INPUT PAPER

Prepared for the Global Assessment Report on Disaster Risk Reduction 2015

USING INNOVATIVE UNIVERSITY DIDACTICS FOR FLOOD RISK REDUCTION AND TRANSFER OF RISK KNOWLEDGE

Lars Nyberg[1], Mariele Evers[1,2], Magnus Johansson[1], and Shu-Nu Chang-Rundgren[3]

[1] Centre for Climate and Safety, Karlstad University, Sweden

[2] Department of Geography, Bonn University, Germany

[3] Department of Engineering and Chemical Sciences, and Centre of Science, Mathematics and Engineering Education Research (SMEER), Karlstad University, Sweden

12 January 2014

Table of Contents

Introduction 3
Methods 4
Description of three education initiatives 4
Local level: The Flood walk concept in the city of Karlstad 5
Sub-national level: The IntECR concept used for courses on Lake Vänern and Lake Mälaren 6
European level: The masters course Integrated Flood Risk Management 7
Analysis from a HFA perspective 11
Discussion 12
Acknowledgement 13
References 13

Introduction

In an ever changing surrounding world, risks are a moving target. The importance of recurrent education and development of well-adapted didactics for increased risk reduction and transfer of risk knowledge is fundamental (Hyogo Framework for Action 2005-2015). The understanding of disaster risks, which is a prerequisite for prevention and mitigation of risks, is normally built mainly upon experiences from previous events. Future changes in society, due to e.g. climate, urbanization or economic growth, are connected to probabilistic uncertainties, which require a longer time perspective in planning and action in comparison with traditional risk reduction work (cf. LAVELL, et al., 2012). The need to integrate disaster risk reduction (DRR) with future changes posing emerging risks is challenging (BIRKMANN, et al., 2009; LAVELL, et al., 2012), and in practical risk management historic known facts still constitute the base. A broad picture with a well described socio-economic and ecological context of events with a high learning value, has to be used for an enhanced comprehension of the complexity that risk reduction face. The knowledge base has to be inclusive, acknowledging the multi-sectoral, multi-actor, and multi-disciplinary characteristics of disaster risk reduction (WISNER, et al., 2012). The knowledge about disastrous events, which are relatively few, thus needs to be transferred in time and space, for example from one generation to the next and from disaster areas to other areas where disasters not yet have occurred. The transfer is also needed between societal sectors (horizontal) and between levels in society (vertical). Another type of transfer is the exchange between the academy and different societal organisations.

Education about disaster risks is not only an intellectual transfer of textbook knowledge but also about a deeper understanding of concepts like risk perception and risk awareness, which is connected to a broader learning using different senses (UNESCO and UNICEF, 2012). This means that the "classroom" – the place where the learning takes place – is an important part of the education.

Different target groups can be identified, and children and young generations are of special interest since they will build and manage the future society, and as not yet being fostered in the sector thinking, could be assumed to have a more open-minded attitude towards being part of new innovative solutions within DRR. Another important target group is the professionals: the experts and decision-makers at different levels, which have a key role in creating increased resilience in the existing society.

One of the five priority areas in the Hyogo Framework for Action (HFA) addresses knowledge and education: *"Use knowledge, innovation and education to build a culture of safety and resilience at all levels".* Key activities that HFA identifies are information management and exchange, education and training, research, and public awareness. One aspect mentioned in the framework is the opportunity of integration of the DRR education as an intrinsic element of the United Nations Decade of Education for Sustainable Development (2005-2014). Other aspects that need promotion are "*the implementation of local risk assessment and disaster preparedness programmes in schools and institutions of higher education*" and to "*develop training and learning programmes in disaster risk reduction targeted at specific sectors (development planners, emergency managers, local government officials, etc.)*".

