RESEARCH AND INNOVATION IN EDUCATION FOR SUSTAINABLE DEVELOPMENT

Wim Lambrechts / James Hindson (editors)

Lifelong Learning Programme

CoDeS
Schools and Communities - Working together on Sustainable Development

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Exploring collaborative networks, critical characteristics and evaluation practices.

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Introduction:

Education for Sustainable Development in a complex and changing world

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Education for Sustainable Development (ESD) has become an important issue in society. The United Nations Decade for ESD (DESD, 2005-2014) has encouraged innovative approaches in education in order to contribute to the societal transition towards sustainability through both the formal education system and non-formal and informal learning settings (Buckler and Creech, 2014). Furthermore, as learning does not take place in separate silos, the interconnection of different stakeholders is also seen as a necessity in ESD. During the last decade an abundance of ESD initiatives have grown at all levels in society. Governments have implemented the topic in policy briefings and educators and researchers have developed models for curriculum innovation and the integration of sustainability competences. Civil society partners have developed initiatives to embed ESD in non-formal settings, schools and teachers worldwide have started ESD projects at the local level focusing on a variety of topics.

Despite the abundance of initiatives ESD deals with a conceptual problem. A multitude of definitions and interpretations circulates about ESD and this makes it very hard to understand the essence of the concept, let alone explain it to educators who need to integrate it in their teaching. While it would stretch far beyond the scope of this introduction and this publication to dive into the many definitions and interpretations of ESD, it is worthwhile to take a pragmatic approach and adopt a working definition. The following might suit this purpose: "Education for Sustainable Development is learning to think about and work towards a liveable world, now and in the future, for ourselves and for others, here and elsewhere on the planet" (Van Poeck and Loones, 2011, p. 5). The definition clarifies that ESD is not just adding sustainability as an extra topic to the curriculum, but rather enabling learners to contribute to sustainable societies.

ESD is about preparing the learner for an active role in society oriented towards sustainability. In this sense ESD is connected to the tradition of citizenship education, preparing students to become active citizens in society (Dewey, 1944). On the other hand ESD is opposed to current trends in education, influenced by global capitalism, and focusing on a managerial approach and economic efficiency demands (Kitcher, 2009). In a context of active citizenship in society a key point of ESD is to develop a deep understanding of which sustainability issues are at stake, now and in the future. However, the world is constantly and rapidly changing, what we think is sustainable today might not be sustainable tomorrow (Wals, 2015). Sustainability issues are characterised by complexity and uncertainty, and as a result ESD needs to evolve itself in order to be able to provide skills and competences that enable to cope with this complexity and uncertainty (Lambrechts et al., 2013). In order to deal with future sustainability issues, societies need to become flexible, adaptive and resilient.

The innovative strength of ESD could be the variety of approaches and stakeholders involved, creating new opportunities to foster the sustainability transition. In order to follow-up the DESD, the Global Action Programme (GAP) on ESD has been launched with the overall goal to accelerate progress towards sustainable development. The GAP has five priority action areas (UNESCO, 2013):

1. Advancing policy;
2. Integrating sustainability practices into education and training environments (whole-institution approaches);
3. Increasing the capacity of educators and trainers;
4. Empowering and mobilizing youth;
5. Encouraging local communities and municipal authorities to develop community-based ESD programmes.

The diversity of ESD approaches resulting from the Decade as well as the new priority areas defined by the GAP, are both reflected in this publication. Following the complexity and uncertainty of sustainability issues and the need to interpret ESD in a flexible way, the publication focuses on innovation and research in ESD. Innovative approaches are necessary when it comes to realise change processes in education, whilst the nexus research-education provides guidance for this process, with attention towards quality and results.

This book is the outcome of the work of Environment and School Initiatives (ENSI), an international network of educational partners, and the European project CoDeS,

Collaboration of Schools and Communities for Sustainable Development (2011-2014). The objective of this publication is to provide collaborative experiences in ESD research and innovation. It provides a look back at initiatives during the DESD and an outlook on future possibilities in the field of research and education for sustainable development during the GAP.

The contributors of the chapters all come from different organisations including universities, secondary schools, non-profit organisations and governmental bodies, and in itself this variety demonstrates the possibilities of connecting different stakeholders through ESD initiatives. The authors also come from a variety of European countries (Austria, Belgium, Germany, Greece, Hungary, Italy, Poland, Spain, Switzerland, United Kingdom), as well as some South-East Asian countries (Korea and Malaysia).

The book is divided into four parts. Part I. is devoted to networks and collaboration approaches for ESD, and opens with a chapter on the ENSI-network, which has been active in the field environmental education (EE) and ESD for thirty years. The second chapter focuses on an example of a strong and mature national network for ESD, the Austrian network "Ecologising Schools" (ECOLOG), while the third chapter provides insights into the process of initiating a new national network: WEEC-Italy. Chapter 4 describes the added value of the global network of the Regional Centres of Expertise on ESD through a focus on the Asia-Pacific region. Chapters 5 and 6 examine collaborative approaches between different partners, with case studies of an intergenerational dialogue in Austria and a local initiative focused on waste management in Italy.

Part II. explores critical characteristics in ESD. Chapter 7 reflects on what happens when ESD does not produce the results we expect or want. Chapter 8 focuses on the role of education in times of uncertainty and the necessity of integrating knowledge uncertainty into the learning process. Chapter 9 provides an interesting study of ESD in remote communities and makes a call to introduce place-based and place-conscious pedagogies in teacher education. Chapter 10 looks at the different possibilities of competences for sustainable development in higher education. Chapter 11 further elaborates on this topic and provides insights in how to enhance young people's competences to contribute to the sustainability transition. Chapter 12 provides a case study in which local ecological knowledge is valued and integrated in urban schools in Malaysia.

Part III. is oriented towards the connections between education and research for sustainable development. Chapter 13 opens the debate by reflecting on 'committed' research into ESD and the challenges it poses to different stakeholders. Chapter 14 provides a case study in which collaborative approaches among researchers were encouraged in the ENSI network. Chapter 15 explores the role of transdisciplinarity in research and ESD as a possibility to deal with multifaceted and complex sustainability issues. Chapter 16 describes an example of a change process for sustainability in higher education and the role of the critical friend in this process. Part III concludes with chapter 17 exploring sustainability concepts in master and PhD theses in a Korean graduate school.

Part IV. provides insights into different evaluation and assessment approaches to ESD activities. Chapter 18 looks at ESD programmes and the evaluation in line with values inherent to ESD. Chapter 19 connects the evaluation of sustainability aspects to science education programs. Chapter 20 provides a comparative evaluation of the approaches in ESD integration in Polish and English schools. Chapter 21 looks at the analysis of evaluative discourse regarding ESD projects. The final chapter 22 provides a case in which a formative model to promote professional skills in ESD is assessed.

This publication is one of the outcomes of CoDeS, a Comenius multilateral Network with the support of the Lifelong Learning Program of the European Union. The final words of this introduction are devoted to acknowledge the collaboration and support of so many people in editing this book. First, we would like to thank all the forty authors who contributed to the chapters of this publication. Thank you all for your efforts to revise your contributions and willingness to take our (sometimes critical) comments into account. We hope the process of publishing your chapter has been as rewarding as it was for us editing it. A special word of thanks goes out to our colleagues from ENSI who initiated and supported this publication: Christine Affolter, Michela Mayer, Reiner Mathar and Günther Pfaffenwimmer and Without the support from ENSI, this publication would not be possible. Thank you!

Wim Lambrechts and James Hindson
Antwerp / Shrewsbury
15 October 2015

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PART I.

Networks and Collaboration for Education for Sustainable Development

Environment and school initiatives – ENSI: a precious network for thirty years!

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ENSI HISTORY

Environment and school initiatives (ENSI) was set up as a research and development project of OECD 's Centre for Educational Research & Innovation (CERI) from 1986 to 1994 and changed into a decentralized international network under the umbrella of CERI in 1995. As a result of a reorganization of OECD all decentralized networks became independent in 2002 and ENSI was recognized as an international non-profit-association in 2008. ENSI is now an association under Austrian law and is based at the Ministry for Education and Women's Affairs in Vienna. The ENSI network is financed by its members and through its own project work.

ENSI cooperates with major international organisations such as UNESCO, UNECE, UNEP (Carpathian Convention), RCE/UN-Universities, CEE India, Baltic21 and others. The members of ENSI are all experts coming from governments, international organisations, institutions such as universities, schools, NGO's and civil society. Partners come mainly from Europe, Asia and Australia. The network's organisational structure consists of a permanent board with a secretariat for daily businesses and project coordination. ENSI partners cooperate actively in projects proposed by them to the general assembly and being planned and submitted by the secretariat in cooperation with the interested partners.

Through these collaborative processes ENSI's work and activities are directed by working environments and the needs of its members: the network prepares studies on teacher education, carries out research and develops guidelines for future oriented teacher education. ENSI also organises studies on school development in education for sustainable development (ESD) and develops guidelines and quality criteria through cross analysis of these studies. ENSI influences policy decisions at the international level by combining international processes of quality development and quality improvement and formulating guidelines and criteria. It supports schools by helping them in their own development and promotes international exchange by influencing networks across Europe and other regions of the world: "ENSI organises and affects the exchange of expertise in the field of research education on sustainable development (SD) and also offers a platform for senior experts, as well as for young, innovative researchers." (Quotation from UNESCO Review of Contexts and structures for Education for Sustainable Development 2009, Arjen Wals). The engagement to actively involve young researchers in the ENSI network is described further in this book in the chapter "Cultivating Action and Collaborative Research on ESD: Case study on the 'new researchers generation' in ENSI's network" (Mayer and Tschapka, in this publication). Furthermore, the involvement of young researchers is also reflected in the innovative contributions that many of them provide in other chapters of this publication.

ENSI's strength lies in the combined work of policy makers, researchers, teacher educators and their students, pilot schools with teachers and students, communities and a broad variety of organisations from the field of environmental education (EE) and ESD. As a result of the unique framework of partners ENSI is able to react swiftly to needs and questions and because of this is one of the frontrunners in international ESD developments.

