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## ANDROID: an inter-disciplinary academic network that promotes co-operation and innovation among European Higher Education to increase society's resilience to disasters

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### Abstract

Using knowledge, innovation and education to build a culture of safety and resilience at all levels is one of five priorities for action (PFA) that were identified in the Hyogo Framework for Action (HFA). The responsibility for such capacity building resides largely with educators such as higher education institutes, but the complexity of resilience poses a number of challenges. This paper describes ANDROID, an EU funded international partnership of higher education institutes and key actors in disaster resilience, which has been formed to develop innovative European education. ANDROID is based on an inter-disciplinary consortium of partners that comprises scientists from applied, human, social and natural disciplines. ANDROID set out to achieve this aim through a series of inter-linked projects, identified as work packages and led by a sub-group of international partners. This paper describes these projects and highlights key outputs achieved to date: an inter-disciplinary doctoral school; a survey capturing and sharing innovative approaches to inter-disciplinary working; a survey of European education to map teaching and research programmes in disaster resilience; a survey analysing the capacity of European public administrators to address disaster risk; emerging research and teaching concerns in disaster resilience; and, open educational resources.

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*Keywords:* ANDROID, education, research, disaster resilience, inter-disciplinary

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## **1. Introduction**

Using knowledge, innovation and education to build a culture of safety and resilience at all levels is one of five priorities for action (PFA) that were identified in the Hyogo Framework for Action (HFA). The HFA, established in 2005, aimed to substantially reduce disaster losses, including the number of people killed, as well as damage and destruction of the social, economic and environmental assets that underpin our communities and countries (UNISDR, 2005). Within HFA, PFA3 identified that disasters can be substantially reduced if people are well informed and motivated towards a culture of disaster prevention and resilience, which in turn requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities.

The responsibility for such capacity building resides largely with educators such as higher education institutes, but the complexity of resilience poses a number of challenges. The term resilience has been widely adopted in research, policy and practice to describe the way in which they would like to reduce society's susceptibility to the threat posed by hazards. Resilience has also been used freely across a range of academic disciplines, including materials, ecology, economics and sociology. Despite this, the complex nature of disasters has led to recognition that risk reduction through increased resilience will require a strategy that is inter-disciplinary. True inter-disciplinarity only occurs where a number of separate disciplines surrender their own concepts and goals, and collectively define themselves by reference to a common set of strategic concepts and goals.

This paper describes ANDROID, an EU funded international partnership of higher education institutes and key actors in disaster resilience, which has been formed to develop innovative European education. ANDROID is based on an inter-disciplinary consortium of partners that comprises scientists from applied, human, social and natural disciplines.

## **2. Background**

The risks and vulnerabilities exposed by natural hazards and disasters are on the rise globally, and the impacts are severe and widespread: extensive loss of life, particularly among vulnerable members of a community; economic losses, hindering development goals; destruction of the built and natural environment, further increasing vulnerability; and, widespread disruption to local institutions and livelihoods, disempowering the local community. Rising population and infrastructures, particularly in urban areas, has significantly increased disaster risk, amplified the degree of uncertainty, challenged emergency arrangements and raised issues regarding their appropriateness (Haigh and Amaratunga, 2010; Haigh and Amaratunga, 2011).

What is becoming equally apparent, however, is the importance of resilience - not only in the structures that humans design and build, but in the way society perceives, copes with, and reshapes lives after the worst has happened: to use change to better cope with the unknown. In ancient times, cities like Pompeii were simply abandoned after disaster struck - a move that today seems unthinkable. But learning to bounce back is an emergent behaviour that must be both improvised and adaptive, and our creativity is vital.

In order to overcome the increasing hazard frequency, severity and exposure, the notion of building resilient communities has been adopted by many scientists and policy makers to describe the way in which they would like to reduce society's susceptibility to major incidents of all kinds, reducing their probability of occurring and their likely effects, and by building institutions and structures in such a way as to minimise any possible effects of disruption upon them. Disaster resilience has arisen from an amalgamation of historic developments in the disaster planning process, but the term resilience has been used freely across a range of academic disciplines, including material science (Tredgold, 1875), ecology (Holling, 1973), economics (Perrings, 1998), and sociology (Adger, 2000).

