be conducted with visitors. The different phases of participatory research were therefore exercised by participants in their full cycle: approximation, joint work with actors, and sharing of research results (even if preliminarily) as a philosophical approach to knowledge construction between participants and groups of social actors. A Cotriguacu Knowledge Fair was held with the participation of urban and rural residents. In this event, the group of course participants organised nature-themed playful activities with children; an interactive timeline was set up to tell the story of the municipality together with residents; there was a photographic exhibition about the Rikbaktsa People; and monograph posters by the participants were exposed (Figure 3).



Photos: Simone Athayde.

Figure 3. Specialisation course on "Collaborative Management of Complex Social-Ecological Systems in the Brazilian Amazon." A-C: Cotriguacu Knowledge Fair, event held at the municipal square. A. Projection of slides and explanation of course results to the population of Cotriguacu. B. Construction of a time line with visitors, telling the local history. C. Exhibition of participants' monograph posters, and a

visit of representatives of the Rikbaktsa indigenous people. D. Group of participants, local actors and course teachers.

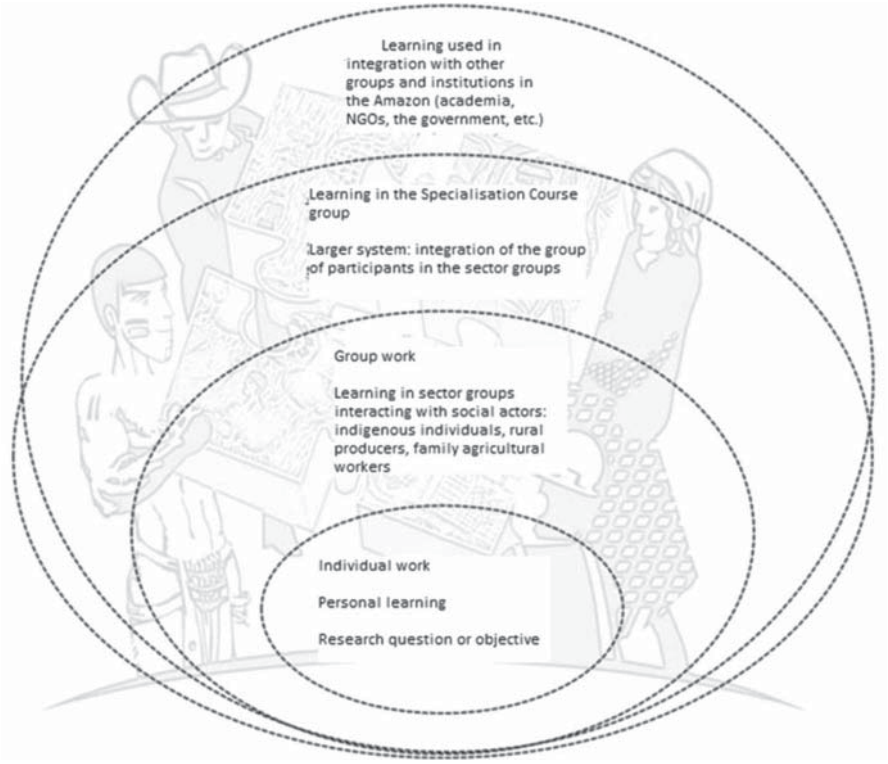
The products developed by the Alta Floresta Course participants were preliminary models of the interaction of critical environmental variables in key regional sectors – forest management, agriculture and livestock, and conservation – and possible future scenarios with and without governance (BUSCHBACHER; ATHAYDE; BARTELS, 2010). In Cotriguacu, the products generated were end-of-course monographs, group reports and other products under preparation (a book for the general public and scientific papers). It is important to note that the research exercises and the regional analysis tools were used with the objective of developing skills and using collaborative learning pedagogy, generating subsidies for regional management. However, in both cases a systematic effort would be needed to examine and review the results with local actors to validate these as a detailed description of the regional system.

As an indicator of success, several activities to adapt and reuse these approaches were developed by participants themselves. A training course was led by Federal University of Acre (Ufac) teachers and by a few participants of the Alta Floresta and Cotriguacu courses in 2010. A new specialisation course is being implemented in Alta Floresta for technical personnel of the Life Centre Institute and Ouro Verde Institute. In addition, principles and lessons from this approach are being used to develop an Integrative International Research Programme on Hydroelectrical Dams in the Amazon, a cooperative effort between the Federal Universities of Rondonia and Tocantins, the State University of Mato Grosso and the University of Florida.

Reflection: transdisciplinarity, collaborative learning and adult education in the Amazon

Both courses provided learning at various levels and scales, from the personal or individual scale through to the scale of groups of participants, who took these experiences back to their institutions and to the Amazon

system. One can understand the construction of transdisciplinary knowledge as a set of levels that feed each other, like the concept of panarchy introduced by the scientists who developed the complex social-ecological systems approach (GUNDERSON; HOLLING, 2002). Figure 4 presents a diagram illustrating this multidimensionality and the levels of learning and knowledge exchanged among academia, social actors and institutions within the transdisciplinary paradigm.



Note: The dashed lines indicate the fluid boundaries between learning levels. The background figure represents groups of social actors having different natural resource management systems in the Amazon.