In a global study about DRR in school curricula for pupils in primary and secondary education in 30 different countries, UNESCO and UNICEF (2012) pointed at several important findings regarding DRR education. Even though they found a number of good examples of DRR education, several important aspects of DRR quite often were lacking. One example of that was an interdisciplinary approach, and horizontal and vertical integration of curricula. UNESCO and UNICEF also calls for more initiatives regarding "*interactive, participatory and 'in-the-field' learning through which competencies, involvement literacy and confidence are built*". Affective learning, where feelings and emotions are involved, is important and with an increasing number of disasters in the future the educational methods need to be adapted to areas where post-disaster conditions prevail. Apart from affective learning, five different learning methods were identified: interactive learning, inquiry learning, surrogate experiential learning (e.g. film, games, etc.), field experiential learning, and action learning. No examples of teacher training programmes were found in the studied countries.

HFA points out the possibility to integrate DRR education with education for sustainable development, promoted during the Decade of Education for Sustainable Development (DESD). DESD is in action between 2005 and 2014 under the leadership of UNESCO, and promotes for example interdisciplinary and holistic learning, value-based learning, participatory decision-making, and locally relevant information.

The objective of this paper is to describe and analyse three innovative approaches, performed and tested in practise, regarding flood risk education and didactics at different scales: 1) local level in Karlstad, Sweden (appointed resilient city by UNISDR), 2) sub-national level in the large-lake districts in central Sweden and 3) European level among 5 countries. All three initiatives are related to HFA processes.

Methods

Three education initiatives have been described based on documentation and publications, together with experiences from the planning and implementation of the activities made by the four authors. An analysis of the three initiatives was made, from a perspective of fundamental principles of the Hyogo Framework for Action and the findings by UNESCO and UNICEF (2012). From that analysis, a number of new potential indicators for DRR education were identified.

Description of three education initiatives

Three initiatives have been taken at the Centre for Climate and Safety (CCS) at Karlstad University, Sweden. The establishment of the centre in 2008 and much of its education and research activities have been oriented and structured following the principles of HFA.

CCS is addressing flood risk issues as trans-disciplinary and cross-sectoral phenomena. Flood risk is produced at the interface of natural and societal systems and typically spans multiple disciplines as well as sectors of society. It has been crucial for CCS – beside its research – to facilitate educational training and knowledge transfer for students and professionals in these various fields. One important component of that education has been to open the courses for professionals from different sectors and levels of society, as well as for the traditional student groups. Another component has been to use the risk areas studied in the courses as

a classroom, emphasizing excursions, study visits and other types of distributed on-site education.

Local level: The Flood walk concept in the city of Karlstad

The city of Karlstad is located in a flood prone area on the delta of River Klarälven at the northern edge of Lake Vänern. Both the river and the lake pose threats, and flooding has not been uncommon throughout the history of the city. The expected future effects of climate change in the area, such as increased precipitation and runoff, serves to accentuate the challenges of the city. To meet these challenges Karlstad Municipality, appointed Resilient City by UN-ISDR in 2010, has developed a comprehensive Flood Program to reduce flood risks. Access to information such as the Flood Program and applicable knowledge among societal actors as well as the general public are identified as crucial components in the prevention and mitigation of adverse effects of future flood events. The development of risk awareness and knowledge building through education is a key to achieve this goal.

At CCS a concept called *The Flood Walk* has been developed since spring 2010, to increase knowledge about flood risks in general, using the city of Karlstad as an example (Figure 1). The flood walk was conceptualized to meet the following goals:

- providing learning through multiple aspects in a communication between students, lecturers, researchers/experts
- giving a major input and interest about flood hazards and societal consequences as well as strategies to reduce risks
- giving the possibility to examine examples of events and risks
- providing hands-on information in the field, using all senses

This Flood Walk is to a large extent based on information from the above mentioned Flood Program. The material is mainly a city tour with 14 optional stops. There is a written instruction guide prepared, freely available to use for guidance of groups. The normal walk includes 5-6 stops and lasts for 1.5-2 hrs.

A location-based learning material with slides and images has been developed for each of the 14 stops in the walk. Historical photos, illustrations, tables with interesting facts of previous flood events, etc., are used as a "mobile outdoor power point presentation". There is also discussion questions prepared for each stop or subject in the guide material.

Figure 1. Photos from physical flood walks during 2010 and 2011.