Despite longstanding usage of the term, there is little consensus regarding what resilience is, what it means to society, and how societies might achieve greater resilience in the face of increasing threats from natural and human induced hazards. There is however an underlying assumption that resilient communities are far less vulnerable to hazards and disasters than less resilient places. But for this assumption to be validated and useful, knowledge of how resilience is determined, measured, enhanced, maintained, and reduced is vital. Specifically, it is not obvious what leads to resilience within coupled human–environment systems or what variables should be utilised to measure it. Several studies have attempted to highlight the fundamental aspects of resilience (Berkes et al, 2003; Plummer and

Armitage, 2007), but because of the multi-dimensional and cross-disciplinary nature of resilience, a broad model of resilience has yet to be empirically tested at the community level (Cutter, 2008; Ainuddin and Routray, 2012).

Multiple definitions of resilience exist within the literature, but there remains no broadly accepted single definition (Manyena, 2006). The term was used by Tredgold (1875) in the 19<sup>th</sup> Century to describe a property of timber, and to explain why some types of wood were able to accommodate sudden and severe loads without breaking. However, Holling's 1973 paper is frequently cited, with resilience introduced into the ecological literature as a way of helping to understand the non-linear dynamics observed in ecosystems. Since then, there has been a range of interpretations as to the meaning of resilience.

For some, resilience refers to a return to a stable state following a perturbation. This view advocates a single stable state of constancy, efficiency and predictability, or, as the ability to absorb strain or change with a minimum of disruption (Horne and Orr, 1998). For others, resilience recognises the presence of multiple stable states, and hence resilience is the property that mediates transition among these states. This requires very different attributes, as for example advocated by Douglas and Wildavsky (1982), who define resilience from the perspective of risk as, 'the capacity to use change to better cope with the unknown: it is learning to bounce back' and emphasise that, 'resilience stresses variability'. More recently but in a similar vein, Dynes (2003) associates resilience with a sense of emergent behaviour that is improvised and adaptive, while Kendra and Wachtendorf (2003) argue that creativity is vital.

Further discrepancy can be found in the degree to which resilience should be defined in merely passive terms. Douglas and Wildavsky (1982) focus on the ability to simply 'bounce back' from a 'distinctive, discontinuous event that creates vulnerability and requires an unusual response'. Wildavsky (1988) further characterises resilience as the, 'capacity to cope with unanticipated dangers after they have become manifest' and notes that resilience is usually demonstrated after an event or crisis has occurred. Lettieri et al. (2009) suggest a 'contraposition' in the literature between two concepts: resilience and resistance. Resilience they argue focuses on after-crisis activities, while resistance focuses on before-crisis activities. These all suggest a reactive approach whereby resilience is considered a pattern rather than a prescribed series of steps or activities (Lengnick-Hall and Beck, 2003). Others stress a positive approach that suggests resilience is more than mere survival; it involves identifying potential risks and taking proactive steps (Longstaff, 2005). The objective is to build resilience by maximising the capacity to adapt to complex situations (Lengnick-Hall and Beck, 2005). Similarly, Paton et al (2001) write of a paradigm shift that accommodates the analysis and facilitation of growth, whereby resilience describes an active process of self-righting, learned resourcefulness and growth.

Political ecology and climate change research also incorporate the idea of adaptive capacity with resilience. Adaptive capacity is defined as the ability of a system to adjust to change, moderate the effects, and cope with a disturbance (Brooks et al, 2005). While adaptive capacity is a prominent theme in the environmental or climate change view of resilience, it is less established in the hazard literature. Instead, mitigation is a key construct: an action taken to reduce or avoid risk or damage from hazard events (Mileti, 1999). When tackling disaster risk, many applications of resilience involve engineered systems. In these frameworks, the properties of resilient infrastructure—robustness, redundancy, resourcefulness, and rapidity—reduce the probability of failures (Tierney and Bruneau, 2007). Yet, these frameworks often fail to capture underlying social and economic factors that occur at the most local levels or to account for the vulnerability or resilience of the natural environment.

