Capacity Development in IWRM through E-learning – Initial Experiences of Water Virtual Learning Centre at AIT, Thailand

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ABSTRACT: The targets of developing Integrated Water Resources Management (IWRM) plan and Water Efficiency (WE) plan by 2005 could not be realized in most developing countries due to a number of institutional barriers related to sustainable water management, including the lack of trained human resources, applicable best practices and experiences. To address the need of capacity building in IWRM of current generation of water managers, e-learning is considered to be a viable and effective method wherein participants can acquire required knowledge and skills without being away from their routine work for a long period to an academic institution. This paper presents initial experiences gained on the distance-based IWRM program offered by the Regional UN-Water Virtual Learning Centre (WVLC) at the Asian Institute of Technology (AIT), Thailand. Objectives and approach, curriculum and courses and their customization and specific features of the program are presented. Based on the lesson learned during the initial implementation of the program and the feedback received from the participants, the paper further discusses issues and constraints for the sustainability of the program.

Keywords: Integrated water resource management, Capacity building, e-learning, Water professionals, Virtual Learning.

Introduction

Water in its multiple roles - as a resource that meets basic necessities, as a critical factor in the economic development of a society, and as a vital element in supporting the earth's ecosystems - has become a global policy priority. In 2002, an estimated 1.1 billion people (17%) of the global population were without access to improved water supply and 2.6 billion people (42%) lacked access to improved sanitation. Nearly two thirds of those without improved water supply live in Asia. Over half of those without improved sanitation – nearly 1.5 billion people – live in China and India. These facts lead to the simple conclusion that lack of water hinders development and the right to live in dignity.

The United Nations Millennium Development Goals pledge to halve the number of people in the world without access to safe drinking water and basic sanitation by 2015. To achieve these targets by 2015, as estimated in 2005, an additional 260,000 people per day will require access to safe water supply and 370,000 people per day should gain access to improved sanitation up to 2015 (UN Millennium Project, 2005).

Asia-Pacific region itself represents the 27% of the world surface, and the 58% of the world population. Its major challenges are the elimination of poverty, the vulnerability to natural disasters and the lack of basic services, particularly in the Southern and

South-eastern sub regions. Estimations suggest that 678 million people lack drinking water and more than 1,900 million have no adequate sanitation services. The current trends show that half of the countries within this region will not be able to achieve the water and sanitation coverage targets defined in the Millennium Development Goals.

Apart from achieving the MDGs, there is another aspect of sustainability that has to be considered. This is the requirement to provide the capacity to deploy and maintain the infrastructure, economic mechanisms, legal, and social and community frameworks necessary to sustain the progress achieved and to go further and provide safe water and sanitation to the remaining un-served populations.

WVLC represents a concrete and strategic response to recent UN declarations (e.g., UN Millennium Declaration and the Johannesburg Summit on Sustainable Development), which have called for integrated water resources management through capacity building of national officials, water managers and their institutions.

IWRM – Concept and Development

Integrated Water Resource Management (IWRM) can be defined as *"a process, which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"* (Global Water Partnership – Technical Advisory Committee, 2000). It is goal-oriented and seeks to develop a consensus-based vision of ideal water resources conditions for the area of interest.

IWRM is not a new approach. In a number of countries, water management has been institutionalized in an integrated way over centuries. Rahaman and Varis (2005) provides an account of examples from different countries where water resources is managed with multidisciplinary, integrated and participatory approaches.

At the UN Conference on Water in the Mar del Plata (1977), IWRM was the recommended approach to incorporate the multiple competing uses of water resources. Although in the 1980s, water disappeared from the international arena, the situation changed in the early 1990s with the International Conference on Water and Environment held in 1992. Since then several mega water events at the global and regional levels were held, which helped bringing the water problems and issues onto the top political agenda and the IWRM concepts have evolved to the implementation stage. Table 1 provides a summary of the main global levels water events with their broad objectives.