Since the first Flood Walk took place in March 2010 around 30 guided walks have been arranged. Participants have been pupils and students, the public in the city of Karlstad, and

different expert groups from local, regional, national and international levels. Examples of the latter are representatives from national platforms in various countries, visiting the Swedish Civil Contingencies Agency's office in Karlstad. One example of the use of Flood Walks in regular education is the Integrated Flood Risk Management-course (described below) that was held for the first time in springtime 2011. During one of the excursions in the master course the students participated in a flood walk. Several Flood Walks have also been arranged for pupils from the local high-schools in Karlstad.

As a second step of the Flood Walk concept development, a prototype of a virtual flood walk was developed in 2012. The reason for this step was to extend the possibilities to use the Flood Walk concept in time and space. A web-based version could be used by a much larger target group, and using the full capacity of an Internet based learning environment. At the same time some of the strong parts of the walk concept is lost, e.g. the on-site meeting between people and their social interactions. Video-recorded information at 5 stops along the walk together with some other material was arranged in a digital learning platform. In order to analyse the learning outcomes of the different approaches an evaluation of the physical and virtual learning environments was made using two groups of high-school pupils, in total 65 pupils. The results from that study are currently under publication (CHANG-RUNDGREN, et al., in prep.).

Sub-national level: The IntECR concept used for courses on Lake Vänern and Lake Mälaren

A didactic concept for university courses called IntECR has been adopted for two large lakes in Sweden: Lake Vänern and Lake Mälaren (JOHANSSON, et al., 2013). The major characteristic of the concept is the *in situ* study of cases, presented in close collaboration with stake-holders and researchers in an academic arrangement that favour open exchange and creative knowledge building. The participants can be ordinary university students, but preferentially risk managers and other related professionals in need for life-long learning. One important idea behind this concept is to decrease the gaps between academy and societal actors, and between theory and practice. The concept is especially useful for knowledge development and sharing across management areas, in relation to complex problems and their solutions.

Blended learning is used, a mix of web-based learning components and a number of on-site education days distributed in cities within the specific study area. These days were used for lectures from local experts and invited researchers, study visits to interesting sites in each city, and discussions among participants and representatives of the local authorities. The education days have several roles, e.g. to bring the course participants to the problem areas, to fully realize the problem complexity and the proposed actions/strategies, as described by local and regional problem owners and invited experts and researchers. Another role is to build informal networks and trust among participants, experts and researchers, in a social learning process with the academy as a guarantor for an exchange without favouring any *a priori* knowledge held by some agencies (SCHUSLER, et al., 2003). The overall goal is to raise the knowledge and awareness of each other´s perspectives, adding new insights and facts, to build a shared problem identification, which is a starting point for constructive development (MOSTERT, et al., 2007).

The IntECR concept was used for two university courses at Bachelors level, adopted to two large Swedish lakes: Lake Vänern and Lake Mälaren. For both lakes issues like floods, climate change, water resources, land use planning, and water regulation is of highest relevance. Both lakes were flooded in the year 2000 and has since then been investigated, after both local and national initiatives, regarding flood risks and potential solutions.

In 2009 a 15 credit course about Lake Vänern was held. The course content corresponds to a semester's studies at 50% pace. Lake Vänern is the largest lake in the European union and has a complex multi-risk situation, including flood risks around the lake as well as in upstream and downstream rivers, and landslide risks in the single outlet river (Göta älv) limiting the lake discharge. The lake is used for hydropower production, shipping, drinking water supply, recreation, tourism, fishing, and as waste water recipient, complicating the risk situation further. An analysis of these different interests and the consequences of different water regulation regimes can be found in NYBERG et al. (2014).

The course event included education days in six cities around Lake Vänern. A total of 20 participants followed the course.

In 2010 a 10 credit course was held about Lake Mälaren. The course was arranged in cooperation with the 5 county administrative boards around the lake. Lake Mälaren is the third largest lake in Sweden and plays a major role in central Sweden and the region around the capital Stockholm. Also, this lake is used for shipping, drinking water supply, recreation, as recipient of waste water, etc. The flood in year 2000 revealed several vulnerabilities in Stockholm and other cities, not foreseen in risk plans. A large ongoing infrastructure project in central Stockholm to drastically increase the discharge capacity was studied during the course period. One major implication of climate change in this region is that the water level of the Baltic Sea will rise and within the coming 50-100 years start to cause saltwater (the water in the Baltic Sea at this latitude is brackish) intrusions in Lake Mälaren, if not prevented through human actions.