Cutter et al (2008) note the different temporal and spatial perspectives that tend to be encountered across domains. For rapid onset events, such as a tsunami, an immediate response is required to change or modify behaviours and practices in the preparedness or post-event phases. Yet, for slow onset hazards, such as those resulting from global temperature variations, it is more appropriate to conceptualize these as 'pressures' that allow an individual or community the opportunity to modify existing behaviours and practices to reduce the impact of a hazard while the event is unfolding. In a similar vein, the climate change domain analyses large-scale global processes and changes, and what these mean to humans and their environment. In contrast, from the hazards research perspective, natural processes and impacts are localised and event-specific.

Underpinning much of the confusion surrounding definition and understanding is that resilience has emerged from and been applied to a variety of disciplines. The meaning and approaches of resilience are the result of different epistemological orientations, conceptual and methodological practices. This complexity represents a serious challenge to higher education as it seeks to work towards the development of knowledge, innovation and education, and to build a culture of safety and resilience through the delivery of formal curriculum.

### 3. Resilience and education

Education has been identified as one of the key activities that can contribute to the promotion of inclusive resilience knowledge at all levels. In the context of resilience and disaster risk reduction, education is to be understood broadly as the many forms of formal (through schools and universities) and non-formal transmission of knowledge, skills, experience and engagement of groups of people, including the use of media, awareness campaigns, and special events (DG ECHO, 2013).

Knowledge management and education was one of the five main areas where specific gaps and challenges were identified in the review of the Yokohama strategy (UN, 2005) and was consequently considered as one of the key priorities for actions in the development of HFA. Knowledge and education consists of the elements such as information management and exchange; formal education (curriculum); formal education (training of teachers and materials); community training and public awareness (GNDR, 2009). As such the field of education contributes to increase the public awareness on disaster reduction and to create an impact on the culture of disaster reduction in the long run. Due to the diversity of interests, needs and backgrounds among the people engaged in disaster risk reduction and the varied sectors and geographic locations affected by disaster, the knowledge sharing must be multi-lateral and inclusive (UNISDR, 2013). According to UNISDR (2013, p.11) ‘multilateral knowledge-sharing feeds into education almost naturally, underpinning efforts at raising public awareness and providing the substance of what is taught about risk reduction in schools as well as in the wider community’. They further emphasise that risk sensitive education to be a priority at all levels of the school system and needs to be incorporated in curricula beginning in the earliest school grades, continuing through secondary and higher education. To make this happen, it is important to developing the field of education in such a way so that its contribution towards increasing disaster resilience will be realistic.

Knowledge sharing and education depend on having the capacities necessary to make them function (UNISDR, 2013). Thus education can be considered as a form of capacity building and development that can ultimately contribute to increase the level of resilience within the society. Education and training is an integral part of capacity building in the disaster management discipline as trained personnel respond much better to different disasters and will take proactive measures of mitigation and prevention (IDKN, 2009). Thus, educational capacity gaps such as a lack of awareness, and education and training in disaster management (Bosher et al., 2007) need to be addressed through an innovative development of education to increase resilience to disasters.

Among various levels of education, higher education is considered as a social structure for the control of advanced knowledge and technique with teaching in its system predominantly (Clark, 1986). Higher education programmes that prepare students for careers in disaster resilience have an important contribution to make in terms of the contents of the curriculum, educational methods and study materials (Amaratunga et. al., 2011).

### 4. ANDROID disaster resilience

In recognition of the vital role that the higher education sector has in promoting inclusive resilience knowledge, the ANDROID disaster resilience network was established in 2011 (Academic Network for Disaster Resilience to Optimise Educational Development). The network was set up to promote co-operation and innovation among European Higher Education and in doing so, to increase society’s resilience to disasters of human and natural origin. An underlying tenet of ANDROID is that higher education should be more innovative, providing opportunities to work in close collaboration with industry, communities, humanitarian agencies, private sectors and other higher education institutions.

The ANDROID Network is funded under the EU Lifelong Learning Programme. With a budget of nearly €7 billion for 2007 to 2013, the programme funded a range of actions including exchanges, study visits and networking activities. Projects are intended not only for individual students and learners, but also for teachers, trainers and all others involved in education and training.