Table 1: List of major global water events and their objectives

Year	Events/*Venue*	Objectives/Aim
1977	United Nations Conference on Water *Mar del Plata, Argentina*	To assess the status of water resources; to ensure an adequate supply of quality water; to increase water use efficiency; and to promote preparedness at national and international level.
1992	International Conference	To serve as the preparatory event, with respect to

Year	Events/*Venue*	Objectives/Aim
	on Water and Environment *Dublin, Ireland*	water issues, to the Rio United Nations Conference on Environment and Development (UNCED) Conference.
1997	First World Water Forum *Marrakech, Morocco*	To develop a long-term vision for Water, Life and the Environment in the 21st century
2000	Second World Water Forum *The Hague, Netherlands*	To address visions produced and structured by the World Water Council and invaluable views in reforming the water sector, better addressing the need to integrate water management. It also considered the outcomes of previous water initiatives and acknowledged water's social, environmental, and cultural values.
2001	International Conference on Freshwater *Bonn, Germany*	To contribute for finding solutions for global water problems, and to support preparations for the World Summit on Sustainable Development (WSSD) in Johannesburg, and the Third World Water Forum in Kyoto.
2002	World Summit on Sustainable Development *Johannesburg, South Africa*	To provide specific targets and guidelines for implementing IWRM worldwide, including developing an IWRM and water efficiency plan by 2005 for all major river basins of the world; developing and implementing national/regional strategies, plans, and programs with regard to IWRM; improving water-use efficiency.
2003	The Third World Water Forum *Kyoto, Japan*	To discuss on key issues, i.e., safe, clean water for all, good governance, capacity building, financing, public participation, and various regional topics. The forum recommended IWRM as the way to achieve sustainability regarding water resources.
2006	The Fourth World Water Forum *Mexico city, Mexico*	To raise the awareness on water issues all over the world. To assure better living standards for people all over the world and a more responsible social behaviour towards water issues in-line with the pursuit of sustainable development.

Source: Modified from Rahaman and Varis (2005)

The WSSD (2002) had taken an important step to develop IWRM and Water Efficiency (WE) plans by 2005, with support to the developing countries. However, this target could not be accomplished in most Asian countries due to a number of institutional barriers related to sustainable water management, including an inefficient supply of qualified human resources, shortage of relevant methods and experiences in IWRM application. Integrated capacity building is therefore of overriding importance

for supporting the implementation of IWRM. Universities and research institutions need to be better geared to educate and train people who can successfully plan, implement and maintain IWRM strategies under constantly changing social, economic, environmental and political conditions. Therefore, IWRM is a fundamental basis for providing the long-term environmental security necessary for sustainable development and the provision of water and sanitation required to meet the UN MDGs.

To meet these challenges, the UN Water Virtual Learning Centre (UN-WVLC) program is developed by the United Nations University – International Network on Water, Environment and Health (UNU-INWEH) in partnership with the UN Department of Economic and Social Affairs (UN-DESA).

The UN-WVLC Program

This program is designed to enhance the capacities of developing nations to plan and implement sustainable national water strategies at local, sub-regional and basin levels through IWRM practices by Distance Learning via CDROM or the Internet. This program is especially targeted to provide training to water professionals who do not have luxury of time to undertake regular graduate degree programs and cannot be away from their routine work to contribute towards capacity building and sustainable development.

The UN-WVLC is designed to function as a series of linked Regional Centers, each of which is responsible for customization of courses for that region and delivery of the program through CD-ROMs or over the Internet (Grover *et al.*, 2005). At present five Regional Centers located at the Asian Institute of Technology in Bangkok, Thailand, the University of Ghana, Ghana, University of Nairobi, Kenya, University of the South Pacific in Fiji, and University of New Brunswick in Canada are in operation. Other regional centers for South America, Central America, South Asia and other regions are presently being investigated. Current WVLC Regional Centers can be accessed at http://wvlc.uwaterloo.ca/.

