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New Learning Foundations for Building Water Knowledge Bridges

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Abstract: Five regional meetings promoted by UNESCO in 2009 addressed the growing need for transdisciplinary approaches, holistic vision, incorporation of non-formal knowledge and views, effective participation and bottom-up action for identification of water problems and solutions. There is, however, a general context of tension and competition between specializations within different disciplines, and without specialization it is difficult to obtain formal and academic recognition. This paper presents insights into new co-learning methodologies centred in the experience of participants, inspired by and adapting the pedagogic approach developed by Paulo Freire, to the context of water management educational needs. This innovative approach has been applied as part of the Erasmus Mundus Master in Ecohydrology. The courses utilized the network of the UNESCO Hydrology for the Environment, Life and Policy (HELP) Programme to access experts with practical and academic experience. Drawing on their experiences and those of their colleagues, guest presenters and course leaders, the participants reflected on their practical IWRM challenges and reconsidered their options from new perspectives. Participants were encouraged to think "outside the water box" and focus on the role of IWRM in delivering society's broader policy objectives.

Keywords: *IWRM, co-learning methodologies, Paulo Freire pedagogy, UNESCO HELP network*

This paper is a first attempt at discussing the adaptation of a very powerful pedagogic stream, developed in the 1970's for a specific social context by Paulo Freire, to the challenges of knowledge-building to solve the increasingly complex problems in water management. Departing from a set of practical experiments through three Masters courses, we reflect on the challenges and outcomes of this approach. The following text is an exploratory incursion, bridging the worlds of water management and alternative views of education and the learning process, aimed at guiding water management practice and, ultimately, influencing policy change.

Introduction

The growing global water challenges are well documented (e.g., FAO 2011; UNWWAP 2009). Demographics and increasing consumption resulting from rising per capita incomes are the most important drivers or pressure on water (UNWWAP 2009). According to the UN, population dynamics such as growth, gender and age distribution, and migration create pressures on freshwater resources through increased demand and pollution. Further, landscape changes associated with population dynamics, such as migration and urbanization, can create additional pressures on local water resources and increase the need for water services (UNWWAP 2009). The anticipated impacts of climate change pose additional stress on food production systems already under pressure to satisfy the food needs of a rapidly growing and progressively wealthier world (FAO 2011). As agriculture develops and land and water use intensifies, the impact of agriculture on natural ecosystems becomes even more apparent. This impact damages the integrity of those ecosystems, undermining the food-producing systems that they support. According to the FAO (2011), effective adaptation to the impacts of climate change on water and agriculture will require a sound understanding

and integration of agronomic science with water management and hydrology, together with due regard for the resulting environmental interactions and trade-offs.

As pressure on the world's water resources has increase, it has translated into new and increasingly interconnected challenges. In response, water management has also changed over time with the introduction of new disciplines, new techniques, new language, and new thinking. Ecology, economics, and other social sciences have all progressively added to the historic hydrology and engineering base. The evolution and verification of new problems led to the need to adopt "imported" terms from other sciences (Neto 2010). This often led to the use of concepts that were originally defined for a determined purpose in a specific disciplinary context, being commonly used with diverse scope in other disciplinary areas. According to Neto (2010) "this gave rise to a certain conceptual confusion and the construction of a mixed terminology that was not always duly referenced. For example, the concern to bring the efficiency angle into the management of water resources so as to contemplate economic costs led to various terms originating from economics being added to the "hydrology" vocabulary. An illustration of this is the generally unsuitable and out of context application of the term "supply" and "demand" of water or the "water market," restricting the assertion to a service provision and interpreting water as a mere "commodity" subject to "natural monopoly." More recently, sociology, anthropology, and social psychology have also become part of solution to the challenges of water management. This has required re-thinking of some of the previously integrated terms and encouraged a more rigorous definition of the concepts used by different specialists (Neto 2010).

