

Inland Water Quality Assessment - A Joint European Masters Programme

K.-O. Waara,^{1,16} A. Petersen,² T. Lanaras,³ V. Paulauskas,⁴ S. Kleiven,⁵ G. Crosta,⁶
O.-P. Penttinen,⁷ A. Quesada,⁸ N. Kovats,⁹ S. Galinou-Mitsoudi,¹⁰ M. Lapinska,¹¹
A. Newton,¹² M. Balode,¹³ F. Hindak,¹⁴ and B. Marsalek¹⁵

At present, there is a European shortage of personnel qualified to adequately address the comprehensive scientific and regulatory requirements of the Water Framework Directive (WFD). The joint Masters programme described in this paper will provide students with the requisite expert knowledge and skills to progress the implementation of the WFD. Its development was financially supported by the European Commission because of its specific goal of producing qualified personnel in relation to the implementation of the WFD. Since its proposed structure acknowledges the educational intent of the Bologna Accord, it thereby provides a useful template for structuring a Masters degree-level programme in accordance with Bologna principles.

KEY WORDS: Bologna process; inland water; joint Masters programme; WFD

INTRODUCTION

The Water Framework Directive (WFD) focuses on good water quality in Europe as its principal objective. Coordinated legislation for water quality—together with long-term protection for all classes of water—is among the key features of the Directive. The goal is to ultimately attain a uniformly good

water status across the EU—thus obliging Member States to variously maintain or enhance the quality-status of currently-compliant waters whilst avoiding any loss of existing quality. In order to reach its goal, the Directive requires each State to assess the current quality-status of its waters in terms of chemical, physical and biological standards. Central to this task are the acquisition of information concerning the

¹Department of Public Technology, Mälardalen University, 721 13, Västerås, Sweden

²Cork Institute of Technology, Cork, Ireland

³Department of Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece

⁴Department of Chemistry, Lithuanian University of Agriculture, Kaunas, Lithuania

⁵Telemark University College, Bø, Norway

⁶Department of Biotechnology and Molecular Science, Università dell'Insubria, Varese, Italy

⁷Department of Ecological and Environmental Sciences, University of Helsinki, Niemenkatu 73, 15140, Lahti, Finland

⁸Department of Biology, Universidad Autónoma de Madrid, Madrid, Spain

⁹University of Veszprem, Veszprem, Hungary

¹⁰Department of Fisheries & Aquaculture Technology, Alexander Technological Educational Institute of Thessaloniki, N. Miltiadi 1, GR-632 00, Nea Moudania, Halkidiki, Greece

¹¹Department of Applied Ecology, University of Lodz, 12/16 Banacha Str., 90-237, Lodz, Poland

¹²FCT-Gambelas Campus, University of Algarve, 8005-139, Faro, Portugal

¹³Department of Biology, University of Latvia, Riga, Latvia

¹⁴Botanický ústav SAV, Dubravská cesta 14, SK-84523, Bratislava, Slovakia

¹⁵Department of Experimental Phycology and Ecotoxicology, Institute of Botany, Academy of Sciences of the Czech Republic, Kvetna 8, Brno, CZ-60365, Czech Republic

¹⁶To whom correspondence should be addressed; e-mail: karl-otto.waara@mdh.se

extent of point and diffuse sources of polluting discharges to the water bodies, and the setting of limits for discharges—assuming the use of best available skills, techniques, procedures and measures.

An increasing human population brings increasing pressures on clean water resources. Mindful of such problems almost a decade ago, the European Environment Agency (EEA) and the UN Environment Programme (UNEP) (Press release, 1997) launched a first joint statement on the environment focusing on water resources and serious water stressors, including shortages, floods, pollution and damaged ecosystems, in Europe. More recently, the European Commission has introduced/begun to implement the WFD (2000/60/EC) whereby all EU-countries are obliged to carry out appropriate actions with the objective of attaining, before 2015, a good quality status for surface and ground waters, in conjunction with good ecological potential.