The core contents of the WVLC courses were developed by UNU-INWEH in consultation with a large number of professionals drawn from universities, private industries and government sectors, working in various disciplines, with a common interest and experience in water resources management from across the world. The complete program consists of 10 courses, each of which is equivalent to 25 hour of lectures normally given over a period of about 8 weeks. The program curriculum offers a broad-based coverage of the principles and practices of IWRM, providing students with core knowledge on natural sciences, engineering, health, governance, public administration, social sciences, economics, resources conservation, strategic planning as well as aspects of program/project management. Table 2 lists the program courses and their scope. The courses are all customized by regional centers by adding local examples or case studies while retaining all of the core content, which brings everyone around the world to use the same terminology in IWRM. The idea is to train the professionals in IWRM and also build the capacity of local institutes in the South

to deliver the programs. At the end of all 10 courses students are awarded a UNU diploma.

Table 2: IWRM curriculum for the WVLC program

No.	Course	Description
1	An Introduction to IWRM	Introduction to the fundamental concepts, techniques, and knowledge required to understand and manage water resources in an integrated manner.
2	Water Transfer	Understanding of the hydrological cycle, processes and measurements; the factors affecting movement and behavior in terrestrial, riparian and lacustrine environments; surface and groundwater environments; the watershed concepts and the impacts of weather and climate.
3	The Terrestrial Ecosystem and The Impacts of Land Use Changes	Introduction to fundamental ecological concepts, the role of natural environment in the hydrologic cycle; the effects of changes in land use on water processes; the impacts of water on land; tools of watershed analysis; aspects of land use planning, control and conservation.
4	The Aquatic Ecosystem	Provide a basic understanding of the physical, chemical, biological and ecological aspects of streams, rivers, lakes, wetlands, estuaries and groundwater systems
5	Aquatic Ecosystem Health and Impact Assessment	Builds directly on knowledge gained in the previous course on “The Aquatic Ecosystem” to examine the impacts of anthropogenic activities on the aquatic environment and the methods of measuring those impacts.
6	Water Use	Examines the various direct anthropogenic uses of water and the many impacts of such uses. In addition, this course examines human consumption of water and aspects of public water supply and health.
7	Wastewater	Examines in detail the problems resulting from point and non-point discharges; waste treatment processes; best management practices, monitoring and assessment approaches and urban versus rural environments.
8	Governance and Community Based Approaches	Introduces the concepts and practices of community based water resources management, domestic and international governance, community involvement and gender issues.
9	Organizational Infrastructure and Management	Examines the issues, concerns and the various approaches to finance, budget, infrastructure, management and planning as well as public health administration and project management
10	Applying IWRM	Customized case studies, practical illustrations of the concepts and procedures of IWRM through project work,

No.	Course	Description
		and investigative techniques for students to assess their own IWRM needs, conducted in tutorial format

Source: Mayfield et al., 2003

Learning Platform

StudySpace™ learning environment software is adopted as it has the ability to deliver the courses on CD ROM, over the Internet or through printed versions. This software was initially developed at the University of Waterloo, Ontario, Canada by the Computer Systems Group and was significantly modified and tailored for use in the WVLC. It provides familiar environment to view the topics within a given lecture. Each topic consists of a series of pairs of "concept" and "discussion" pages. Each of these sets of concept and discussion pages are then linked and the order of presentation specified in an XML course structure file that simply lists the pages and determines whether they are included in the overall menu for the course. Detail of this software is presented in Mayfield et al. (2003). It is effective and friendly tool for e-learning environment from the student's and instructor's views as given in Table 3. Another important feature of the software is that courses can be 'customized' based on the regional requirement.