There has been a shift from seeking solutions within individual scientific disciplines to multidisciplinarity, interdisciplinary solutions and, more recently and increasingly, to transdisciplinary thinking and approaches – to seeking solutions in the interstitial spaces between scientific disciplines. Bammer (2005) describes the important differences in these approaches. Multidisciplinarity does not require researchers to leave their disciplines. It tackles issues by getting researchers in a range of disciplines to use their traditional theories and methods to present an understanding and then attempts to integrate these different understandings. In an interdisciplinary approach, researchers from small clusters of neighboring disciplines, such as physics, mathematics, and chemistry, or sociology and anthropology, look beyond their own discipline and work together to find areas of overlap likely to yield new understanding. A transdisciplinary approach aims to develop a new common conceptual framework that provides a new level of coherence for the different disciplines. According to Bammer (2005), "researchers must collaborate and integrate across traditional boundaries. They must bring together academic disciplines, and become more involved in the implementation of research in policy, product, and action."

There has also been a shift towards globalization of both problems and solutions. As problems become increasingly connected, they are also increasingly globalized. Recognition of this globalization of water problems has triggered awareness of the opportunity to draw ideas and possible solutions from a world of practical experiences in both similar and different contexts. "Researchers, funders, and research end-users are increasingly appreciating that new research skills must be developed if human societies are to be more effective in tackling the complex problems that confront us and in sustaining the sort of world we wish to live in" (Bammer 2005).

Recent experiences have increased awareness of the risks and consequences of water use decisions. Communities now expect developments to not only have acceptable environmental impacts but also deliver social and economic benefits. Furthermore, non-government organizations and individuals are better trained, connected and equipped to monitor decisions. Together, these trends are increasing pressure on decision-makers. Dealing with complexity and uncertainty emerges as a shared need and responsibility for government, developers, and the community so that good decisions can continue to be made (Camkin et al. 2008). In response to this pressure, there is rapid growth in the development of on-line

technology that utilizes new approaches to learning and supports communities of practice in the resolution of complex problems (Camkin et al. 2008).

Five regional meetings promoted by UNESCO in 2009 (North-America, Europe, Asia, Australia, Africa) addressed the growing need for transdisciplinary approaches, holistic vision, incorporation of non-formal knowledge and views, effective participation and bottom-up action for identification of problems and solutions in water education. There is, however, a general context of tension and competition between specializations within different disciplines, and without specialization it is difficult to obtain formal and academic recognition, either at undergraduate, masters, or Ph.D. level. The 2010 Capacity Building Workshop on Water Education in Paris identified the need to build tertiary or vocational levels that include participants with different backgrounds in order to facilitate cooperation and exchange of views. The integrated approach should enable communication between specialists addressing specific problems and other experts and practitioners, providing new skills and knowledge competences – a new "water practitioner" profile.

A key question is whether any ongoing tension between the need for transdisciplinary thinking and the disciplinary focus of traditional science, and the inclusion of non-scientific knowledge, is being sufficiently addressed to create the freedom and flexibility needed to tackle the increasingly interrelated and complex water challenges the world is facing. The UNESCO-IHP Hydrology for the Environment, Life and Policy (HELP) Programme, including its network of 91 river basins in 67 countries and more than 2,000 individual lawyers and policy makers, industry and community stakeholders, together with scientists of many different disciplines, provides an outstanding source of experiences, ideas, and potential solutions to water challenges. The UNESCO-IHP Ecohydrology Programme also includes a suite of demonstration sites where sustainable, innovative, and transdisciplinary water management practices based on ecohydrology principles are being implemented, providing yet another important source.

But what more needs to be done? The remainder of this paper presents insights into experiences of new co-learning methodologies being applied as part of the Erasmus Mundus Master Course (EMMC) in Ecohydrology, in collaboration with the UNESCO International Centre for Coastal Ecohydrology (UNESCO-ICCE) and the HELP and Ecohydrology networks. We describe the conceptual framework and our methodological approach, feedback from the courses, what we learned as course coordinators and some suggestions for the future of HELP and the Ecohydrology Demonstration Sites Programmes.