It set out to gather a wide and advanced set of competencies in the field of disaster resilience, sharing knowledge, discussing methodologies, disseminating good practices and producing and promoting innovation. It aimed to achieve these goals by bringing together a range of addressing topics of direct relevance for European Union policy.

The network brought together a consortium of inter-disciplinary scientists and inter-sectorial partners. The academic partners comprise scientists from applied, human, social and natural disciplines. These partners from across Higher Education were chosen for their complementary skills, expertise and competences in order to identify and understand the varied attributes of resilience that underpin the capability and capacity of a community to cope with the threat posed by natural and human hazards. The consortium also has major International Organisations as partners, including the UNISDR, and a Stakeholder Advisory Board that includes representatives from key actors in disaster management. These partners offer strong inter-sectorial linkages and have been established to assist the network in becoming a reliable partner as stakeholders seek to reduce society's vulnerability to hazards. In recognition of the global impact of disasters and the complex nature of their causes, which frequently require international action to address them, alongside the 64 European partners from 28 countries, the consortium also includes partners from Australia, Canada and Sri Lanka, who contribute specific scientific expertise.

The network's teaching and research is concerned with what resilience is, what it means to society, and how societies might achieve greater resilience in the face of increasing threats from natural and human induced hazards. The network seeks to create a European approach that will help us understand the attributes that enable physical, socio-cultural, politico-economic and natural systems to adapt, by resistance or changing in order to reach and maintain an acceptable level of functioning. The network is also raising awareness and promoting a common understanding among stakeholders of the importance of disaster resilience education and the essential role of European Higher Education in improving society's ability increase disaster resilience.

At the outset, three objectives were identified for the network:

- 1) Promote discourse among European applied, human, social and natural scientists to, pool their results and findings, discuss methods and develop inter-disciplinary explanations that increase society's resilience to disasters;
- 2) Describe, analyse, and compare the capacity of European cities and HE to address disaster risk, and thereby reinforce the link between education and society; and,
- 3) Build the capacity of HE to address emerging challenges in disaster resilience, strengthen the link between research and teaching, and inform policy development.

## **5. ANDROID workplan**

ANDROID set out to achieve these objectives through a series of inter-linked projects, identified as work packages (WP) and led by a sub-group of international partners. This section describes these projects and highlights key outputs achieved to date. Many of these outputs can be downloaded from [www.disaster-resilience.net](http://www.disaster-resilience.net) or accessed via the referenced publications indicated.

### *5.1. Inter-disciplinary doctoral school (WP3)*

WP3 aimed to develop HEI capacity for research and teaching by establishing an EU-based Doctoral School that is open to all interested doctoral candidates from Europe and beyond. The ANDROID Doctoral School is a fully coordinated, innovative, and international interdisciplinary doctoral teaching and research programme focused on the most salient issues and features shaping society's ability to tackle the challenges posed by disaster risk. To date (September 2014), the School has provided two online and two residential innovative research training programmes aimed at honing the students' skill set and drawing on the wide disciplinary base of the network's partners to promote inter-disciplinary working for doctoral students. In particular, the School has raised awareness and understanding of inter-disciplinary methodologies and good practice, and promoted coordination of education across Europe. The two residential doctoral schools resulted in the publication of formal proceedings.

### *5.2. Capturing and sharing innovative approaches to inter-disciplinary working (WP4)*

WP4 aimed to gather information on the state of art and practice in the field of disaster resilience and promote co-operation and interdisciplinary methodologies in research and education. A survey was carried out by means of a questionnaire focusing on disaster-resilience projects and on the main challenges faced in interdisciplinary working. The results of the questionnaire (Faber et al, 2014), which collected 57 answers from more than 20 European



countries and few extra European countries as well, allow for three main considerations: i) projects involved 5 different disciplines as average and geography and sociology were present in the majority of the projects; ii) the level of interconnection between disciplines seems intermediate, meaning that information and methods are exchanged, but a full integration of methods and concepts into a common shared language and system of axioms is missing; iii) the lack of a common framework and common terminology represents a major barrier to good interdisciplinary work. The results highlight the role played in disaster-resilience design by social and cultural aspects, which are instead not often adequately considered in the practice. The establishment of an education on resilient design of urban system, which includes both social and technological aspects, emerges as a possible solution to overcome barriers to interdisciplinary work and improve the efficacy and quality of resilience design.