The evaluation of existing quality status in all waters in all countries and the implementation of action plans to sustain good water quality represent a truly formidable challenge. However, the availability of scientific personnel having requisite knowledge, skill and competence to satisfactorily address the requirements of the Directive is currently low and inadequate. For this reason, there is an urgent need to educate and upskill personnel so as to ensure an effective and timely implementation of the Directive.

The Bologna process—an EU initiative—endeavours to promote a wider international recognition of European education. It exhorts a uniform structure consisting of a 3-year Bachelors, a 2-year Masters and a 3-year Doctoral degree-level education. Given the varied assortment across Europe at present of educational structures, contents, accomplishments and legislative instruments (Reichert and Tauch, 2003; Tauch and Rauhvargers, 2002), the Bologna process will not be a straightforward exercise in convergence. Extensive collaborative efforts and substantial supports from disparate educational structures, at international and domestic levels, will be a difficult precondition for most (EUA publications, 2004).

To date, 15 European universities and third-level institutes (Table I) have acknowledged the challenge for European water resource quality and have agreed to develop a Masters-level degree programme entitled “Master of Inland Water Quality Assessment”, with support funding from the EU Socrates Office. The post-graduate programme will provide students with the specialist knowledge, skills and competence essential to fully implementing the WFD in Member States.

Table I. Universities Participating in the European Joint Master of Inland Water Quality Assessment

Name of University	City	Country	Planned Start-up
Mälardalen University (Coordinator)	Västerås	Sweden	2007
Telemark University College	Bö	Norway	2007
University of Insubria	Varese	Italy	2007
Cork Institute of Technology	Cork	Ireland	**
Lithuanian University of Agriculture	Kaunas	Lithuania	*
University of Latvia	Riga	Latvia	*
Autonomous University of Madrid	Madrid	Spain	2007
Masaryk University of Brno	Brno	Czech Republic	2007
University of Veszprem	Veszprem	Hungary	2007
University of Lodz	Lodz	Poland	2007
Aristotle University of Thessaloniki	Thessaloniki	Greece	2007
Slovak Academy of Science	Bratislava	Slovakia	*
University of Algarve	Faro	Portugal	2007
Alexandrian Technological Educational Institute of Thessaloniki	Thessaloniki	Greece	*
Helsinki University	Lahti	Finland	*

*programme start-up contingent on legislative endorsement.

**editorial partner.

It is envisaged that the programme will, in time, acquire an international dimension having particular appeal to a global student constituency. In the context of burgeoning concerns regarding escalating water quality problems outside of the EU, the intrinsic worth of the Masters programme will increase in the long term.

This paper describes the structure of the Masters Programme, including participating universities, the application and acceptance procedures, as well as the pedagogical and scientific characteristics of the programme structure.

GUIDING PRINCIPLES OF THE JOINT MASTER OF INLAND WATER QUALITY ASSESSMENT DEGREE PROGRAMME

Cooperation between the participating universities in the Masters programme will be guided by the following principles:-

- Commitment to the Bologna process
- Quality assessment programme
- Socrates agreements between participating universities for student-exchange

- Socrates agreements between participating universities for teacher-exchange. It is a requirement that applicants for the programme should be educated to at least Bachelors degree level in an appropriate or cognate discipline. Benefiting from the extended geographic spread of participant universities across Europe, students may study under eminent tutors in technical areas of particular or special interest. The experience of a European dimension to their studies will further benefit students by the addition of social and educational gains from the exchange agreements. Students will also be given an opportunity to undertake research work supervised by distinguished research teams.

Acknowledgment of the Bologna process is a significant feature of this Masters programme whose mission is to produce high-quality personnel having the requisite skill, knowledge and competence to progress the implementation of the WFD in Europe. Additionally, cross-collaborations between participants in this programme and other similar, Masters programmes are anticipated to significantly enhance and promulgate the European system of educations.