Conceptual Framework for a New Learning Methodology – a First Approach

An interdisciplinary approach to research is becoming essential for many reasons. As a foundation, we strongly agree with Siew and Döll (2012) who stress that "due to the interconnectedness of a multitude of scientific and social issues in human-environment systems, sustainable goals can neither be achieved by single scientific disciplines nor single groups of societal actors. Scientists from a variety of disciplines need to work in an interdisciplinary manner with a number of practitioners from problem-relevant sectors to seek collaboratively knowledge-based solutions, using new integrative approaches and methods." The core of transdiciplinary research is joint generation and integration of scientific and stakeholder knowledge (Jahn 2008), including recognition of the important role of non-scientific knowledge (Mobjörk 2010). By addressing real-world problems, transdisciplinary research goes beyond merely improving the implementation of scientific knowledge in practice (Siew and Döll 2012). The participatory transdisciplinary research process offers an opportunity for social learning towards sustainability (Luks and Siebenhüner 2007), helping to bridge the gap between the demand for knowledge and knowledge production (Cronin 2008).

The methodology used in these courses aims to apply transdisciplinary research approaches in a tertiary education context. It seeks to help bring out both the scientific and non-scientific knowledge held by course participants, lecturers and coordinators, and to apply that knowledge to real problems drawn from the experiences of the participants. From the outset, this approach was developed consistent with the main principles

and HELP philosophy – to include scientific and academic knowledge in useful usage by society, and also to improve the dialogue between scientific and non-scientific knowledge and practice. The methodology is fundamentally inspired in the work and pedagogic philosophy of Paulo Freire.

In Pedagogy of the Oppressed (Freire 1972), Freire provides a rationale for a pedagogy where he introduces the notion of banking education. Highlighting the contrasts between education forms that treat people as objects rather than subjects, he explores education as cultural action. The participant focus is a premise for a deeper understanding and involvement in the learning process. This requires also a strong capability of understanding (from the facilitators or mediators) and evaluating good practices and effectiveness of results towards some aimed principles (in this case IWRM goals and principles). The previous experience of the participants and the facilitators are, jointly, determinants of the success of the co-learning process.

Several aspects of Paulo Freire's work were particularly influential. Freire states that dialogue involves respect and that it should not involve one person acting on another, but rather people working with each other. However, he was also concerned with praxis - action that is informed (and linked to certain values). To Freire, dialogue is not just about deepening understanding - it is also about making a difference in the world. Dialogue in itself is a cooperative activity involving respect. The process is important and can be seen as enhancing community and building social capital and to leading us to act in ways that make for justice and human flourishing (Smith 1997, 2002). An important element for this process is the concept of "containerization," introduced by Freire, which means "developing consciousness that is understood to have the power to transform reality" (Taylor 1993: 52).

Situating educational activity in the lived experience of participants and its impact on informal educators was inviting. Freire's metaphors drawn from Christian sources, including the way in which the divide between teachers and learners can be transcended, also seemed particularly relevant. It was this path we chose to start building our contribution for a new learning process towards better water management practices, based in an integrative and transdisciplinary vision.

Water Education in the Erasmus Mundus Master Course (EMMC) in Ecohydrology

The EMMC in Ecohydrology is delivered through a consortium of the UNESCO Institute for Water Education (Netherlands), University of Lodz (Poland), Christian Albrecht University of Kiel (Germany), National University of La Plata (Argentina) and University of Algarve (Portugal). Several other research institutions and UNESCO Centres from Europe, Latin America, Asia, and Australia are associated with the course, contributing with advanced study courses and promoting student exchange. The EMMC is delivered over 18 months through four modules (thematic areas):

1. Understanding function, processes and threats to aquatic ecosystems;
2. Toolbox for applying Ecohydrology: environmental impact modelling;
3. Development of personal skills and research project implementation; and
4. Integration and specialization in management or engineering of aquatic ecosystems.

The authors of this paper were invited to develop new short courses as part of the EMMC curricula to be delivered at the University of Algarve in Faro, Portugal. Three courses were subsequently developed and delivered: Global Water Issues and Integrated Water Resource Management (IWRM) in December 2010 and January 2012; and Global Ecohydrology in Action in August 2011.