The course event included 5 education days in 4 different cities. Ca. 20 participants followed the course, and about half of the group contributed to a course assessment at the end of the course (reported by JOHANSSON, et al., 2013). The assessment showed basically a positive attitude from the participants to the course concept. They mentioned specifically informal networking, holistic perspective, shared problem identification and the possibility to study several examples of local management within a common context, as successful outcome of the concept.

The participants in the two courses were professionals from e.g. authorities at local, regional and national levels, employees from private companies such as insurance business, teachers at secondary level. Other participants were students from study programs such as environmental science, ecology, societal planning, etc.

European level: The masters course Integrated Flood Risk Management

The third example in this paper is the masters course "Integrated Flood Risk Management", developed during the EU project *SAWA* (Strategic Alliance for Integrated Water Management Actions). Six European universities, together with 12 other project partners, created an

interdisciplinary course for students and professionals. Four course themes cover governance and legal framework, risk analysis, integrated planning and measures and strategies. Important learning components have been case-studies from 22 project partners (from 5 countries) and excursions in flood-prone river basins. The course has attracted participants from all-over the world. The course design has been described by EVERS and NYBERG (2013).

There are several incentives for European education on water management and flood risks. One driving force is to spread the knowledge and experiences from the serious flood events that has occurred in Europe the last decades. Another strong force is the effects of climate change, which causes need for new knowledge and education. A third incentive in the floods area is the EU Flood Directive that was adopted in 2007 and now is implemented in all member states. The directive with its broad perspective on flood risk management (FRM) requires new methods and practices regarding risk mapping and risk-reducing measures, which all in all create needs for education. It also requires the integration of climate change aspects and transnational coordination of flood risk issues in Europe.

Joint education, involving universities from different countries, has different positive effects:

- bringing knowledge between countries, by exchange of students, teachers and researchers, and professionals
- shared experiences of flood events and different conditions
- shared examples of approaches, strategies and measures taken in different countries

Six universities within the SAWA project contributed to the development of the master course: Karlstad University (host), Hamburg University of Technology, HafenCity University, Hamburg, Heriot-Watt University, Edinburgh, Leuphana University, Lüneburg, and University of Salford.

The scope for the course is flood risk management principles and practices. The relation to neighbouring management perspectives, like water quality and land-use, is elucidated. There is a need for an integrated approach which has to consider economic, social and ecological aspects of vulnerability and potential risk-reducing measures. Interdisciplinary and trans-sectoral work as well as collaboration among stakeholders is needed. The EU Flood Directive and its requirements are central in the course content, as well as the interface between the Flood Directive and the Water Framework Directive.

The course content is structured into four areas.
1) Governance and legal framework: • Floods directive (& WFD) • Risk governance
2) Flood risk analysis: • Hydrological/hydraulic modelling • Vulnerability analysis
3) Integrative planning: • Flood risk management plans • DSS/PSS
4) Adaptive measures: • Structural/non-structural • Relation to sustainable development

The course is both offered to students in masters programs and to professionals that need wider and deeper knowledge. Suitable disciplinary background for the participants are for example water management, risk management, environmental science, physical planning, geography, ecology, technical infrastructure, contingency planning and education. To be admitted to the course, the students needed at least 120 credits at bachelor level from previous studies, or at least three years of work experience in the area.

From the syllabus, approved at Karlstad University, you can read the following.

Upon completion of the course, students should be able to:

- *explain how water management and flood risk management can contribute to sustainable development,*
- *give an account of legal and planning instruments included in the EU floods directive and other pertinent directives,*
- *contribute to vertical integration (local, regional, national and international) and horizontal (different sectors, disciplines and institutions) with regard to flood risk management,*
- *present a broad view of various European strategies and methods,*
- *present specific analysis tools and use them,*
- *apply adaptive measures and analyse their effect on people, society and ecological system.*

The didactic format is a blended learning approach which consists of online courses, web-seminars, assignments and a group work and excursions within SAWA member countries where partners demonstrates case studies and different approaches of handling flood risk issues.