### *5.3. Surveying European education to map teaching and research programmes in disaster resilience (WP5)*

WP5 aimed to establish the current teaching and research capacity among European HEIs in the field. In the subsequent survey (Perdikou et al, 2014), 96 participants directly related to disaster resilience education responded. The findings suggest that disaster resilience related educational programmes across Europe are enjoying rapid growth and there is still potential for further growth. The field is also multidisciplinary in nature and involves a variety of organisations, including academia, professionals, governmental organisations and research institutions. The survey also found that the multidisciplinary nature of these programmes will prepare specialists for organizational positions with a good, broad knowledge. However, the knowledge will not be deep enough for many detailed spheres. Therefore the specialists must also be able and ready to cooperate with many other branches/organizations and specialisations.

### *5.4. Analysing the capacity of European public administrators to address disaster risk (WP6)*

WP6 aimed to establish the capacity of local government's public administrators in European urban areas to address disaster risk. The team conducted a survey of the capacity at both national and local levels. The survey respondents represented organisations with total disaster resilience personnel of approximately 19,000 people.

Of these people, only 13% reportedly held an educational qualification in a disaster resilience field. A majority of the organisations (68%) were reported to be interested in their staff obtaining disaster resilience-related academic qualifications. In terms of progress in implementing the HFA priority actions, the majority of respondents reported moderate progress having been made. With regard to all 5 of the national actions and all 7 of the local level actions, a majority of respondents indicated that the necessary capacity to fulfil the actions existed so that the non-completion of the actions was due to other factors (e.g. time, other priorities, etc.) rather than being a consequence of capacity constraints. Those respondents who did report the existence of capacity constraints indicated that the financial resources dimension of capacity presented the greatest challenge to their organisations (at both local and national levels). The capacity dimension most directly reflecting the demand for disaster resilience education, staff knowledge and skills, was ranked as the third most pressing constraint facing local level organisations after financial resources and staff availability. For national level public administrations, staff knowledge and skills, was one of four capacity dimensions considered to be equally pressing in second place behind financial resources (the other three being staff availability, systems and infrastructure and legal framework).

The survey has thus given insight into the relative demand for academic qualifications within European public administrations and the degree to which staff knowledge and skills have affected the implementation of disaster resilience initiatives.

### *5.5. Emerging research and teaching concerns in disaster resilience (WP7)*

WP7 selected Venice and its territory as an emblematic case study of a region that could be affected by cross-border disastrous events. A case study was carried out not only as an engaging exercise, but with the purpose to provide a reference point for scientists and teachers interested to translate multifaceted knowledge into specific solutions. A series of papers have been written (Indirli et al, 2014; Knezic, 2014; Borg, 2014; Kaluarachchi, 2014), which deepen respectively hazard, vulnerability/resilience, and mitigation about the site taken into consideration.

### 5.6. Developing and hosting OERs for disaster resilience education (WP8)

WP8 aimed to develop innovative educational resources in order to support capacity building for improving societal resilience to disasters. It has set out to achieve this by developing an Open Educational Resources (OER) platform to host digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research. The platform is based on a set of Open Educational Resource standards defined by the project team (Haigh, 2013), which set out the platform, accessibility and inclusion, rights management, and approaches for ANDROID network members to describe, manage, and share learning resources online.

## 6. Developing a roadmap for European education

A major output of the first ANDROID workplan, due for completion in late 2014, is the development of a roadmap for European education in developing societal resilience to disasters. The roadmap will collate the major findings that arise from the network's survey and analysis projects in order to set an agenda for educational policy in the field.

This report will not be about predicting the future. Instead, its starting point will be simply to consider some of the greatest challenges and opportunities for education in the 21st century in helping society address the threat posed by hazards of natural and human origin. The report will consider society's requirements in terms of skills and scientific advances. It will also consider the existing capacity of European HEIs to meet these requirements. Finally, the report will consider what needs to happen in education policy to help address this key European and global challenge. The report will be a major output for the network that can be disseminated to key stakeholders, and also form the basis of the network's future activities.

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