Global Water Issues and IWRM Short Courses

The first Global Water Issues and IWRM intensive short course was delivered over six days at the beginning of Semester 1 of the EMMC in Ecohydrology in December 2010 as an elective subject within Module 2: Toolbox for Applying Ecohydrology. There were 11 student participants from 11 different countries: Bangladesh, Bosnia, China, Ethiopia, Germany, India, Poland, Portugal, Tanzania, Turkey, and USA. The second Global

Water Issues and IWRM intensive short course was delivered over three days during Semester 1 of the EMMC in Ecohydrology in January 2012. There were 12 student participants from 11 different countries: Bangladesh, Chile, India, Indonesia, Italy, Malaysia, Poland, Portugal, Slovenia, Spain, Trinidad, and Tobago. In both courses, participants had a range of experience and a variety of backgrounds, including hydrology, geography, biology, ecology, fisheries science, environmental science, aquaculture, meteorology, and oceanography. They were introduced, through presentations and discussions with the course coordinators, to the range of current global water issues, the history and intent of key international agreements relating to water and the core principles of IWRM. In recognition that each of the participants already had important skills and experience, and that collectively the breadth of backgrounds and nationalities brought a wealth of learning opportunity, the participants were engaged in a co-learning dialogue with the course coordinators and their colleagues over the duration of the course. Through semi-structured exercises, including IWRM role-playing, participants expressed their own experiences and accessed those of their colleagues and coordinators. They were encouraged to continually think "outside the water box" and to focus on the role of IWRM in delivering a broader set of policy objectives. Participants were asked to reflect on the practical IWRM challenges they have been involved with and to considered their options from a range of new perspectives. At the end of the course, each participant give a brief "IWRM in Practice" presentation and submitted a final "Implementing IWRM in Practice" essay on a chosen experience, demonstrating how they might do things differently taking into account what they had learned through the course.

Global Ecohydrology in Action Short Course

The Global Ecohydrology in Action short course was delivered over three days at the end of Semester 2 of the EMMC in Ecohydrology in August 2011 as a core subject within the EMMC Summer School. It was designed to help balance the theoretical components of the EMMC with access to real life experiences. There were nine student participants from eight different countries: Bangladesh, China, Ethiopia, India, Kazakhstan, Poland, Tanzania, and Uganda. Participants were introduced to several practical examples of Ecohydrology in Action, drawn primarily from the UNESCO HELP and Ecohydrology Demonstration Site Programmes. On the first day, the UNESCO Global Coordinator for HELP and Ecohydrology Programmes gave an online welcome to the participants and each day they received online presentations from leading scientists, policy-makers, industry or community stakeholders involved with a HELP Basin or Ecohydrology Demonstration Site. From their offices or homes in New Zealand, Malaysia, Philippines, and Belgium, the guest presenters gave an overview of the HELP Basin or Demonstration Site and described the practical role that Ecohydrology is playing in management. Presenters were encouraged to add a personal touch through their own experiences and views. Participants and presenters were in visual and audio contact and the students had opportunities to ask questions or seek clarification during the presentations, and to discuss issues directly with the presenters during the online tutorial session that followed. Reflecting on what they had heard, participants were asked to identify the challenges faced, the management objectives, the ways in which Ecohydrology was contributing to meeting the management objectives, and to share their thoughts on whether the use of Ecohydrology principles has made a substantial difference. On the final day, each participant gave a brief presentation describing what they had learned about Ecohydrology from the Ecohydrology in Action examples and the EMMC.

At the completion of all three courses, participants were asked to provide feedback to the EMMC course convenors. To record their thoughts, at the end of the Global Ecohydrology in Action course, participants interviewed each other on video, spontaneously, and at their own initiative. These video recordings demonstrate that participants appreciated the course methodology. The participants obviously connected with the guest presenters and were able to recognize the relationship between the practical challenges being faced in the HELP Basins and Ecohydrology

Demonstration Sites, and the theory they had learned during other EMMC subjects.