ENSI MISSION

From its beginning ENSI has supported and initiated educational developments that promote environmental understanding, active approaches to teaching and learning and citizenship education, through research, policy development and the exchange of experiences and knowledge.

ENSI's projects and work all try and include a number of what have been called ‚dynamic qualities'. These include ‚dealing with complexity', ‚the ability to reflect on personal values', ‚the ability to take responsibility' and ‚initiative and readiness to take action'. Very importantly, projects also include the will to bring these competences into reality. This set of skills has been part of ENSI projects since the beginning and are favourably accepted internationally. They have guided ENSI over many years of intense and fruitful international and national work.

Using these dynamic qualities and respecting to the cultural identity of the partner's, ENSI has made a significant contribution throughout the ten years of the UN-Decade on Education for Sustainable Development. Five large projects with a total of more than hundred partners have been delivered between 2002 and 2014.

- School and community collaboration for SD (CoDeS, 2011-2014)
- Partnership and participation for SD (SUPPORT 2007-2009)
- ESD in the Carpathian region (CASALEN 2007-2009)
- Teacher competences for ESD (CSCT 2004-2007)
- School development through Environmental Education (SEED 2002-2005)

Partners in these projects came from the following countries - Australia, Austria, Belgium/Flanders, Canada, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Italy, Japan, Republic of Korea, Malaysia, The Netherlands, Norway, Poland, Romania, Serbia, Slovakia, Slovenia, Spain/Catalonia, Sweden, Switzerland, United Kingdom, Ukraine.

The outcomes of all five projects have delivered significant contributions to the work of teachers, principals, authorities, teacher educators, students and research partners.

WHOLE SCHOOL APPROACH - A RED LINE IN ENSI ACTIVITITES FROM THE BEGINNING

In 2012 a UNESCO Report on the global status of ESD is strongly emphasizing, that ESD has to build up competences FOR a more sustainable life and is not teaching and learning ABOUT sustainable development only.

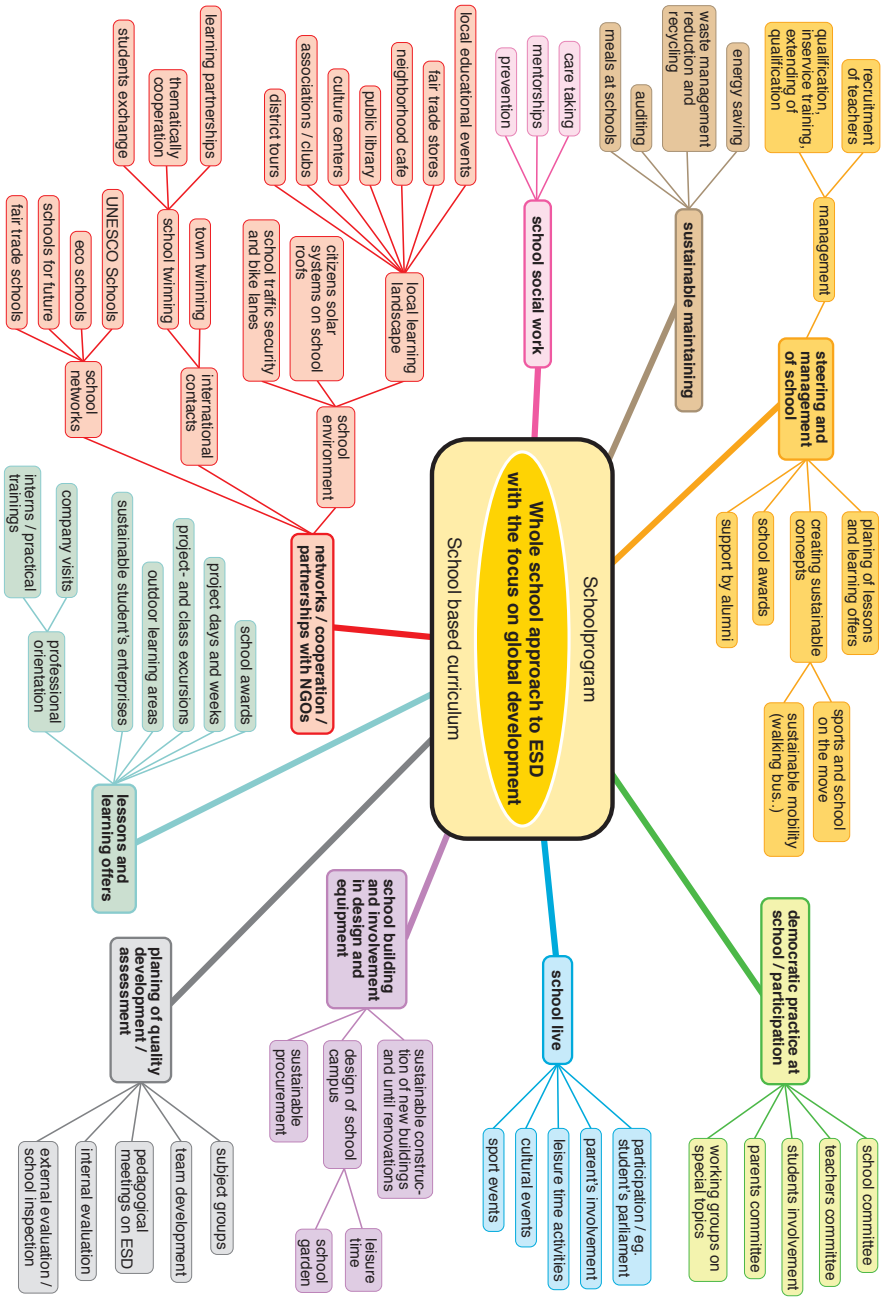
The concept of sustainable development has to change the general guidelines and core elements of societies. That means ESD is not about, but for sustainable development. Looking at ESD from this perspective integrating topics of sustainable development into the curriculum of just some subjects is not enough. The question is, what are the contributions of all subjects at school and all training in the vocational sector? Learners and educators must link the concept of sustainable development to their subject and everyday practice of education. That includes the educational organisation or schools as an institution. However, a prerequisite for this is that sustainable development should not be seen as a closed concept with given solutions. It must be considered as an on-going process, finding new and the best solutions. That's why ESD should introduce the concept of life-long learning to everyone at school. While children stay at school they need the possibility to develop and realise their specific concept of life-long learning. Against this background there is a need for change within the whole education sector. Teaching, learning, student's participation and cooperation with the local community and partners in the society all need to change. Instruction must be replaced by co-construction between students, teachers, parents, partner and experts from outside schools.

Different areas of cross-curricular education such as Environment Education, health education, education for democracy etc. can be doorways to ESD. The impact on the concept of the whole school approach will be shown by describing the elements in detail.

This general change of education towards ESD means that schools must be seen as role models for sustainable development. Pupils and students spend an increasing part of their daily lives in school, so that school becomes more and more the place of authentic real life experiences. ESD must be offered and realised at school and include issues such as food- and consumer education, social learning, energy use and personal resource management. Furthermore, a school is the perfect place to reach a whole generation in a safe learning environment. Young people can test and develop key life skills and their own lifestyle. The understanding that sustainability is the guiding principal will help schools to develop.

From its beginning ENSI integrated this in the basic concept of Environment Education and later on in ESD. The concept of dynamic qualities is one element of it using the school and it´s organisation as a learning area for EE and ESD is the other side. When schools made research on their energy consumption and then developed solutions on the technical and behaviour side, they contribute to the development of sustainable lifestyles. Other projects and areas for schools include traffic and mobility, water and waste management. From the beginning ENSI schools linked their activities to the local community and sought to spread their experiences and change even the behaviour in the local community and families. Elements of the whole school approach to ESD include all elements of teaching and learning, the management and the maintenance of the school. The mind map shown in figure 1 links the various aspects of the whole school concept.

The ENSI network works with ENSI based experts and supports studies on school development and ideas of the whole school approach to ESD. ENSI experts have been involved in studies by the Australian Research Institute in Education for Sustainability (Ferreira et al., 2006) and the British "S3 concept" (UK Government, 2008). While the Australian study investigated ways in which learning for sustainability can be mainstreamed in teacher education, the "S3 concept" of the British school inspection system offers an interesting self-evaluation instrument for ESD It presents a great possibility to interlink different aspects of SD and ESD, by identifying different doorways to ESD including:



Quelle: Orientierungsrahmen KMK 2015, Reiner Mathar

Figure 1. Whole school approach

- focus on food and drink;
- focus on energy;
- focus on water;
- focus on travel an traffic;
- focus on purchasing and waste;
- focus on school buildings;
- focus on school grounds;
- focus on inclusion and participation;
- focus on local well-being;
- focus on the global dimension.

The transition from different areas of ESD to a whole concept means that different "cultures" of cross-curricular education need to be considered, especially in the following areas: environmental education, education for global development, health education and education for democracy.

The latest realisation of the concept is integrated in the national curriculum framework for ESD decided by the standing conference of Ministers of education (KMK) June 2015 in Germany. This curriculum framework includes a new chapter on whole school approach for ESD ('Der Lernbereich Globale Entwicklung als Aufgabe der ganzen Schule') and will lead to a change in the practice of German schools in the long run (Mathar, 2015).

CODES: SCHOOL AND COMMUNITY COLLABORATION FOR SUSTAINABLE DEVELOPMENT

CoDeS is a multilateral network - a network of networks comprising twenty-nine partner organisations whose work focuses on collaboration between schools and communities to address ESD and issues of sustainability. Experiences before and during the UN-Decade on ESD showed that establishing collaborative networks, including schools and civil society, is crucial for the implementation of ESD. These locally based networks are on the one hand places where citizens can find local identity and on the other they can act as change agents for fostering local culture and knowledge, develop a common language and act as a forum for ideas and visions. Schools and communities share many challenges including the integration of immigrants, dealing with the consequences of the economic crisis and a loss of cultural identity in a more and more globalised world. Better mutual understanding of these and collaborative work on future leading developments is crucial for the well being of a local society.