In relation to implementing the postgraduate programme, the participating universities have approved the following operational arrangement:

- A total of 120 ECTS credits are required to complete the programme and qualify for the Masters level award.
- The programme comprises mandatory course work (valued at 40 ECTS credits), elective course work (valued at 20 or 50 ECTS credits) and a diploma element (valued at 30 or 60 ECTS credits).
- Students are required to study at a minimum of two different universities in order to comply with the diploma element requirement.
- Applications for acceptance into the programme must be sent to the coordinating university
- The coordinating university for the programme is Mälardalen University, Sweden.
- Evaluation of all applications for entry into the programme will be undertaken by an Acceptance Committee, whose decision in the matter will be final.
- All course lectures, instructions, advice and laboratory information will be given in English only.
- The number of e-learning courses will increase over time with the introduction of new modules and additional network universities. The familiar European Credit Transfer System (ECTS) will be employed to express results and trace academic progression within the 2-year programme. In this system, 1 year of full-time academic studies corresponds to 60 ECTS credits. Selection of study-options by students and universities for the accumulation of ECTS credits may embrace numerous taught modules in a broadly-based programme or a more research-oriented preference for the full-year diploma element, with fewer taught modules. Notwithstanding any specific combination of mandatory, elective and diploma modules chosen in the programme, students must, however, accumulate a minimum of 120 ECTS credits in order to successfully

complete the programme and be eligible for the award of the Masters-level degree.

This programme strongly encourages and invites participation by interested universities and other institutes in the third-level educational sector. A planned transition to a more international profile is anticipated to make this unique programme extremely attractive to students from the rest of the world. Support for this latter development may be made available from the EU Commission.

Applications from intending students should be sent directly to the coordinating university, stating their preferred *home* university, i.e. the university base where the first part of the Masters programme studies is undertaken. At the close of the application period, the coordinating university forwards copies of applications for the attention of the partner universities offering the programme. Based on subsequent discussion and evaluations, via a web-meeting with partners, an Acceptance Committee identifies and offers selected applicants a place on the Masters programme.

The programme consists of seven mandatory courses, six of which are given six ECTS credits and one attracts four ECTS credits. All elective courses are, however, valued at four ECTS credits. By offering a wide selection of elective courses, students may choose to obtain either a broad knowledge of courses in similar fields or a deeper knowledge of one discipline. Students undertaking the diploma element valued at 30 ECTS credits will choose from a wider range of courses, thereby acquiring a wider knowledge of water quality assessment. Accordingly, this avenue will provide a stronger CV for employment at a regional environmental authority. Conversely, students planning for a research career may choose a more restricted range of courses directed towards the 1-year research-based diploma element. The range of courses currently available in the Masters programme is presented in Table II.

APPLICATION AND PARTICIPATION IN THE MASTERS PROGRAMME

For purposes of illustration, a flow chart providing a navigation route for the Masters Programme, is shown in Figure 1. The first step for a potential student of the programme is to open the Home Page located at the coordinating university

Table II. Courses in the Joint Master of Inland Water Quality Assessment Degree Programme

Mandatory courses	Elective courses (4 ECTS)	
(6 ECTS)		
Environmental law	Health risks	Applied algology
Ecological risk assessment	Ecological certification	Molecular ecotoxicology
Aquatic ecology	Sewage and wastewater treatment	Applied aquatic microbiology
Bioindicators	Groundwater	Case studies
Biological monitoring	Water treatment	Water catchments
Chemical monitoring	Applied hydrology	Sedimentology
	Remediation	Biodiversity
(4 ECTS)	Ecotoxicology	Population genetics
Environmental informatics	Ecotoxtests/bioassays	Eutrophication
	Anthropogenic pollution	Predictive limnology
	Ichthyology	Environmental GIS
	Environmental economy	Oligotrophic lakes
	Environmental embryotoxicity and teratogenesis	Biostatistics

and carefully read the application details and the prerequisites for entrance to the programme. The minimum educational entry-requirement to the programme is a Bachelors degree or equivalent (180 ECTS credits) in Environmental Engineering, Environmental Science or Biology. A Selection Committee consisting of one representative from each university offering the programme will evaluate the applications and identify suitably qualified students. Selected students will be offered a home university at which the first semester, at least, will be spent, as well as research-thesis writing. During this semester, consisting of mandatory course-studies, students plan their remaining studies and organise the preparation of a thesis. Following discussions and agreements with potential home university supervisors and/or potential industrial supervisors regarding thesis work, the students choose elective courses for the remaining ECTS credits (20 or 50) needed for successful completion of the programme. The thesis, which must be submitted in printed form before the examination, is defended against an external examiner in an open seminar. Final approval of the thesis is at the discretion of a Degree-Setting Committee which also decides on an appropriate award-grade.