14 lecture themes plus an introduction to the flood phenomena have been available for the students. The standard format for the lectures was a 20-40 min session of streamed video (taped), uploaded on the web platform, slides in Powerpoint format and further documents and/or literature.

For the first course event, in 2011, two excursions were made to:

1) Germany/Netherlands: Hamburg/Lüneburg area, Elbe, Blauestadt/Almere/Rotterdam

Main topics were: flood protection in urban and rural areas, flood adaptive city planning, awareness rising activities, flood risk and nature protection and agriculture, synergies in WFD and FD, structural and non-structural measures, super dykes

2) Sweden/Norway: Göta älv and Lake Vänern, Karlstad/Arvika, River Klarälven and River Glomma in Norway

Main topics were: water supply, landslides, flood risk management and sustainable development, awareness rising activities (flood walk, flood model), different types of dike protection, conflicts with hydropower and nature protection

Each excursion lasted for 5 days. The students were obliged to participate in one of the two excursions. Both excursions were partly videotaped and could be experienced via the web-platform. A total of 12 SAWA partners contributed actively to the excursions, via lectures, study visits, and much practical support.

Figure 2: Excursion to the Höljes hydropower dam at the border between Sweden and Norway, May 2011.

For the course event in 2011, 31 students were registered for the course. 23 students were examined partly or fully. Among these 23 students, 12 nationalities (from Europe and other regions of the world) were represented. 15 out of 23 course participants were studying other courses or programmes, whereas 8 were professionals. The disciplinary background was very differing, e.g. engineering, hydrology, risk management, environmental science, business administration, law, and economy. The student group for the course in 2012 included 10 students from 5 different countries.

The course event in 2011 was evaluated with a web questionnaire. 13 students contributed to the questionnaire and the mean grades on a five-degree scale (1 = bad, 5=good) were as follows: Information before and during the course 4.3, Quality of lectures 3.7, Individual tasks 4.0, Group task 3.0, Excursions 4.3, Course literature 3.8, Overall grade for the course 4.1.

Apart from the quantitative grades, much qualitative information was gathered from the questionnaire, comments that were used to improve the design of the second course event in 2012. Here are some quotations from the questionnaire:

"The integration of the different themes was necessary since water and flood need an integrated perspective"

"The international exchange was very important. For me it wasn't only important for the topic flood risk management but also for general cultural understanding. I learned very much from all of the members in our group and I was surprised how well the communication went."

"The excursions were very important. First of all it was good to get to know the group and it was also very helpful to have space for discussions. The examples we got to learn about were very helpful for understanding the complexity of flood risk management."

Analysis from a HFA perspective

The three education initiatives described above are in this chapter analysed, using basic aspects of HFA and DESD, as well as the findings by UNESCO and UNICEF (2012). These aspects are listed in Table 1, together with a characterization of the three initiatives.

Table 1: A characterization of the three education initiatives based on a number of aspects of DRR education.

Aspects of DRR education according to HFA, UNESCO and UNICEF, and DESD	**Local level: Flood walk**	**Sub-national level: "Big Lake" courses**	**European level: Masters course IFRM**
Integration of perspectives/interdisciplinary and holistic learning	Different perspectives of flood hazards, the full spectrum of vulnerable objects and structures, and potential risk-reducing measures and strategies are presented and discussed.	Flood risk management, climate change adaptation, land use planning, etc, were the basis for the courses. Different authorities, experts and problem-owners presented their views in an open exchange.	Different aspects of Flood risk management were presented in lectures, excursions, etc. Synergies and conflicts with neighbouring management fields such as management of the aquatic ecology and land use planning were included in the course.
In-the-field education	The city centre of Karlstad is used as classroom. Several stations/stops are visited during a walk, each with a specific topic.	Each of the education days, distributed in the lake area, included excursions and study visits.	Excursions were carried out in four European countries. Video-recordings of these excursions have been used for later course events.
Engagement of youth and professionals	High-school pupils and experts from local/ regional/national/ international levels have participated.	Professionals from authorities and private sector participated both among the students and as experts/ lecturers, yielding a mutual exchange of knowledge.	A mix of younger students and professionals has participated in the three course events. Several professionals have acted as teachers.
Creation of formal and informal networks	Each walk is also a meeting between people. During the	The repeated education days created informal	Each course event created a strong network among the