CoDeS' overarching aim throughout the project from 2011 to 2014 was to explore, and provide models, ideas, learning and teaching methods, case studies, tried and tested tools as well as helpful suggestions for reflection. A challenge for any holistic approach to a thematic field lies in the diversity of stakeholders. Hence in the CoDeS project team as well as in school-community collaboration projects, CoDeS started its work with an investigation of existing school-community collaboration, focusing on the factors that made them successful. The context of the existing case studies and experience was diverse in terms of stakeholders, cultural backgrounds, and countries and therefore demanded methodologies that respected and acknowledged diversity, developed its theoretical base and produced tools to facilitate practical applications. Project partners, all of them experts in the field of teaching and learning as well as collaboration analysed, developed and piloted methods and materials for collaborative partnership projects. CoDeS tools for school-community collaborations used the quality areas for such collaborations developed in the publication 'Keystones on school-community collaboration for sustainable development' (Espinet and Zachariou, 2014). These quality areas include participation, communication, learning, action, vision, resources, mandates and research. The CoDeS partners have developed the following products:

- Travelling Guide for school-community collaborations for SD (Handbook for the reflective practitioner) (Affolter and Réti, eds., 2014);
- Toolbox for school-community collaborations for sustainable development (Methods, techniques and tools for collaborations) (Maso, ed., 2014);
- Interactive Website for school-community collaboration (Platform open for school and community projects);
- Digital Handbook for local authorities for school-community collaborations (Wagner-Luptacik and Smith, 2014);
- Profiles of isolated communities and ways into integration (Research in cooperation with remote communities) (Liarakou et al., 2014);
- Key Stones on school-community collaboration for sustainable development (tool for reflection on the quality of school-community collaboration) (Espinet and Zachariou, 2014);
- Selected Cases of school-community collaborations for sustainable development (Selection of successful collaboration projects) (Espinet, ed., 2014).

THE FINAL EVALUATION OF CODES BY THE EACEA

The EACEA (Education, Audiovisual and Culture Executive Agency of EU) ranked the project as excellent. Some of the challenges and highlights of CoDeS are mentioned by the evaluators: "The nature of ESD as a subject demands an approach which is multidisciplinary; in order to be meaningful, it must operate at the interface between formal education and the different levels of the community, so the approach has also to be multidimensional. The emphasis, placed in the original CoDeS application, on the need for the network to exemplify collaborative knowledge-building in its processes and in its products, was appropriate. But this assemblage of key factors produces complexity laid upon complexity, and careful attention is needed to ensure that the necessary complexity does not prejudice the clarity and applicability of outcomes. In the event, CoDeS products between them, and in some cases within a single product, manage to achieve a fair balance between complexity and applicability. For example, the Keystones document provides an analytical framework for school community collaboration for sustainable development, whereas the blog collection of cases is aimed above all at the practicing teacher. Within a single outcome, the Travelling Guide addresses basic questions arising from collaboration and includes a Theory Box, but also exemplar cases. A key objective for the network was to promote the adoption of ESD methods in science education more generally, thereby further enhancing inquiry-based learning; in the event, over 50% of CoDeS cases have science education at their heart."

Over the full project period a group of ENSI Junior researchers collaborated closely with experts, conducting a multi layer evaluation, setting focus on internal and external learning processes. The analyses and reflection of processes within the project group contributed significantly to a deeper understanding of 'learning' and 'intercultural understanding'. This unique matrix of evaluation is described further in this book, in the chapter "Evaluating Education for Sustainable Development Programmes consistently with Education for Sustainable Development values: a challenge for evaluators" (Mayer and Dillon, in this publication).

The CoDeS partners experienced an intense and fruitful collaboration over three years – CoDeS has reached its goal of growing into the status of a learning organisation, with a strong link to reflection and to democratic, solution finding processes.

For more information about ENSI and CoDeS, visit ENSI's homepage at www.ensi.org and find here all projects outcomes free for download.

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The Austrian Network "Ecologising Schools" (ECOLOG)

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ABSTRACT
This chapter describes the Austrian ECOLOG programme and network as an example of a nation-wide school network in the field of education for sustainable development. Embedded in social network theories this network aims at greening Austrian schools. The network was established in 1996 and includes 450 schools in 2015. Evaluation results show that communication, the head teachers, the backing of the initiative by the Ministry of Education as well as the openness of the concept are important factors that support the network. The chapter concludes with some advantages and challenges of the development and maintenance of networks in general.

KEYWORDS
education for sustainable development, educational networks, environmental education

EDUCATION AND SUSTAINABLE DEVELOPMENT IN AUSTRIA

Current education debates in Austria focus, among other things, on the notion of sustainable development and environmental education and these debates have sparked a wider discussion on the nature of education in general (Rauch and Steiner, 2006). As with human rights, sustainable development may be regarded as regulatory idea (Kant, 1787/1956). Such ideas do not determine how an object is made, but serve as heuristic structures for reflection. They give direction to research and learning processes. In terms of sustainability this implies that the contradictions, dilemmas and conflicting targets inherent in this vision need to be constantly renegotiated in a process of discourse between participants in each and every concrete situation (Minsch, 2004). This is a challenge, but one that has considerable

potential to enhance innovative developments in education. In Austria, one of these is the creation of the ECOLOG school network that aims at ecologising schools and establishing a sustainable school culture. ECOLOG was set up as a network, not only to disseminate innovation and best practice, but also to fill a structural gap in the Austrian educational system.

THEORETICAL CONCEPTS OF NETWORKS IN EDUCATION

According to Castells (2000), networks constitute a new social morphology in society, where dominant functions and processes are increasingly organised around networks. These networks are enhanced through new information technologies that provide the material basis for their expansion throughout the entire social structure. Castells (2000) conceptualises his notion of 'network' as a highly dynamic, open system consisting of nodes and flows.

In the wake of these general societal trends and structural transformations, networks have also become increasingly attractive in educational systems. In the 1990s, systemic school modernisation processes were launched by policymakers, prompted by the need for reformatory change in the light of the results of international assessments such as the TIMSS and PISA studies. Since proclaiming "school autonomy" as key goal the central administration in Austria has focused more and more on contextual activities whilst delegating responsibilities to decentralised units (Posch and Altrichter, 1993; Fullan, 2007; Rauch and Scherz, 2009). Less bureaucratic steering generates a need for alternative ways of coordination (Altrichter, Rauch and Rieß, 2010), and intermediate structures (Czerwanski et al., 2002) such as networks are expected to fill a structural gap and take over functions traditionally assigned to the hierarchy. Ideally, networks are conceived as an interface and effective means of pooling competencies and resources (Posch, 1995; OECD, 2003). As intermediate structures, they manage autonomy and interdependent structures and processes and try to explore new paths in learning and cooperation between individuals and institutions.

Per Dalin's (1999) description of how networks function in education is an important theoretical basis underlying the formation of the ECOLOG network. According to Per Dalin networks have four functions. Firstly they have an informative function which becomes visible in the direct exchange of practice and knowledge for teachers and schools, and through the network acting as a bridge between practice and knowledge. A second function is to enhance professionalism. Through networking, opportunities for further learning and competence development are encouraged by the members who themselves establish learning function of the network. Trust is a prerequisite for cooperation within a network, it is the basis for the third function - the psychological function which encourages and strengthens individuals. The fourth function is the political function. The enforceability of educational concerns is based on the motto "together we achieve more" (Rauch, 2013).

In order to understand the development of education for sustainable development (ESD) in Austria through networks, social network theories might help. In this respect the authors consider the following aspect of a network to be paramount:

1. Mutual Intention and Goals (Liebermann and Wood, 2003);
2. Trust Orientation (McDonald and Klein, 2003; McLaughlin et al., 2008);
3. Voluntary Participation (Boos et al., 2000; McLaughlin et al., 2008);
4. Principle of Exchange (Win-Win Relationship) (OECD , 2003; McCormick et al., 2011);
5. Steering Platform (Dobischat et al., 2006);
6. Synergy (Schäffter, 2006);
7. Learning (Czerwanski et al., 2002; O'Hair and Veugelers, 2005).

The following section describes the establishment and structure of the ECOLOG network based on these network characteristics.

THE AUSTRIAN ECO-SCHOOLS PROGRAMME – EDUCATION FOR SUSTAINABILITY (ECOLOG)

ECOLOG is key action programme and network on the greening of schools and education for sustainability. The network was developed in 1996 by an Austrian team of teachers co-operating through the international project Environment and School Initiatives (ENSI) (Posch, 1999). It is a national support system with the aim of promoting and integrating an ecological approach into the development of individual schools. Attempts are being made to embed the programme in the federal states of Austria through regional networks. Overall coordination was originally undertaken by the FORUM Umweltbildung (FORUM Environmental Education) which operated as a contractor for the Austrian Federal Ministry for Education and Women's Affairs (BMBF) and the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW). Since 2015 the Institute of Instructional and School Development (IUS) at the Alpen-Adria-University Klagenfurt has coordinated the network in cooperation with the BMBF. Within this setting the ECOLOG programme may itself have become sustainable and can be seen as an interface between environmental education and school development. By 2015, over 450 schools (out

of approximately 6,000 schools in Austria) with about 90,000 students are currently engaged in the network. Six University Colleges of Teacher Education also participate and many others are reached by the website, teacher in-service-training seminars and newsletters.

ECOLOG is based upon an ENSI approach (ENSI, 2014): The mutual intention and goal of network members and ESD-Schools is to analyse the ecological, technical and social conditions of their environment and, on the basis of these results, define objectives, targets, concrete activities and quality criteria, to be implemented and evaluated. Another objective is cooperation between schools, researchers, teacher education as well as instructional management. Students as well as all the other actors within schools should be involved in a participatory way and collaboration with authorities, businesses and other interested parties is encouraged. Areas of concern that the network focuses on include among others saving resources (eg energy, water), the reduction of emissions (eg waste, traffic), spatial management (from the classroom to the campus), the culture of learning (communication, organisational structure) health promotion and opening the school to the community. [1]

One area of work focuses on the reorientation of technical and vocational education and training in support of sustainable development and the transition to a green economy. Since 1992 a whole range of training on environmental, health and social aspects have been offered in Austrian vocational education and training system and curricula have been developed as a result.