PEDAGOGICAL BACKGROUND BEHIND THE PROGRAMME STRUCTURE

The essential question concerns the extent to which this programme differs from other programmes or conventional Masters Degree level studies. The central elements in executing change

typically embrace well-defined goals and learning objectives, core material and contents, and selection of the most effective methods of teaching and evaluation. In this programme, the Bologna process is taking preliminary steps towards European higher education with the direct objective of increasing the mobility of teachers and students. We believe that enhanced mobility and networking in association with the commitment of all stake holders will make studying more flexible for students and enhance the learning experience. From the point of view of equal learning opportunities, it is important that all students are provided with a basic set of skills necessary in order for them to take full advantage of the learning opportunities provided in this program. This is significant since students will differ in terms of background and individual characteristics such as anxiety, learning and cognitive styles, activity or passivity in learning, self-efficacy beliefs and self-regulation skills.

From a student perspective, the experiences of relevance and meaningfulness are central facilitators of learning. In the proposed programme, the active use of information technology not only obliges educators and students to view online education as a normal activity of the universities but it also increases students motivation experience of relevance. Targetting e-Learning issues aims to incorporate different tools in the every day work. From a pedagogical perspective, the Masters degree programme is strongly characterised by an interdisciplinary problem-solving approach. This follows the burgeoning need for operational tools and professional skills required for ensuring, at the same