	walk there is time for exchange of knowledge, values and perspectives.	networks among participants (which mainly were professionals), teachers and visiting experts.	participants and teachers. Especially the exchange during excursions is of large importance.
Interaction and empowerment of communities and local authorities	Local and regional authorities, responsible for DRR, have been using the walk for knowledge transfer among the staff, and have acted as guides for the public and other groups.	Each education day were hosted by a municipality. Their flood problems were addressed based on their problem formulation. Alternative perspectives were given by invited experts and researchers, and discussed by the course participants.	Several local and regional authorities, as members of the SAWA project, contributed to case studies and study visits during excursions.

Discussion

Even though the three educational initiatives presented in this paper have different geographical settings and different target groups, we can see from Table 1 that there are many generic characteristics from a DRR and DESD perspective. It shows that DRR learning and knowledge generation has to be contextualised based on different levels and scales. The different learning approaches in this paper a clearly adapted to the respective level and scale.

An important element in learning processes is to adapt and internalise knowledge in order to build capacity. The initiatives presented are illustrating ways to realise this internalisation by exchange between experts and students, regarding real case studies where knowledge is applied, and using distributed on-site learning to reach a deeper understanding of the geographical context.

The initiatives and their positive evaluations show that different methods and frameworks for social learning processes, tailored for DRR needs, can give important knowledge transfer and contribute to disaster risk reduction at different levels and in different target groups. The criteria from Table 1 can be used for new indicators for progress in DRR education. This could for example be:

- The integration of natural and social scientific aspects of disaster risks and reduction (interdisciplinary and holistic perspective)
- The inclusion of professionals at all levels in DRR education and training activities
- The use of spatially distributed on-site education

Acknowledgement

This study has been financed by the SAWA project (EU Interreg North Sea program), Karlstad University and the Centre for Natural Disaster Science (CNDS).

References

Birkmann, J., G. Tetzlaff and K.-O. Zentel. 2009. *Addressing the Challenge: Recommendations and Quality Criteria for Linking Disaster Risk Reduction and Adaptation to Climate Change*. DKKV Publication Series 38, Bonn.

Evers, M., and L. Nyberg. 2013. Transnational education for integrated flood risk management – the Master Course IFRM. *Hydrologie und Wasserbewirtchaftung, 57:100-109.* In German.

Johansson, M., L. Nyberg, M. Evers and M. Hansson. 2013. Using education and social learning in capacity building - the IntECR concept. *Disaster Prevention and Management*, Vol. 22 Iss: 1 pp. 17 – 28. Emerald Group Publishing.

Lavell, A., M. Oppenheimer, C. Diop, J. Hess, R. Lempert, J. Li, R. Muir-Wood, and S. Myeong, 2012. Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. Chapter 1. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.). A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 25-64.

Mostert, E., C. Pahl-Wostl, Y. Rees, B. Searle, D. Tabara and J. Tippett. 2007. Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins. *Ecology and Society*, Vol. 12 No. 1, p. 19, available at: www.ecologyandsociety.org/vol12/iss1/art19/ (accessed 27 April 2012).

Nyberg, L., M. Evers, M. Dahlström, and A. Pettersson. 2014. Sustainability aspects of water regulation and flood risk reduction in Lake Vänern. Accepted for publication in *Journal of Aquatic Ecosystem Health and Society*.

Schusler, T.M., D.J. Decker and M.J. Pfeffer. 2003. Social learning for collaborative natural resource management. *Society and Natural Resources* 15: 309–326.

UNESCO and UNICEF. 2012. Disaster risk reduction in school curricula: case studies from thirty countries. Report from UNESCO and UNICEF. ISBN 978-92-3-001087-4.

Wisner, B., J.C. Gaillard and I. Kelman, 2012. Challenging risk. Chapter 1. In: *The Routledge handbook of hazards and disaster risk reduction*. Wisner, B., J.C. Gaillard and I. Kelman (Eds.). New York, USA.