How are ECO-Schools supported and what are the incentives?
In order to provide support, BMBF organises network support structures. The groups mentioned below meet twice a year centrally and also function in their regions. Most of the people involved know each other and collaborate in different projects as well as the network.

- The ECOLOG regional teams coordinate the network in their regions.
- The ENSI-Teacher team advises the Ministry as well as the ECOLOG regional teams regarding the further development of the network.
- The Scientific Advisory Board has an advisory role for the Ministry and for the central coordination of the network.

1 The aims and principles of ENSI are described under the following link: http://www.ensi.org/media-global/downloads/Publications/197/TheroleofENSIinAglobalen__1_.pdf (page 4, principles of procedure).

The network of representatives of university colleges of teacher education also has an advisory and development role, especially for the university colleges.
As stated above, the support provided by the BMBF and the IUS involves the coordination of the regional support teams that meet twice a year to exchange information, the maintenance of the website (www.oekolog.at), the publication of periodical news, the organisation of events and seminars, synergies with the regional science networks of the "Innovations make schools top – IMST" project, international contacts (EU projects), as well as evaluation and research. Furthermore, cooperation with the FORUM Umweltbildung provides educational materials, events and contacts with other stakeholders in the field of ESD.

The inclusion of the BMBF in the network as well as representatives of university colleges of teacher education enhances the application and adoption of educational concerns, an important aspect of the *political function of a network* (Dalin, 1999).

At a regional level, support is provided by the ECOLOG regional teams. Their major task is to organise further education and training and to promote the exchange of experience between schools so that teachers may benefit from the growing pool of ESD competence. In addition, the regional teams provide annual regional activities and events aimed at all ECOLOG schools of the federal state. As a link between practice and knowledge, the regional teams fulfil the *information as well as the learning function* of a network. The regional teams are made up of people nominated from the regional school boards and the regional university colleges of teacher education. One of the ENSI teacher team is also a member of a regional team. In some provinces the ECOLOG regional teams have managed to establish co-operation with the Environment Departments of the provincial governments and with NGOs, and have been able to access financial support for the ECOLOG network schools. Participation in the ECOLOG network is based on trust orientation and volunteering both of which are related to the *psychological function* of networks.

Three other measures of support provided are: Seminars for heads and coordinators to enhance the quality of ESD in schools; an Education Support Fund for Health Education and Education for Sustainable Development and a National Environmental Performance Award for Schools and University Colleges of Teacher Education (Rauch and Pfaffenwimmer, 2014).

The Austrian ENSI-Teacher team has been involved in the development of the ECOLOG programme from the beginning and is the link with the international ENSI

network. It provides encouragement for the quality development of schools and innovation in teacher training and therefore operates between the *informative and political function*.

The advantages for schools participating in the ECOLOG network are fourfold. Schools receive a starter kit which includes information about sustainable school development and suggestions for concrete measures and projects as well as an access to freely available publications. Schools may also apply up to EUR 1,200, for a project that deals with environment and sustainability from the Education Support Fund for Health Education and Education for Sustainable Development. To make the schools' achievements visible, annual school reports are published on the ECOLOG website. Another benefit is that ECOLOG schools have a good pedagogical and organisational basis on which to work towards the Eco-Label for Schools and University Colleges for Teacher Education. Finally the ECOLOG programme acts as a good foundation for school quality management initiatives as it uses a common structure for planning and reporting.

Evaluation of the ECOLOG Programme

Throughout the 19 years of the ECOLOG Programme, a series of evaluations and studies have been written: Thonhauser et al. (1998), Ehgartner (1999), Rauch and Schrittesser (2003) and Rauch and Dulle (2011). These evaluations are based on a mixture of interviews with teachers, head teachers, and facilitators of schools as well as on observational data and an analysis of material produced by the schools. Payer et al. (2000), Schober-Schlatter (2002) and Knoll and Szalai (2009) used questionnaires and Heinrich and Mayr (2005) did a cross-case-analysis of the reports of the regional networks. These evaluations highlighted a number of factors that have been critical to the success of the network.

Communication has proved to be the central element allowing schools to produce a common understanding of ESD. Communication is a key precondition for learning by all members of the school community (i.e. Thonhauser et al., 1998; Ehgartner, 1999).

Head teachers play an important role through their "official" support of the project shown through actions such as putting sustainability on the agenda of teachers' conferences and by repeated statements of support in the public arena. In addition, heads enhance motivation by recognizing small steps with photos or an information wall by maintaining contacts outside the school through public relations and the media and by providing incentives, through for example, negotiating financial

support with the body responsible for maintaining and financing schools (Payer et al., 2000; Schober-Schlatter, 2002).

The backing of the initiative by the Ministry is also seen as a motivating factor. The homepage of the network (http://www.oekolog.at) is an important source of information. Regular in-service training workshops for teachers provide time and space for meetings, bringing people together face-to-face and giving them a sense of identity. Activities in the future will focus on the need to maintain funding, to develop local advisory support further and to develop quality assessment and educational standards. Support should also include a revised political mandate, strengthened quality assurance (agreements on goals that are clear and achievable), early feedback on feasibility, quality monitoring, scientific support, and continuing the resource base (material and non-material incentives) (Rauch and Schrittesser, 2003; Heinrich and Mayr, 2005).

The openness of the ECOLOG concept allows a wide range of issues to be included and fosters creativity. Its impacts are seen in different areas, such as a change in teaching methods resulting in more project work and social learning, the increased integration of health education e.g. through the availability of healthy snacks, including ecological and social issues in lessons and considering the design of buildings such as the school yard and energy optimization of the school. Participation in ECOLOG results in an enhancement of a schools image and a further development of external relations such as those with the community (Rauch and Dulle, 2011).

ECOLOG schools that are living out a sustainable culture can influence the environmental consciousness and competencies of pupils in a positive way through for example demonstrating a sustainable use of resources. Approximately one third of the 23 ECOLOG schools that were surveyed in one evaluation noted an increased consciousness and self-reflection by pupils towards sustainability topics including a greater awareness of resources use, eating healthy snacks and changes in shopping habits. Addressing values and the interconnection of knowledge are especially important. Having said that, the importance of a school should not be overestimated as it is only one influencing factor among many. Some schools successfully involved parents in sustainability activities and this is another supporting factor. More primary schools than secondary schools managed this (Rauch and Dulle, 2011).

On the one hand ECOLOG is an active network due to the personal engagement of individual teachers. On the other hand it is necessary to establish a culture of

teamwork to enable the development of a sustainable school culture. This is a challenge for schools (Rauch and Dulle, 2011).

ECOLOG schools are committed to quality development and assurance. The production of annual reports along the lines of a school development plan caused some difficulties in the beginning. After 10 years, schools have written these reports with greater ease and the ECOLOG annual report is seen as a helpful tool for reflection and planning. ECOLOG supports quality development through the definition of visions and aims such as the shaping a liveable world and the perception of nature as a whole. Furthermore, ECOLOG offers a broad range of evaluation and reflection methods and as a result contributes to the implementation of legal provisions like the quality management of educational standards (especially in science) (Rauch and Dulle, 2011).

RESUME AND OUTLOOK

The example of the ECOLOG school network shows that the theoretical concept of networks, including the seven aspects from literature and the four functions of networks according to Dalin (1999) serve as a good basis for the establishment of a national ESD network in education.

The ECOLOG network carries out creative projects and through these tries to raise the attractiveness of ESD. Based on the example of ECOLOG the following points can be made about networks in general.

- Networks in education offer goal-oriented exchange processes among teachers (information function) which support the professional development of teachers through providing fresh ideas for classroom teaching and encouraging interdisciplinary cooperation in schools for example (learning function).
- Networks have the potential to create a culture of trust, with the effect of raising self-esteem of, and risk-taking by, teachers (psychological function) and in particular of upgrading science at school (political function).
- Good practice cannot be cloned, but exchanging experience on a personal level promotes learning and innovation.
- It is necessary to maintain a balance of action and reflection (goal-directed planning and evaluation) and autonomy and networking (analysis of one's own situation). Critical friends are also useful when setting up a sustainable support system for schools.

- Evaluation and research needs to be driven by an active link between the interest in gaining new knowledge and a developmental interest. A culture of self-critical and collective reflection might flourish, but reflection should not hamper a project from being taken forward. When maintaining a network, the case of the ECOLOG network shows that there are a number of risks. These include that
  - the network moves away from the interests of the stakeholders;
  - common visions and goals disappear;
  - the network fails due to weak coordination and steering;
  - the network fails due to a lack of resources (money and time);
  - the network mutates into a bureaucracy.

The overall challenge might be described as keeping momentum between structures and processes or, in other words, between stability and flow, to enable sustainable development and learning.

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Research on Education for Sustainable Development: a national network at its first steps

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ABSTRACT
At the end of the United Nations Decade of Education for Sustainable Development (2005-2014) the Italian socio-economic situation urgently required new ideas and suggestions, highlighting the need for research in Education for Sustainable Development with more energy and incisiveness. As a result, a number of Italian actors considered that networking would be one strategic way of meeting these needs and decided to found a National Network on Education for Sustainable Development: WEEC – Italia. The goal of the network is to develop new opportunities and new ways of learning. It also aims to affect policies and practices in such a way as to fill some current gaps (e.g. research-practice, institutions-citizens) and thus to address the complexity of a changing world. This chapter discusses some of the contributions this network can make to research on Education for Sustainable Development.

KEYWORDS
Community of practice, Education for Sustainable Development, Network, Research

INTRODUCTION
The increasing complexity of societies and problems faced at different levels (local and global) together with the uncertainty related to their solutions, urgently calls for new themes, spaces and approaches to research in different fields. Reflecting from the perspective of Education for Sustainable Development (ESD) it has become clear that achieving a sustainable world, especially from both a social and an environmental point of view, requires the promotion of knowledge, skills, abilities and attitudes to combat important and urgent issues, such as climate change, loss of biodiversity, desertification, hunger, poverty, injustice and disease. It is widely

agreed that effective learning in society needs to include various forms of diversity: different cultures, contexts (formal, non-formal and informal), disciplines (inter-disciplinarity), methods (qualitative and quantitative) and subjects (researchers, teachers, students, decision-makers, citizens) (Wals et al., 2013; Glass et al., 2012). One way of achieving this integration of diversity is through cooperation between different subjects and overcoming the obsolete distinction of formal and informal education (Wals et al., 2013).