Table 3: Summary of students' and instructors' views for the WVLC courses

Students' View
• Layout of course is essentially linear but with full navigation facilities • Courses are designed to replicate the "Slide" plus discussion method of lecture presentation • All facilities of the web server plus browser combination are available in a StudySpace™ course (hyperlinks and internal or external URLs, images, animations, interactive exercises, video, sound, programs, etc) • Students can track progress and submit their progress to a central server • The software allows students to make notes on the side and also highlight similar to what is traditionally done on a printed matter. All notes, highlighting progress through course and "level of understanding" are stored in the computer or server if working directly over the internet
Instructors' view
• Installation routines are standardized • Pages stored as concept and discussion pages in two directories • Easy entry of material either by direct entry or "cut and paste" into an HTML editor • Layout of the course and its structure is determined by a separate "course_structure.xml" file that can be edited to reflect a newer layout • Pages can be added or removed by simply editing this course structure file • No computer programming is required to customize the course

Source: Mayfield et al. (2003)

UN-WVLC at the Asian Institute of Technology

The Asian Institute of Technology (www.ait.ac.th), established in 1959, promotes technological change and sustainable development in the Asian-Pacific region through higher education, research and outreach. AIT has become a leading regional postgraduate institution and is actively working with national governments, development agencies, universities, research institutions, and public/private organizations around the world in the promotion of technological change and sustainable development in the Asian region through higher education, professional training, research and outreach. Its mission is to develop highly qualified and committed professionals who play leading roles in the region's sustainable development and its integration into the global economy. AIT's academic programs are conducted at the Doctoral, Master's, Diploma and Certificate levels through its three professional Schools: School of Engineering and Technology (SET), School of Environment, Resources and Development (SERD), and School of Management (SOM).

The Water Engineering and Management (WEM) program under the School of Engineering and Technology imparts education and training toward an understanding of the complexity of water use and water resources management problems. It offers a balanced curriculum, which covers both the engineering and management aspects of water resources development. Water Engineering and Management covers five major areas- Agricultural Water, Coastal Water, Urban Water, Water Resources, and Extreme Events and Risk Management.

WVLC Regional Centre (WVLC-RC) was established at the Water Engineering and Management (WEM) program in January 2005 in collaboration with UNU-INWEH with support from UN-DESA to enhance capacities of mid-level water professionals in IWRM methods and practices for environmental sustainability through innovative and cost-effective e-learning methods in the region. Currently, the regional centre at AIT is responsible for capacity building in South Asia and Southeast Asia. A Steering Committee (SC) consisting of a coordinator and five faculty members oversees the overall administration and management of the WVLC, AIT. For day to day operations the coordinator is assisted by a program associate and a secretary.

The uniqueness of the WVLC program at AIT is the delivery mode, which consists of both face-to-face and distance-based learning. Course 1 and Course 10 are offered face-to-face at AIT over a period of 2 weeks each while the other courses (Course 2 to Course 9) are internet-based as well as CD-ROM supported. Each course has an assigned instructor and each course is covered within a planned schedule of about 6 to 7 weeks with a break of one week between the two courses.

To enhance the contents and materials of the WVLC courses, the courses are 'customized' to include examples and case studies from Asian region whilst maintaining the content of the core curriculum. The assigned faculty members are responsible for customizing the courses and to update the students with latest developments in IWRM practices. The course are improved and customized on a regular basis.

During the delivery of Course 1, participants are introduced to the concepts and practices of IWRM and are also introduced to other courses (Courses 2 to 10). Course 10 is a practical course where participants are required to work on a project. The implementation of Course 10 starts when the Course 6 is given. Participants are asked to submit two topics of their choice and related to their work for the project. Participants develop the project proposal, collect and analyze data and information and prepare a draft report before coming to AIT for two weeks. During the 2-weeks they discuss the project with the assigned supervisor, present the draft report to an evaluation committee consisting of 3 faculty members and improve the report based on comments and suggestion; and at the end they are required to make a presentation of the improved project. Upon successful completion of the entire program of 10 courses, the participants are awarded with a UNU Diploma in IWRM. The tuition fee of the whole program is US$5,000 (US$500 per course) exclusive of expenses related to international travel to Thailand and accommodation and living expenses for attending Course 1 and Course 10 at AIT.

Program Implementation

A website "http://www.set.ait.ac.th/courses/wvlc" containing all the information regarding WVLC-RC, AIT was developed. The program is advertised by sending WVLC brochure and information to target audience (water professionals) through various pertinent email groups, individual emails to relevant and interested parties and posting the announcement on several websites including AIT and UNU-INWEH. Apart from this, the members of the steering committee (SC) carry with them the brochure when on travel in the region for meetings and for attending workshops and conferences.