The EMMC Coordinator summarized feedback from participants of these short courses: "The courses were very interesting. They covered a broad range of issues dealing with water resources and participants realized the crucial importance of considering the human dimensions in the management of water resources. They realized that without engaging society, both from the perspective of driver for the changes but also as receiver of the changes, it is not possible to find and establish sustainable solutions for water resources globally. The methodology of promoting dialogue with stakeholders and society that was taught was considered very useful by participants and it provided good results in enabling profitable dialogue with all the actors involved in the complex management of water resources" (L. Chicharo, pers. comm. 25 August 2011).

Conclusions

In these three courses we attempted to develop a new co-learning methodology, aiming at a transdisciplinary approach, which is built from the different background of each student, their own experience and expertise, and their expectations. Through the presenters and coordinators, participants not only benefited from new information and experiences but accessed personal professional networks that are based less on any disciplinary framework and more on a shared vision for IWRM. The participants were invited by several of the guest presenters to contribute their experiences and ideas towards solving existing challenges within the HELP Basins and Ecohydrology Demonstration Sites, further representing a fundamental shift from accessing a professional network and knowledge to becoming part of the network and knowledge base itself.

Critical to this methodology was also the commitment of individuals within the HELP network. The clearly evident emotional involvement and generosity of the guest presenters - they gave more than just their abundant knowledge - was a catalytic factor that helped participants make the connection between the individual subjects they had studied through the EMMC and the real problems they will have to solve in practice. This commitment and generosity, delivered in relation to real problems through subjects that consolidate the learning from the more technical subjects in the EMMC, was a powerful combination.

Besides different disciplinary backgrounds and countries, there were also very different socio-political contexts represented by participants from developing and developed countries. Actively encouraging the participants to put their stories on the table enabled all participants to view water problems from the widest range of perspectives, providing a significant learning opportunity.

The experiences of the EMMC Global Water Issues and IWRM, and Global Ecohydrology in Action short courses suggest that a substantial opportunity exists for the HELP community to actively and cost effectively contribute to meeting the needs identified at the 2010 Capacity Building Workshop on Water Education in Paris: tertiary and vocational level courses that include participants with different backgrounds in order to facilitate cooperation and exchange of views. Through courses such as these, the HELP community can support both immediate and longer-term communication between specialists addressing specific problems, other experts, practitioners, and emerging water professionals, providing new skills and knowledge competencies that help to develop a new "water practitioner" profile.

As ever, there is a need for both specialists and generalists to effectively address complex challenges. In addition, however, there is also the need for some specialists to broaden their knowledge beyond their basic training and explore the epistemological frontiers with other disciplinary areas. Here we call this higher level of expertise - of being able to "read" among different disciplines - "facilitators" (or "mediators"). This skill typically requires long experience and broad knowledge on the field, gained through different disciplinary exploration and experience. The methodology requires that these "facilitators" have that breadth of understanding of water issues and, most importantly, the ability to connect issues and concepts. It also requires acceptance that these knowledge "mediators" are part of the learning process, as co-learners. The ability to adapt and reshape the contents according with

the local needs of the community of participants is, therefore, essential to the success of this methodology. On the other hand, deeper and more specific disciplinary knowledge, where required, is also contributed through the use of extensive international networks, in this case primarily the UNESCO-IHP HELP Programme.

The methodological approach applied in these courses aims to support the development of new knowledge and skills that appear to be necessary to meet the increasingly complex water-related challenges the world is facing. This new knowledge and skills are complementary to deep disciplinary knowledge and there is no current risk of developing incompetence in disciplinary terms as the scientific process and educational systems remain strongly weighted towards disciplinary development. What is needed is greater capability for transdisciplinary thinking – for disciplinary specialists to work together to find the solutions in the interstitial spaces between individual disciplines, and to explore and develop epistemological bridges. This is the process we seek now, of moving from knowledge to wisdom in water management.

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