It is also suggested that there is an urgent need to promote networking at different geographic levels (local, regional and/or global) (Wals, 2009) and the establishment of communities of practice on ESD made up of different stakeholders (researchers, teachers, citizens, etc.) (Trez et al., 2011). Communities of practice as groups "of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger, 2011), could be seen as a promising way for promoting ESD teaching and learning strategies. Such communities allow interaction between their members in a variety of formats and encourage the co-construction of knowledge (Wenger et al., 2002; Hildreth and Kimble, 2004). Through this hybridity and synergy the development of new opportunities that enable transformative learning take place.

The International Implementation Scheme of the Decade of Education for Sustainable Development (DESD) recognises the importance and encourages the development of networks and communities of practice (2005-2014) (UNESCO, 2005). For example some goals listed are to:

- "Give an enhanced profile to the important role of education and learning in sustainable development;
- Facilitate networking, linkages, exchange and interaction among stakeholders in ESD;
- Provide an opportunity for refining and promoting the vision of and transition to sustainable development – through all forms of education, public awareness and training;
- foster an increased quality of teaching and learning in education for sustainable development".

An overview of some of the existing networks in ESD discovered a multifaceted situation in relation to the structure and organisation of networks in different countries. These ranged from the local Manchester Environmental Education Network

managed voluntarily by teachers, to the worldwide UN supported Regional Centres of Expertise (RCE) Network of formal, non-formal and informal organisations working together and sharing common goals. The general goals of all networks include: to promote the importance of school development in the field of ESD (e.g. ENSI); to support the exchange of ideas, programs, research amongst educators and researchers; to enhance the professional skills of different groups and to promote interdisciplinary communication (e.g. Columbia Basin Environmental Education Network, European Educational Research Association, Environmental and Sustainability Research Network).

The majority of the networks pursue these goals through sharing resources, events and services, organising meetings and seminars, publishing and promoting academic publications and information (e.g. EnviroLink Network, Canadian Network for Environmental Education and Communication). Active participation in these communities of practice is also sustained through websites, newsletters, emails and other social networking forums (Trez et al., 2011). Very often the networks set up ad hoc committees and working groups for the fulfilment of specific tasks or to approach particular issues.

Not all the networks have been directly established by ESD practitioners but have resulted from initiatives of national and regional governments. Examples include the Australian Government-National Education for Sustainability Network and the California Regional Environmental Education Community. These networks are supported organisationally and economically and as a result are free to join.

The World Environmental Education Congress Network (WEEC Network) provides an interesting international experience. Starting in 2003, the World Environmental Education Congress (WEEC) has been organised every two years. The first Congress held in Espinho (Portugal) was followed by events in Rio de Janeiro (Brazil), Torino (Italy), Durban (South Africa), Montréal (Canada), Brisbane (Australia), and Marrakech (Morocco) with the most recent being in Goteborg (Sweden) in the summer of 2015. These events are an effective way at an international level to discuss key issues in ESD, to share ideas and experiences as well as promoting the growth, improvement and diffusion of ESD practices and research, and sustaining a global community of research and practice in this field. To support these goals in the time between the congresses the WEEC Network was started. The WEEC network is coordinated by the International WEEC Secretariat based in Torino (Italy) and has thousands of members worldwide. The aim of the network is to encourage

discussion amongst different actors involved in environmental education and sustainable development including universities, institutes and research centres, public institutions, non-governmental organisations, schools, parks, professional associations, mass media and companies.

Taking into account this international scenario, some specific traits of a network on ESD in a national context are discussed with a focus on the Italian experience.

In the mid 1990's the National Environmental Information, Training and Education system (INFEA) was established in Italy to coordinate the planning and delivery of ESD. INFEA is based at the Ministry of the Environment with the cooperation of Regional Offices which disseminate information and provide training and education in the field of sustainability. This system was very active for the first 6-8 years, and focused mainly on formal education (primary and secondary schools) and on training of teachers and environmental educators. Over the last 5 to 7 years, however, it has run out of steam largely because of a complete halt in funding and the lack of political interest. Only a few regions have continued to support ESD initiatives. However, despite this situation, a multitude of ESD experiences have been developed in the school and extra-school contexts.

A further important weakness in the Italian context is a lack of transversal thinking. Transversality is a central concept in the UNESCO and UNECE visions (UNESCO, 2005; UNECE, 2005) where the crossing and the blurring of boundaries have become strategic goals for actors involved in ESD allowing the development of new forms of understanding and knowledge. This is a challenge in Italian society which is characterised by a strong tradition of disciplinary research in different fields. Add this to the lack of institutional support for ESD and of a specific political design, the deep crisis of the role of the school in Italian society and the critical Italian socio-economic situation, there is an obvious and urgent need for new ideas and approaches in all areas. In turn this highlights the need for more energetic and incisive research in this field.

Starting from these reflections a group of Italian ESD practitioners decided to turn these weaknesses into opportunities through the concept of networking. This seemed a good way to promote common and integrated action in a way that might catalyse the attention of politicians and institutions towards ESD. So in 2013, arising from these needs and from the international movements described above, the idea of an Italian network for ESD linked to WEEC (WEEC - Italia), began to take shape.

WEEC – ITALIA: THE FIRST STEPS

This new network aimed to develop new opportunities and new ways of learning and to foster reflection on the "Call of Marrakech", a document elaborated at the WEEC Congress (VV.AA., 2013). The Call of Marrakech recommended action to:

> "Reinforce the conciliation and the coordination among all concerned actors with a view to an improved synergy in the definition of strategies and the application of environmental education projects.
> Establish networks of environmental education actors in order to facilitate the share of knowledge, know-how, experiences and good practices.
> ... Promote research and development in different areas of environmental education: learning methods, attitudes, values and environmentally respectful behaviours".

WEEC-Italia has the goal of creating and sustaining the development of a virtuous and recursive cycle (from the international level to the national and then back to the international level) that can support research, debate, and sharing of experiences and hence the growth of a community of practice on ESD at a national level (Trez et al., 2011). In addition, the network has the ambitious aims of impacting on policies and practices, removing some current gaps (e.g. research-practice, institutions-citizens) and thus addressing the complexity of a changing world, allowing new ways of learning to take place.

From the beginning, WEEC-Italia has adopted an inclusive and wide interdisciplinary perspective linking contributions of researchers, scientific and cultural institutions, parks, non-governmental organisations, schools, companies and other stakeholders involved in ESD within different local communities.

From August 2013, people from different cultural and professional backgrounds interested in the network, took part of a series of meetings throughout Italy held in Milano, Bologna, Roma, Venezia, Genova and Bergamo. The aim of these meetings was to encourage wide participation in the network and to promote wider interest. From a methodological point of view the network takes a participative approach with the aim of sustaining the motivation of participants, their commitment and the development of a collaborative and relaxed environment for discussion.

So far the meetings have enabled the members of the network to:

- share a common vision of the state of ESD in Italy from different perspectives, as

the starting point for identifying and clarifying the mission of the WEEC-Italia network;
- identify some key principles around which to elaborate a common "founding document" for the network;
- discuss an efficient way to organise the network giving form to the first initiatives.

DISCUSSION

Even if the formal establishment of the network is not yet complete and its work is still at an early stage, some results can be analysed.

To begin with, more than 150 people from different cultural and professional backgrounds attended the various meetings and demonstrated their interest in being part of the network. Not only this, but the expanded horizon from environment to sustainability and so from environmental education to education for sustainability has made it possible to bring new actors into the community, coming from different fields not involved before. The effects of this growth in the richness and complexity of the stakeholders is a significant one for research on ESD both from a methodological and a thematic perspective.

There is also a wide diversity of groups involved in the WEEC-Italia network including public institutions (schools and universities), local administrations (regions and municipalities), non-governmental organisations, companies, educational and social farms, solidarity purchasing groups, green economists and individual practitioners. The participation of such a wide range of stakeholders enhances the possibility of the integration of ideas, approaches, methods and targets from different disciplines. This will potentially result in a greater degree of interdisciplinarity and emphasis on a life-long learning approach to ESD involving social and political dimensions. In this way, hybridised environments and new spaces for ESD research could emerge, embracing the importance of multiple voices, cultural and theoretical perspectives and more active community-based approaches.

Another important characteristic of WEEC-Italia is its bottom-up approach. Other Italian networks on ESD developed in the past, including the INFEA system, and networks form other countries such as the Australian Government-National Education for Sustainability Network, were promoted and supported by public institutions. WEEC-Italia is the opposite. It is a self-assembled network, developed from the needs and commitments of its members. This characteristic of the network could be considered a strength and a potential weakness.

To sustain current participation and encourage an even stronger involvement in WEEC-Italia throughout Italy, a website has been set up to share ideas, comments and suggestions on the further work of the network. The site also holds documents and information related to the different network meetings (VV.AA., 2014).

As described above, the first meetings of the network undertook a review of ESD in the country and as a result a new and a shared vision of ESD at an Italian level has been elaborated. Different issues emerged from this process, including:
- the weakness of research in ESD;
- the large gap between theory and methodology suggested by the research in ESD, and the practices that take place;
- many activities, especially in schools, are considered to be ESD but in reality, they aren't. Because of a superficial view of ESD, it is often confused with nature or science education;
- a serious lack of training in ESD at the university level, both within undergraduate and post graduate courses;
- by contrast there has been a huge growth in first degrees, masters courses and academic networks on specific issues related to sustainable development. However, ESD fails to attract attention and interest at this level.