Selection of the students to the program is targeted to have representation of maximum number of countries of the region as well as a proper balance of gender with due regard to the following criteria set by WVLC-AIT that a prospective applicant:

- Holds a bachelor's degree of four years or equivalent in water related field
- Currently employed in water sector (preferably government sector)
- Has 3 years of relevant work experience in water sector
- Is a Citizen/resident of a country in the Asia-Pacific region
- Has English proficiency in reading, speaking and writing
- Has computer literacy and accessibility
- Is nominated by his/her employer
- Preferably less than 40 years of age
- Has good health

In order to evaluate the performance of the students and to keep record of their understanding of the course contents, the course instructors provide the students with a set of practice questions. Students are encouraged to discuss among themselves and also with the course instructors. They were also asked to send queries related to the course topics for clarification or further discussion to the respective instructors.

Instructors responded to the queries and concerns twice a week with replies sent to all the participants for their benefit. The mid-quiz is conducted about 3-4 weeks after the beginning of each course. Likewise, students are required to take the final examination at the end of each course. For the mid- and final examinations, students were allowed 3 days to submit their answers/responses to the course instructor as an email attachment. Performance of the students related to the understanding of the subject matter for courses is evaluated based on their response to the quizzes, mid- and final examinations.

The program has successfully completed two cohorts of students and the third cohort has just begun the program and completed Course 1 on 11 April 2008. The pilot cohort was financially supported by UNU-INWEH and a total of 60 applications: 25 from Southeast Asia, 20 from South Asia and 15 applications from other countries, mainly from the Middle East (Iraq and Palestine) were received. The pilot offering of the program started with 13 students from 9 countries across South and Southeast Asia and 11 participants successfully completed the Diploma in December 2006. For the second cohort, a total of 17 applications, a drastic reduction from the first cohort, were received. The second cohort started in September 2006 with six participants from five countries and concluded in February 2008. Five out of six students were sponsored by UNEP Collaborating Centre on Water and Environment (UCC-Water) in Denmark. For the third which began on 31 March 2008, a total of 20 applications were received and seven participants from seven countries joined the program. Table 4 presents the profile of the WVLC participants in three cohorts. For Cohort 3, the information provided is based on the students enrolled.

Table 4: Profile of WVLC Participants at AIT

Characteristic	**Cohort 1** (Sep ’05 - Dec ’06)	**Cohort 2** (Sep ‘06 - Feb ‘08)	**Cohort 3** (Mar ‘08 – Jul ’09)
No. of applications received	60 (25 SEA*, 20 SA**, 15 other countries)	17 (10 SEA*, 3 SA**, 4 other countries)	20 (6 SEA*, 11 SA**, 3 other countries)
No. enrolled	13 (8 SEA*, 5 SA**)	6 (5 SEA* and 1 Japan)	7(3 SEA*, 3 SA**, 1 Japan)
No. graduated	11 (7 SEA*, 4 SA)	5 (5 SEA*)	
Gender of graduates	Male (8), Female (3)	Male (2), Female (3)	Male (3), Female (4)
Educational background of graduates	Engineering (10), Environmental Science (1)	Engineering (2), Environmental Science and Technology (2), Basic Science (1)	Engineering (3), Environmental Science and Management (2), Agricultural and Resources Economics (1), Japanese Literature (1)
Participating countries of	Indonesia (2), Lao PDR (1),	Cambodia (1), Indonesia (1), Lao	Indonesia (1), Philippines (1),