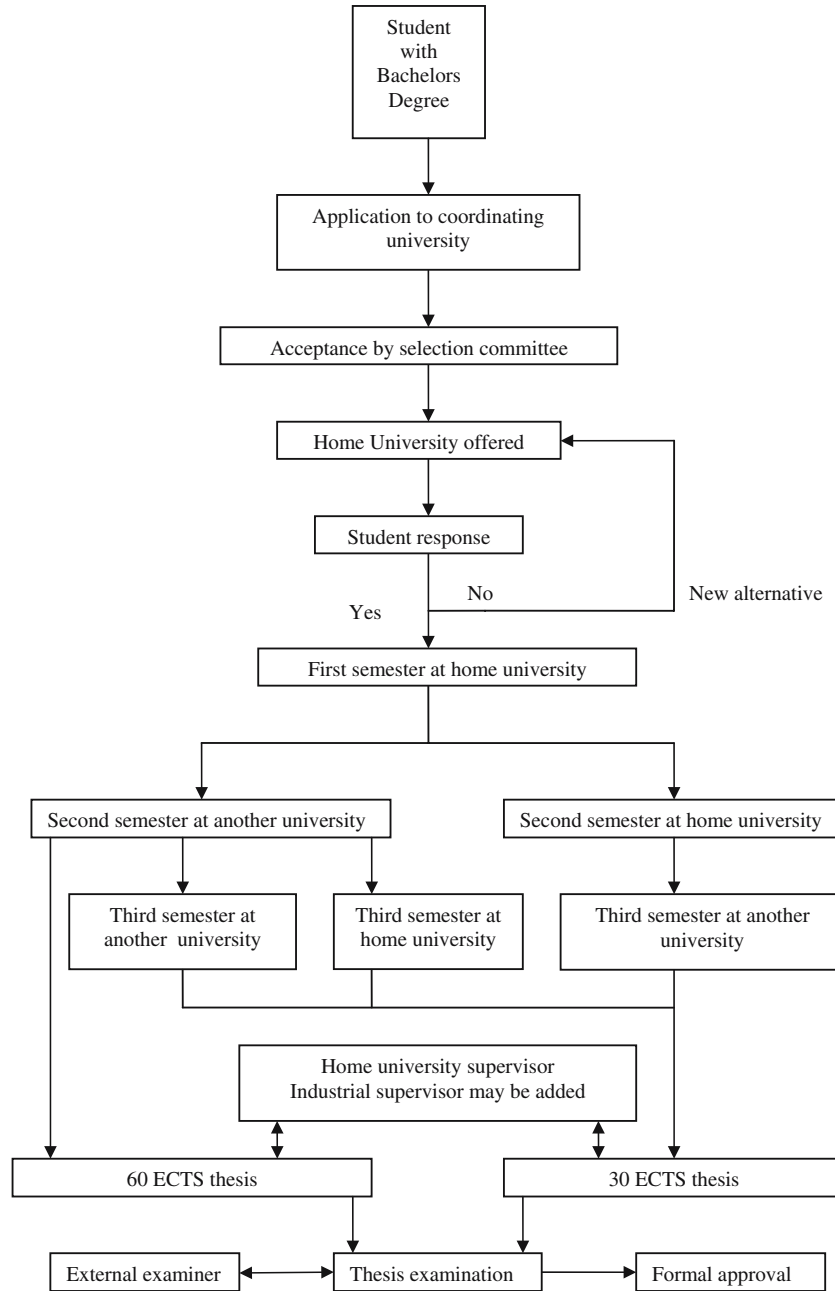


Fig. 1 A flow chart describing the student's path through the IWQA masters programme.

time and with the same management programme, both ecological standards and water usability in an inter-regional dimension. These represent the key points of the WFD marking a significant adjustment of the perspective of previous decades in which water management options were selected with virtually exclusive reference to intended use. The ecology aspect of water bodies were outside the

capabilities of the water managers. In order to address new market requirements, the Masters programme has specifically developed a pedagogical structure which will enable the students to integrate this knowledge with disparate disciplines. With an emphasis, the acquired knowledge will range from discrete water use plans, to wide ranging social and public policy issues. In this way the problem-solving

perspective of the programme will be greatly enhanced. Achieving the foregoing objectives will require the pedagogical structure of the Masters programme to engage the following issues:

1) Multidisciplinarity

This is a feature of both the mandatory and the wide selection of coordinated elective modules. Acknowledging the existence of a large number of scientific subjects potentially useful in the water science field, efforts have been made to represent those scientific disciplines essential to the understanding and application of the WFD.

2) Flexibility in the scientific format

This aspect will enable the students to appreciate and address the environmental problems and challenges arising from regional differences at different levels. In this context, the Masters programme provides a selection of closely related courses, designed to impart a deeper knowledge of selected fields to the students. In addition, the programme allows the student a choice of a diploma assignment valued at either 30 or 60 ECTS, in order to optimize prospects for future employment. On the one hand, a career directed towards research is favoured by the choice of diploma assignment valued at 60 ECTS coupled with fewer elective courses. On the other hand, employment in environmental management with WFD issues is more favourably addressed via a diploma assignment valued at 30 ECTS in conjunction with a wider number of elective courses, providing broader knowledge of a variety of water science areas.

3) Integration within the social context

Given the critical importance of the legislative aspect of all Directives, the Masters programme includes Environmental law as a mandatory course.

Due to little previous exposure to multimedia and/or communication, natural scientists usually have limited competence in informatics. This often reduces success in attracting positive public support for scientific work. In order to address this knowledge gap, the mandatory course in Informatics is a feature of the Masters programme. It is hoped that this approach will develop the student's interest in multimedia and communication technique and to better apply marketing issues into natural science.

Finally, the programme strongly supports student and teacher mobility as a mechanism to enhance a European dimension to knowledge and improve eventual employment across Europe. There is a programme requirement that students must study at a minimum of two different universities in two different countries. An additional support for the European dimension is given by a multiplicity of educational input from teachers from member states of the union.