One of the first tasks of the network has been to elaborate a common founding document; something like an identity card. Such a document was considered fundamental in stating the goals of the network and clarifying its relationship to the international WEEC Network and at the same time making a statement of its national specificity. Many of those involved have emphasised that the document needed to be pro-active and to be put together using a participative process involving different groups of stakeholders. There was also agreement that the document had to be a useful tool for the building of a wide network and real process of growth and not a sterile list of enunciations. Within this debate, a number of critical positions emerged before the first draft of the founding document was produced and discussed. Such a participative approach needs time to develop and as a result the elaboration of the founding document is still in progress. Those involved in the network shared the idea that the way the process happens in producing the founding document is more important than the results.

Progress has also been made on the organisational structure of the network. During the plenary discussions at the initial meetings, different ideas on the structure and the scientific organisation of the network emerged. Consequently, the different

stakeholders shared the idea that an efficient way of working required the identification of priority themes and issues to discuss, together with the formation of working groups to consider these. As a result, the following groups have been set up (VV.AA., 2014):

- formal education; with focus on all types and levels of schools and teachers, especially looking at the strengths and weaknesses of their involvement in ESD;
- informal education; has the aim of considering the multiplicity of languages and communication tools useful for a common strategy on ESD;
- participative approaches; has the aim of working on the development of participative and bottom up strategies to prevent conflicts and to support sustainable management;
- professional competences; aims to deal with the lack of training and professional acknowledgment of people involved in ESD at a national level;
- public administrations; has a focus on the promotion of ESD within the public administration, reinforcing the politics for sustainability and their efforts towards the management of a National System for ESD (such as INFEA system, for instance);
- university and sustainability; approached the role of higher education and supported a debate in the academic world, both as a research and educational institution and a fundamental part of civil society, from an ESD perspective.

CONCLUSION

Despite the fact that the WEEC-Italia network and working groups are only at the start of their work, they have already managed to draw attention to ESD, offered support to practitioners and promoted new research within the Italian national context. As a result of the website and other information and communication technologies (ICTs), others interested in the network have begun to share experiences and discuss and develop partnerships. Research projects have also been promoted. For example the "University and Sustainability" group is undertaking a survey of university teachers and students to identify their ideas, practices and needs related to ESD in the context of higher education. All the activities undertaken so far by the network (specific activities, research and other initiatives), should be seen as catalysts for a virtuous process that contributes to reinforcing the visibility and the role of the network in affecting research, policies and practices on ESD in the Italian context. In spite of these positive signs, some critical aspects need to be highlighted:

(a) the slow development of the network formalisation. This is related to the challenges of managing a voluntary network that has little financial support;
(b) the name "WEEC – Italia". This was given to the network through a participative process and this has contributed to a reduced speed of the progress. In addition, there has not been complete unanimity about the name. For some it is useful as it emphasises the relationship with an international network of practitioners centred around the WEEC Congresses, while for other this name represents a limit, hindering the involvement of people not committed to the WEEC approach;
c) any network on ESD has to move coherently with its mission by being sustainable and more thought has to be given to this process. The sustainability of WEEC – Italia can be considered strategic for its development.

Wenger et al. (2002) propose seven principles that should constitute the ways of thinking, visions or directions to underpin the sustainability of any community of practice. These include: 1) Design for evolution; 2) Open a dialogue between inside and outside perspectives; 3) Invite different levels of participation; 4) Develop both public and private community spaces; 5) Focus on value; 6) Combine familiarity and excitement; and 7) Create a rhythm for the community.

Some of these are particularly relevant for WEEC-Italia at its current stage of development including:

- The dynamic nature of the network is the key to its evolution. Therefore it should be seen and thought of as a structure that evolves and not as fixed and rigid one;
- Different levels of participation have been foreseen but there is a need to encourage more people to participate in the community and especially in stimulating the commitment of less active members;
- The rhythm for the development involves respecting the unique character of each community of practice and the need to be managed with attention, finding the right time (for thinking and for action, for instance) at each stage of the community's development.

Together with these principles, the strong motivation of people involved, the support for active participation given by ICTs and the existence of different working groups, all give an interesting perspective on network sustainability, even if it is probably too early to understand if they are sufficient to give form to a truly sustainable network.

Even if this experience is only the beginning of an exploration of new global/local relationships, it has already engaged in the challenge related to the construction of learning for sustainability, emerging through an increased permeability between

disciplines, cultures, institutions and sectors. With this in mind the WEEC-Italia network will go on, with the awareness that there is not a defined course, a specific road to go along, because "...a path is made by walking" (Poem by Antonio Machado).

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Schooling for Education for Sustainable Development: The contributions of Asia-Pacific Regional Centres of Expertise

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ABSTRACT
Ten years after the launch of Regional Centres of Expertise (RCEs) on Education for Sustainable Development (ESD), there is evidence confirming that much has been achieved and accomplished by these multi-stakeholder networks, committed to building more sustainable communities through learning and action. Indeed, in Asia-Pacific, RCEs have contributed to advancing understanding of the links between ESD and sustainability challenges such as climate change, health, biodiversity & traditional knowledge and disaster risk reduction. This has been achieved through hands-on projects, research and engagement opportunities in all learning and education spheres. This chapter reviews projects and experiences led by RCEs in Asia-Pacific that specifically support the process of embedding sustainability principles in teacher education and in primary and secondary schools. It identifies current trends, analyses teaching and learning approaches and assesses the contributions of RCEs in the region in bringing about innovation for sustainable development. The chapter concludes with a series of recommendations to enhance the impact and relevance of RCEs for effective implementation of the Global Action Programme (GAP) on ESD.

KEY WORDS
Asia-Pacific; Education for Sustainable Development (ESD); Global Action Programme (GAP); Regional Centres of Expertise (RCEs); Schools.

A DECADE OF REGIONAL CENTRES OF EXPERTISE ON ESD
Ten years ago the United Nations University (UNU) acknowledged the first group of seven Regional Centres of Expertise (RCE) on Education for Sustainable Development (ESD) at the UNU-UNESCO International Conference on Globalisation and ESD and during the celebration of the Asia-Pacific launch of the United Nations Decade of Education for Sustainable Development (DESD) (28-29 June 2005, Nagoya, Japan), (Fadeeva and Mochizuki, 2008; 2014). Today, the network has expanded across the world and consists of 135 RCEs in Africa, the Americas, Asia-Pacific, Europe and the Middle East.

RCEs are regional or local networks of existing individuals, organisations and groups who are committed to building more sustainable communities through education and learning. They include partners with a diversity of backgrounds and from different sectors who work together to develop and implement innovative ESD projects and programmes at the community level. RCEs are unique because they bring together members who might not usually work together, but who are critically placed to create local solutions to sustainability challenges (UNU IAS, 2014a).

The RCE global initiative was created with the aim of translating the overall goals of the DESD into specific actions implemented through multi-stakeholder, partnership and action learning approaches, and which could be relevant and have a direct impact on local communities. It was intended that the global impact would be achieved through collaborative undertakings amongst RCEs, which as a growing ESD community, could inform key education and sustainable development dialogues as well as influence national and international policies.

A stated by Fadeeva and Mochizuki (2014), initially one of the most important goals of RCEs was to strengthen the formal education system through progressing learning, research, policy and practice and creating more effective links with the non-formal and informal education sectors. Over the years, the scope, focus and priority areas of RCEs have broadened considerably due to the flexibility provided by each RCE to identify learning gaps, challenges and needs to be addressed within its regional context. RCEs have engaged in social and institutional learning, facilitated community-based learning projects, engaged with policy-makers and supported social entrepreneurship for sustainability. Common sustainable development thematic areas addressed by RCEs include climate change, health, biodiversity & traditional knowledge and disaster risk reduction.

Key ESD documentation and formal RCE evaluations have consistently confirmed the role of RCEs in bringing about change for sustainability and contributing to achieving the goals and ambitions of the DESD (see, for example, Fadeeva et al., 2014 and UNESCO, 2014). The contributions made by RCEs for the past ten years were presented during both the 9th Global RCE Conference (4-7 November 2014, Okayama, Japan) and the UNESCO World Conference on ESD (10-12 November 2014, Nagoya, Japan). Notably, RCEs have provided platforms for the development of educators' and learners' competences on ESD; have built a sustainability culture based on collaboration and partnerships for change approaches; have responded to regional and local systems in crises; have brought innovation into teaching and learning systems for greener and more socially just societies; and, have influenced the development and implementation of sustainable development and ESD policies and programmes.

At the global conference on ESD in November 2014 in Japan, the RCE community also renewed commitments to support relevant international ESD frameworks, including the new Global Action Programme (GAP) on ESD led by UNESCO as a follow-on international platform after the DESD. The GAP on ESD has provided new impetus to continue supporting the ESD agenda and up-scaling efforts, but also opportunities for organisations and networks to re-think priorities and strategic directions for the next five years (Tabucanon et al., 2014). Through the Okayama Declaration (UNU IAS, 2014b), RCEs unanimously reaffirm their commitment to the strategies within the GAP priorities in the implementation of actions for advancing policy, transforming learning and teaching environments, building capacities of educators and trainers, mobilising youth and accelerating solutions at the local and regional levels, in order to create more sustainable communities.

These commitments have also been adopted at the regional level. The RCE Asia-Pacific network, which comprises 49 members, developed and approved a strategic document which identifies pathways to support the implementation of the GAP on ESD in the region (see UNU IAS, 2014c). Building capacities of educators and working with the school sector have been identified as regional priorities in order to increase access to education, enhance quality of education systems and re-orient teaching, learning and pedagogies for sustainability.

This chapter provides an overall picture of Asia-Pacific RCE contributions in engaging and supporting the school sector in bringing about innovation for sustainable development. It reviews projects and experiences led by RCEs in the region that specifically support the process of embedding sustainability principles in primary and secondary schools. The aim is to draw lessons learned and provide recommendations that can assist RCEs to increase their relevance to and impact on this sector as well as progress RCE commitments to the GAP on ESD.