Characteristic	Cohort 1 (Sep '05 - Dec '06)	Cohort 2 (Sep '06 - Feb '08)	Cohort 3 (Mar '08 – Jul '09)
graduates	Philippines (1), Thailand (2), Vietnam (1), Bangladesh (1), India (1), Pakistan (1), Sri Lanka (1)	PDR (1), Vietnam (2)	Thailand (1), India (1), Nepal (1), Sri Lanka (1), Japan (1)
Source of funding	UN-Development account through UNU-INWEH (13)	UCC-Water, Denmark (5), Self-support (1)	UNU-INWEH (3), AIT (3), Self-support (1)
Sector of society of graduates	Government (7), Academia (4)	Government (4), Academia (1)	NGO (4), Academia (3)

**SEA: Southeast Asia; **SA: South Asia.*

Table 4 indicates that the program could attract professionals with different academic background as well as sectors (government, NGOs, Private and Academia) of the society. It is interesting to note that most of the participants are sponsored, except one student in each second and third cohort from Japan was self-support. The Centre received a large number of emails showing interest in the program, however, most of them queried for financial support.

Feedback from Students

At the end of the program, a questionnaire survey is conducted to get the feedback from students on program to assess the effectiveness of courses and for further improvement of the program. The questionnaire covers the opinion/feedback of students on the entire program, course content, StudySpace™ software. Feedback received from the participants of Cohort 1 and Cohort 2 is summarized as:

- A combination of face-to-face and distance-based learning is liked by students and found to be an effective way of delivering the program.
- Teaching/learning materials are quite convenient and easy to carry.
- Students found the program useful and informative. Experience gained through this program helped them to improve their knowledge and skills necessary to understand and apply IWRM concepts and principles in planning and implementation of water resources management programs and projects in their respective countries.
- Knowledge gained through this program is very useful for the professional work they are involved in.
- There is need to add more topics related to water use allocation, ecological river corridor, flow regime and water resources modeling.
- A field visit to a successful IWRM project is suggested as part of the program.

Lessons Learned, Issues and Constraints

During the initial implementation of the program, some issues and constraints originate for the sustainability of the program. These are summarized as:

- Some participants encounter difficulties in following fixed course schedules because of field work in remote areas of their countries and professional trips abroad. This requires more flexibility in the program offering which is currently not feasible due to small group size of students.
- There is a lack of communication/interaction with the course instructor except for some clarifications related to quizzes and mid- and final exams. There is a lack of personal opinion/reflections on exam questions. Most of the time, student copy and paste answers from the easily available Internet sources or CD materials.
- There is a strong interest and enthusiasm among water and related professionals towards the program. There however remains a lack of commitment by the governments and other stakeholders in preparing their staff for adopting IWRM for sustainable development. The government agencies in South and Southeast Asian countries have not sponsored their own their staff for training on IWRM for this e-learning program.
- There is need to explore possibilities of donor funding through rigorous marketing and promotional activities to increase visibility of the program in the region. Attempts are required to develop a mechanism for a long term self-sustained funding for the program.
- Workload, duration and the cost of the program require to be revisited. Moreover, the Diploma awarded at the end of the program is considered to be of less value in several Asian countries, especially for career promotions in the government sector and hence prospective participants would opt for a degree program.

A careful proper consideration to the above identified issues and constraints can help improving the program offering at WVLC-AIT for this region as well as for education and training in IWRM of water professionals in other parts of the world.

Conclusions

Water in the Asian countries is under threat from overexploitation due to increase in population, industrialization, natural disasters and climatic extremes. To achieve the MDGs, there is a need to develop and implement IWRM plans at local, basin, and regional scale for sustainable development of the region by providing training to water professionals. The on-going UN-WVLC e-learning program on IWRM is a very useful and effective tool to enhance capacities of mid-level water professionals who have sectoral knowledge and need to be trained in more integrated approaches to water resources management. Based on the students' evaluation, the approach of a combination of face-to-face and distance learning used in implementing the program at AIT is effective, however it adds to the cost of the program. There is a need for a dialogue with the government agencies and NGOs as to assess their needs in IWRM training and modify the program or program offering accordingly to make it sustainable. Unless the government agencies are convinced, the continuity of the

program is a major concern without financial support from international and regional funding agencies and donors, especially in developing countries in Asia.

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