SCIENTIFIC CONTENT OF THE MASTERS PROGRAMME

Although an extensive list of candidate courses was initially approved by the participating universities for assimilation into the programme, a prudent broadening of content subsequently took place, in order to best address discreet knowledge- and skills-gaps, and to maximise the potential of the existing competence of the consortium. Thus, the emergent list (Table II) is considered to be representative of all of the discipline areas uniquely appropriate to implementing the WFD.

Likewise, two guiding principles were acknowledged in selecting the scientific content of courses:

- Since the Directive will be implemented on a European-wide basis, then a common platform should be developed.
- Since the various ecoregions in Europe—represented by the partner institutions—possess specific features, then specific options for their management should be included in syllabi.

CONCLUSIONS/SUMMARY

The proposed Masters programme acknowledges the aspirations of the Bologna process, which has been widely articulated in various publications of EU ministerial meetings (e.g. The Prague Communiqué, 2001; The Berlin Communiqué, 2003; Bergen Communiqué, 2005).

The advancement of a European dimension both in water quality assessment and in educational developments will be greatly stimulated by the participation of European universities from 14 countries at the formative stage. Eventually, however, this foundation will consolidate as increased course-places become available for applicants from all Europe.

By fully subscribing to and adopting the ECTS system in its delivery, the programme will substantially extend collaborative development of curricula,

stimulate student and teacher mobility, and greatly enhance multiparty educational initiatives. Furthermore, it is likely to be a catalyst for prospective, significant employment of its highly-skilled graduates who will technically support the implementation of the Water Framework Directive.

This programme will produce graduates with good knowledge in how to implement the WFD. By studying in different countries, receiving education from teachers from different parts of Europe, with expert knowledge in different fields of water science, environmental law and environmental informatics, and being given a European dimension of the course contents the graduates will be the best in Europe having a European perspective of the WFD

The students will have two study alternatives. One is preparing for research, having a smaller number of courses in water science and a large strongly research oriented diploma work. The other is preparing for a management position by having the possibility to study a larger number of courses and a smaller diploma work that may be more oriented towards managerial issues.

Finally, through maturation to international recognition and commendation, the programme will endorse a provision by Europe of world-class, leading-edge education.

REFERENCES

- Bergen communiqué (2005). The European Higher Education Area. Achieving the Goals. Communiqué of the Conference of European Ministers Responsible for Higher Education. Bergen, 19–20 May 2005. http://www.bologna-bergen2005.no/Docs/00-Main_doc/050520_Bergen_Communique.pdf.
- Directive 2000/60/EC (2000). Establishing a framework in the field of water policy. Official Journal of the European Communities L 327/1.
- EUA publications (2004). Developing Joint Masters Programmes for Europe – Results of the EUA joint masters project March 2002 – Jan 2004.
- Reichert, S., and Tauch, C. (2003). Trends 2003 – Progress towards the European Higher Education Area. Bologna four years after: Steps toward sustainable reform of higher education in Europe. A EUA report. European University Association.
- Reichert, S., and Tauch, C. (2005). Trends IV: European universities implementing Bologna. A EUA report. European University Association.
- Tauch, C., and Rauhvargers, A. (2002). Survey on Master Degrees and Joint Degrees in Europe. European University Association.
- The Berlin communiqué (2003). Realizing the European Higher Education Area. Communiqué of the meeting of European Ministers in charge of Higher Education. Berlin, September 19th, 2003. http://www.bologna-bergen2005.no/Docs/00-Main_doc/030919Berlin_Communique.pdf.
- The Bologna declaration (1999). http://www.bologna-bergen2005.no/Docs/00-Main_doc/990719BOLOGNA_DECLARATION.pdf.
- The Prague communiqué (2001). Towards the European Higher Education Area. Communiqué of the meeting of European Ministers in charge of Higher Education. Prague, May 19th, 2001. http://www.bologna-bergen2005.no/Docs/00-Main_doc/010519PRAGUE_COMMUNIQUE.pdf.
- UNEP and EEA. (1997). Water Stress in Europe. Press release 20th January.