TEACHER EDUCATION AND BETTER SCHOOLS IN ASIA-PACIFIC

The Asia-Pacific region covers approximately 22 percent of the global area and has approximately 4.3 billion inhabitants, more than half of the world's population. Asia-Pacific is rich in history and cultural diversity, with over 3,200 languages spoken. The region is a remarkable source of economic energy, entrepreneurship, financial dynamism and technological progress. Countries contribute to more than one third of the global GDP (IRA, 2008). Although the region has made significant progress to address poverty and access to education, it still faces many sustainable development challenges such as natural disasters; rapid, uneven and unplanned urbanization; adverse impacts of climate change in vulnerable communities and small island states; job creation and poverty eradication (UNESCO, 2014b).

Sixty per cent of the world's young people live in the Asia-Pacific region (UNDESA, 2013). Therefore, access and quality of education has been identified as a key priority in the region in order to prepare young learners to cope with and address sustainable development issues. In Asia-Pacific, there is a diversity of national and international programmes for green and sustainable schools and some of these provide comprehensive models of change and whole-school approaches (Mogensen and Mayer, 2005). However, schools engaged in this agenda are still a minority and, thus, engagement opportunities on ESD are limited.

As stated by Ferreira et al. (2007), teachers play a key role in changing schools and ensuring that the learning content and curriculum are relevant to the learner's context. They also provide knowledge, skills and values which better prepare students to live and learn in a complex world and uncertain future (UNESCO, 2014c). Although there exist initiatives in the region focused on supporting the development of teachers' competences in ESD, most of these tend to engage with teachers already interested in or committed to this agenda. The challenge is to engage the 'disengaged', so that sustainability principles can be effectively mainstreamed in the school life and learning experience (Henderson and Tilbury, 2004).

Acknowledging the need to bring contextual relevance and innovation into the school curriculum, many RCEs are focused on engaging key stakeholders in primary and secondary school education to re-think teaching and learning; facilitating projects which support the student leaning for sustainability; and, providing training to pre-service and in-service teachers.

A REVIEW OF ASIA-PACIFIC RCE PROJECTS AND EXPERIENCES IN THE SCHOOL SECTOR

This chapter presents the results of a review of sustainability projects carried out during February 2015 and experiences on teacher education and schools facilitated and led by RCEs in the Asia-Pacific region during the period 2010-15. The purpose of the review is to; draw an overall picture of RCE activities and contributions to the DESD; identify the teaching & learning strategies and pedagogical principles aligned with ESD supported by RCE initiatives; analyse challenges and opportunities in supporting change for sustainability processes in the school sector; and, finally, identify recommendations which can assist RCEs to enhance their relevance and impact to the school sector and contribute more effectively to the goals defined by the GAP.

A total of 32 projects from 13 RCEs in 9 countries of the Asia-Pacific region (Australia, Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia and Republic of Korea) have been studied in the process of drawing up the review. From these initiatives, 12 were targeted to the whole school community (teachers, students, school managers and administrators, parents and community); 10 to school teachers and students, 5 to solely teachers, and 5 to solely students.

The case studies have been selected by reviewing key RCE reports and activities and identifying those projects focused on school education carried out during the period 2010-15. The following materials were reviewed:

- annual reports submitted by RCEs through the network´s web portal from 2010-14;
- projects nominated for the annual RCE Award (2013 and 2014); and,
- templates developed, circulated and completed by RCEs in the region during February 2015. The aim of the templates was to identify projects which were not documented in RCE resources. The response rate from RCEs was low. Therefore, while some additional projects were identified, it was difficult to review all the actual RCE school and teacher education initiatives carried out from 2010-15.

In addition, preliminary results of the review were shared and discussed with RCE participants attending the 8th Asia-Pacific RCE Meeting held during 5-8 March 2015, in Cebu City and Tagbilaran in the Philippines. Comments made by RCE colleagues during the meeting have been particularly valuable in refining the findings of the study and identifying recommendations for collaborative future actions.

KEY OBSERVATIONS

A diversity of ESD initiatives and approaches are documented by the RCEs that took part in this review. ESD processes facilitated tend to be contextualized, taking into account environmental settings, cultural diversity, and socio-economic, political and educational systems. A common element from all the initiatives reviewed is that ESD is viewed as an action and participatory learning process where the needs of students and teachers are explored and addressed in order to draw meaningful paths for the future. This section briefly summarises the key observations arising from the review.

- **ESD capacity building and development of resources**

The various experiences reviewed address the need for capacity-building, pedagogical resources and curriculum innovation at the local and national levels. Capacity-building processes aim at providing tools and competences to teachers and schools to embed ESD in their daily teaching practice. Many RCE projects have also focused on developing pedagogical materials which are culturally and locally relevant and on training teachers to use these resources effectively. The use of these materials has had a great impact in many different countries. For example, RCE Chandigarh (India) has developed an activity book for students and a guidebook for teachers on the carbon footprint and handprint, using a participatory approach involving over one hundred key school stakeholders. These materials are now used by over 5,000 students in the region.

- **Range of thematic entry points into sustainability**

Over 50% of the projects and initiatives reviewed share the purpose of creating awareness and building capacities on thematic areas associated with environmental issues. Mostly they cover areas related to climate change, biodiversity, water and waste management, forestry and sustainable agriculture. However, some RCEs such as RCE Western Sydney (Australia) and RCE Tongyeong (Republic of Korea) have also facilitated innovative programmes that connect with contemporary issues facing students and their local and global communities. These projects have focused on building students' and educators' leadership capabilities for sustainability and

global citizenship; connecting sustainable development with cultural heritage and diversity; and, exploring values-based approaches to sustainability.

- **ESD quality and teaching and learning processes**

The different projects reviewed highlight the efforts made in embedding ESD within the formal curricula. Although whole institutional approaches are promoted by some RCEs such as RCE Goa (India), RCE Okayama (Japan) and RCE Tongyeong (Republic of Korea), the reality is that many of these efforts are still based on piecemeal approaches or short term sustainability projects. In order to fully embed ESD within the education system there is a need to challenge existing structures and systems (Mulà and Tilbury, 2011). None of the projects reviewed reflect on this complex process.

Change towards sustainability in schools requires more than just re-orienting curricula. It implies deeper levels of commitment where schools are not only concerned about what is taught, but how student learning occurs. ESD ultimately must engage all members of the school community at the very core of the school culture, influencing curriculum, operations, management procedures, partnerships and relationships with the local community.

The focus of most initiatives studied is on the reorientation processes of formal curricula within existing educational systems. Little attention is given to links with non-formal and informal curricula. An exception is RCE Penang (Malaysia) which is currently facilitating a co-curriculum initiative focused on creating a network of schools engaged in implementing sustainability clubs. This initiative is focused on providing capacity building opportunities to both teachers and students engaged in the clubs and linking the school formal and informal curriculum experiences.

The review also attests that RCEs have still to engage in reviewing the quality of processes taking place to embed ESD in teacher training and school initiatives. Most RCEs highlight participatory, action and context-based learning as pedagogical approaches adopted. Pedagogies related to cultural diversity and intercultural dialogue also appear to be important for RCEs in the region. However, few examples are given about how these pedagogies are used or developed in practice.

- **Culture of cooperation, quality and relevance**

The creation of partnerships, especially with government agencies and NGOs, is viewed as a crucial component in most of RCE projects analysed. Also, some RCEs such as RCE Greater Shangri-la (China), RCE Goa (India) and RCE Okayama (Japan) have started to work with the business sector in search of new funding mechanisms and bringing innovative ideas into school initiatives.

All the initiatives studied show evidence of genuine and formal partnerships being established for ESD. For example, the Water School project, led by RCE Shangri-la (China) in collaboration with Swarosvski, the China's Ministry of Education and the UNESCO Beijing Office, works with 12 Regional Coordination Centres in four river basins in China. Each of these Regional Coordination Centres works with a group of schools which in turn form a Leadership Team usually composed of teachers, students, community members, NGO representatives and university educators. The project also works directly with communities, including villagers, nature reserve organisations, monasteries, local NGOs, Community Learning Centres, youth organisations and government agencies.

RCEs also report on projects which have taken place in collaboration with other RCEs in the region. As an example, RCE Western Sydney (Australia) has worked with RCE Tongyeong (Republic of Korea) and RCE Penang (Malaysia) in its annual Youth Eco Summit (YES!) - a unique, curriculum-based sustainability event for school students and their teachers that promotes student leadership and showcases sustainability achievements and practices in both primary and secondary schools. International collaboration among RCEs has proved to bring an added-value to existing initiatives. Local schools and teachers seem to be particularly interested in sharing sustainability practices with other schools and learning from experiences carried out in different parts of the region.

- **Monitoring and evaluation processes**

RCE Greater Phnom Penh (Cambodia), RCE Greater Shangri-la (China) and RCE Goa (India) are the only RCEs with formal monitoring and evaluation systems in place to review progress and change resulting from the implementation of ESD projects and initiatives in the school sector. This is due to formal requirements from funding organisations. Other RCEs such as Greater Sydney (Australia), Chandigarh (India), Okayama (Japan) and Tongyeong (Republic of Korea) attest that informal evaluation processes and in-house discussions take place in a continuous basis to reflect on learning processes, challenges and achievements. Some RCEs in the region have also participated in the monitoring and evaluation processes facilitated by UNU IAS, but these are focused on the overall RCE performance and engagement and governance strategies, and do not specifically review school projects promoted and facilitated.

LOOKING FORWARD

The projects and initiatives analysed as part of this review reflect on the sustainability complexity and challenges that RCEs are facing in supporting teachers and schools. At the heart of all the ESD initiatives studied are multi-stakeholder processes and partnerships for change, which seek to embed change within school activities and the curriculum experience. Change for sustainability is a long term process. While the projects and initiatives studied have started to engage schools, teachers and students in rethinking teaching and learning, more efforts are needed to transform the school culture. The following recommendations have been identified as part of this review, with the aim of increasing RCEs' relevance and impact to the school sector and contributing to the ambitions set out in the GAP on ESD:

- **Supporting projects that promote whole-institutional approaches and institutional culture change for sustainability**

Most initiatives and projects studied have focused on re-orienting the curriculum towards sustainability through providing capacity building for teachers and engaging students in action learning activities. Change toward sustainability requires more than just rethinking educational curricula. There are significant opportunities for schools to not only rethink what we learn, but also how we learn it. To be successful, transformation will require the involvement of all the school community and rethinking school operations, management, communications and relationships with local partners.