Figure 4.Panarchy or learning levels and transdisciplinary knowledge construction based on the Cotriguaçu specialisation course.

An important lesson learned for the construction of interdisciplinary and transdisciplinary approaches in postgraduate courses in the Amazon Region relates to the issues of disciplinary representativeness and the representativeness of social actors' perspectives. As emphasised by Lele and Norgaard (2005), there are several obstacles to strengthening and enhancing interdisciplinary approaches in academia. Among them is the

fact that interdisciplinarity depends on cooperative and/or collaborative processes between professionals who are willing to cross disciplinary frontiers. Consequently, it is easier for social science academics of certain fields to work with academics of the biophysical sciences (or natural sciences). In general, interdisciplinary work between economists and biophysical scientists is rarer than between anthropologists and sociologists working with biologists and agronomists, for example. In these courses it was difficult to attract professionals from the economic and legal areas. Consequently, interdisciplinary analyses were restricted to the social sciences and humanities (especially to anthropology, education and regional development), and the natural sciences (forest engineering, biology and agronomy).

The Alta Floresta course had more disciplinary representativeness in the analysis of public policies, which are interdisciplinary by nature and require the integration of multiple disciplines for their understanding. Since the focus of the analysis was more open in Cotriguacu, with the use of resilience analysis methodology based on the perspective of local actors, emphasis was given to social science content at the expense of ecological or environmental analyses. The existence of cross-cutting themes can facilitate the construction of these bridges, as in the case of the water resources group formed during the demonstration project in the first face-to-face module in Cotriguacu.

The engagement of and interaction with local social actors was not an easy, natural process either. In Cotriguacu, the group faced difficulties when working with some groups of social actors. The collaborative approximation with the Rikbaktsa indigenous people was a long and slow process, difficult to be accomplished within the course's time frame. Contacting and interviewing rural producers in the forestry and livestock sectors was also complicated, in spite of the presence of local representatives in the group of participants. Therefore, understanding the actors, their identities and their management goals was preliminary, but learning about the multiplicity of actors, identities and knowledge represented in the Amazon frontier was enriching. It should be stressed that the courses focused on developing theoretical knowledge and skills for the analysis of social-ecological systems. There was no ambition

to do academic research with the same scientific rigour needed for a master's or doctor's degree.

Another lesson learned concerns the issue of training leaders and of collaborative management in the Cotriguaçu experience as opposed to Alta Floresta, where we already had a ready-made package of concepts, methods, tools and pedagogy. If, on the one hand, this collaborative course development experience was important to strengthen leadership and encourage creativity among participants, on the other hand, the lack of feedback on collaborative processes and the tension between leading and letting lead were difficult to manage between the coordination team and the group, which brought conflict and frustration. In the future, it will be necessary to determine the role and responsibilities of each course participant clearly and in advance, as well as to emphasise the importance of end-of-learning evaluation and feedback on collaboration and on interdisciplinary and transdisciplinary knowledge production.

It is important to emphasise that this analysis does not advocate transdisciplinarity, collaborative learning or participatory research as the only valid forms of adult education practice in natural resource management processes with the involvement of multiple social actors. The combination of disciplinary approaches in multidisciplinary, interdisciplinary and transdisciplinary processes should occur if deemed most adequate for the achievement of educational or research objectives.

Conclusion

The participatory research and collaborative learning approaches developed in the experiences analysed in this paper bring elements to integrate social actors in the process of knowledge construction, at the same time that they facilitate mutual learning among researchers, technical personnel and other actors interacting in the Amazon. The dialogue between different forms of knowledge, both in postgraduate education and beyond academic spheres, can be boosted by an exchange of experiences and by the participants' individual and collective awareness of the interdisciplinary and transdisciplinary process.

The importance of including professionals from a variety of subject areas and management experiences in formal and informal educational processes related to sustainable development is emphasised. In the case of the Alta Floresta and Cotriguacu courses, the inclusion of professionals from the economic, legal and political areas among others would have enriched the analysis process and the interdisciplinary experience. Another point to be aware of concerns the definition and prior agreement of the roles to be played by educators and researchers in educational processes that involve multidisciplinary groups working collaboratively. We suggest that the evaluation process of training courses be planned in such a way as to enable individual and group learning processes to be monitored, systematised and shared, and the impact of this learning in the professional life of the participants to be understood. Recording, analysing and giving feedback on multidisciplinary group learning is a great challenge to the advancement of formal and informal education in the Amazon.

Postgraduate education in Brazil can be strengthened at various levels and spheres of knowledge construction, aiming at a more thorough fulfilment of objectives in training leaders for collaborative social-environmental management. The coordination of efforts between universities and other institutions to integrate formal and informal training with research and extension processes and local development projects is recommended, using interdisciplinary and transdisciplinary approaches in connection with local and regional actors. Another suggestion is the creation of disciplines that are common to universities and postgraduate programmes, with face-to-face steps complemented by distance learning. It is important to emphasise technical-scientific cooperation to strengthen national and international postgraduate training in Brazil, by creating international cooperation and academic exchange programmes and networks.

Educational proposals that take into account the multidimensional, multicultural and multiscale character of interdisciplinary and transdisciplinary knowledge production and application may create platforms for the transformation of society towards sustainability at

a time of increasing economic and environmental vulnerability after Rio+20.

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