- **Sharing and reviewing capacity building programmes and resources**

This study has identified critical opportunities to collaboratively share and review capacity-building programmes and educational materials developed by RCEs. The aim is to ensure that there is no duplication of efforts among RCEs and look at how resources and programmes could be transferred and adapted to different national and local contexts. Drawing upon pooled resources, capacities and expertise is critical for RCEs to learn from each other, increase the impact of projects and enhance the quality of ESD processes.

- **Engaging with a wider diversity of thematic entry points to teach and learn for sustainable development**

Most of the projects studied are focused on environmental themes such as climate change, biodiversity or water management. This study has identified the need for RCEs to address a wider variety of thematic entry points into sustainable development, which can provide a more complete understanding of regional challenges and bring different perspectives to sustainability. Some examples may include cultural diversity and equality, intercultural understanding, food security, and health and wellbeing. Asia-Pacific RCE annual meetings are critical platforms to explore and discuss these emerging themes as well as develop collaborative inter-RCE projects.

- **Enhancing regional RCE cooperation**

This study has confirmed the key role of RCEs in brokering partnerships for change. There exist many examples that illustrate how RCEs have involved key national and local school stakeholders to develop and implement collaborative ESD undertakings in school settings. In order to increase the RCE impact and upscale ESD efforts, more attention should be given to inter-RCE collaborations. Networking partnerships among RCEs can be used to connect RCE members from different geographical contexts to share best practice and discuss regional challenges.

- **Reviewing the quality of ESD projects and building RCE capacities on monitoring and evaluation**

ESD monitoring and evaluation is a complex area, which needs to be further developed in order to assess the learning processes and outcomes of ESD initiatives (Mulà and Tilbury, 2011). This review has identified the need for monitoring and evaluation mechanisms based on multi-stakeholder participation and focused on assessing the quality and learning processes of ESD projects. Indeed, monitoring and evaluation systems which help to build RCE capacities are required to ensure the quality of facilitation processes. Moving forward, it is recommended that RCEs in the Asia-Pacific build a network of critical friends in order to encourage reflection on teaching and learning quality for sustainability. One RCE can act as a critical friend of another RCE, encouraging critical reflection and providing honest and constructive feedback about projects, processes and initiatives.

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Tracing flax – An Enabling process through an intergenerational dialog

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ABSTRACT
The project "Landscape and You-th – Tracing Flax" (2012-2015) focuses on the relationship between local knowledge, landscape and regional identity through the cultivation and manufacturing of the flax plant in the Lesachtal region of Austria. The aim of the project was to reflect on and preserve traditional structures, practices and knowledge of flax, with the goal of enhancing cultural sustainability to promote regional development. Students from the „Neue Mittelschule Lesachtal" (lower secondary school) and the „HLW Hermagor" (upper secondary school) were trained in methods of recording oral history and then they interviewed local elderly people about the traditional cultivation and manufacturing of flax and its significance in daily rural life. Together, young and older people cultivated flax and processed it into oil, yarn and insulation material. Several media products and performances, including an app and a documentary were produced to enhance sustainable tourism in the region and offer added value for all stakeholders. The project provided an excellent opportunity for intergenerational learning. The project evaluation showed that students became aware of the interrelationships between people and the landscape and the socio-economic changes taking place in their region. They helped restore local knowledge about the landscape with regard to flax. Furthermore, as a result of the project, students strongly identified with their region, they valued living in the Lesachtal and had concrete ideas about its sustainable development.

KEYWORDS
cultural sustainability, intergenerational dialogue, local culture, research co-operation between university, school and community, traditional knowledge

INTRODUCTION: Tracing flax in Lesachtal

The ongoing project "Landscape and You-th. Tracing Flax", is funded by the Austrian Federal Ministry of Science and Research, and started in autumn 2012 as a research collaboration between the Alpen-Adria-University in Klagenfurt and schools in one of the most peripheral Alpine valleys of the region, the Lesachtal. This valley, in the southwest of Carinthia, Austria, borders Italy along a west-east chain of mountains, the Carnian Alps. With a declining population of 1,400 and a basic agricultural economy including some tourism, it displays all the problems typical of peripheral mountain regions. Regional development strategies have been re-focused over the last decades towards an economy based on sustainable tourism focusing on ecological and cultural resources such as the cultural landscape of the valley.

The focus of this research is on the relationship between local knowledge, landscape, intergenerational dialogue and regional identity connected with the cultivation and manufacturing of flax in the Lesachtal (see Figure 1). Flax (Linum usitatissimum) is a food and fiber crop that was planted in Lesachtal until the 1960s to produce flaxseed oil as well as fibres for making linen. When cotton and synthetic fibres appeared on the market, the time-consuming cultivation of flax became less and less profitable.

Photo 1: Harvesting Flax

Photo 2: processing Flax

Photo 3: interviewing the elderly about flax

As the example of the Lesachtal shows, cultural landscapes develop through the interaction of society and nature and involve cultural and economic factors as well as ecological processes. Although these are constantly changing at the same time they provide long lasting structures of continuity. Landscape structures keep their shape sometimes for centuries, even if some practices operating in them change over time. A landscape serves different functions and we can still trace patterns of the medieval colonization such as its field structures in the Lesachtal today - still there from the middle ages. Regional agriculture has changed from a diverse self-sustaining subsistence economy to the specialised cattle farming of today linked with other smaller scale economic activities, mostly tourist based. Up to the 1960s flax, together with various other farm products was an important part of the self-sufficiency in the Lesachtal and this project traces the development of flax production as part of the traditional local culture from this period.

Very little of the traditional knowledge concerning the cultivation and processing of flax has been documented in a written form. Hence it was decided within the project to cooperate with the local lower secondary lower school in the Lesachtal and a secondary high school, the HLW Hermagor ,to trace and document the still existing narratives and stories related to flax.

Figure 1. Research process

METHODS

A participatory approach

The project is structured around co-operative research, including the action research methods developed by Kurt Lewin and John Dewey (widely used in the field of education and pedagogy) (Rauch, 2005), intervention research (Bammé, 2005; Krainer and Lerchster, 2012) and the ethics of the research process. The project design was led by the assumption that co-operation in the research process must be based on mutual interest, shared influence in decisions concerning questions, methods and products of research. There must also be a shared responsibility for the outcomes of the project. Right from the start the research process was defined by a partnership of local and regional schools with the research teams. The research proposal was set up in a co-operation with teachers and the head teachers (one of the requirements for funding) and the first workshop was designed co-operatively. The research team was responsible for project management, but all the activities in the region, the workshops, the oral history interviews, cultivation and processing of flax, the documentary and the media work were done with local and regional partners. The local partners also supported the project with accommodation, transport facilities and most of all in communicating about the project in the region. Two local associations, the "Kulturverein" (Culture Association) and the "Kräuterverein" (Herbs Association) were very much involved in organising the historically based activities such as cultivating flax, "roasting" flax, spinning, weaving and pressing oil. They also played an important role in contacting elderly people, coordinating oral history interviews and inviting some of the interview partners to workshops in the school. This local network of partners was both a precondition for a successful research process and also an important tool for the social integration in the community especially of those who carried the responsibility for the sustainable impact of the project (Strohmeier and Sieber, 2013).

Enabling an intergenerational dialog through oral history interviews

Students aged between 12 and 13 years and 16 to 19, together with their teachers were instructed in how to undertake oral history interviews, both as a scientific method of empirical study and as a communication tool between the generations (see Figure 2). Students interviewed elderly inhabitants of the valley – those from 80 to more than 90 years old – about traditional methods of cultivation and manufacturing of flax and its significance in their daily rural life. Using this method of intergenerational communication, students and teachers accessed local narratives and traditional knowledge. In addition the process generated topics of common interest and curiosity between the youngsters of the valley and elderly people of the community. This form of intergenerational oral history brings together people of different generations in a socially integrating way, creating a mutual interest and emotional bonds. As opposed to passive learning, oral history is highly engaging and hands-on. Not only are stories collected but also social bridges between generations are created.

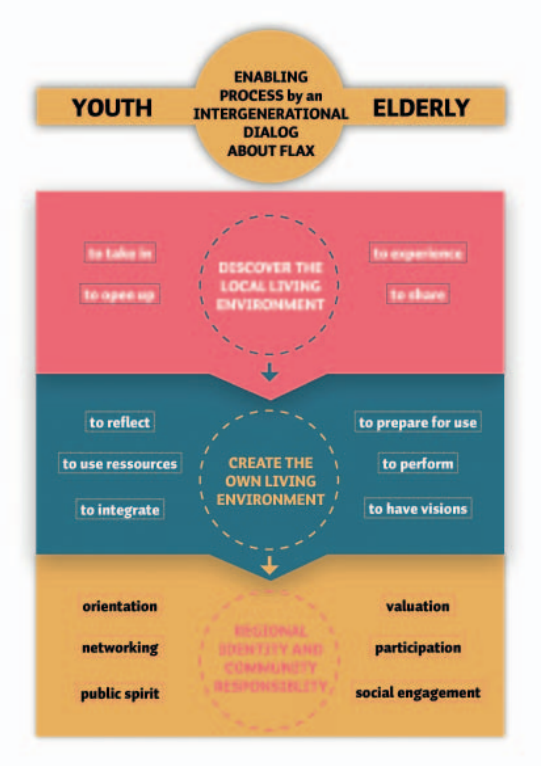


Figure 2. Enabling Process

Evaluating the project

The project was evaluated using qualitative methods (interviews with 5 project participants) and quantitative methods (questionnaires for involved pupils) (Rauch and Dulle, 2013). The interview results were analyzed using content analysis (Mayring, 2002) and the questionnaire results were interpreted descriptively (Lamnek, 2005; Friedrichs, 1990). The evaluation focused on the cooperation between the schools, the region and the university.

RESULTS

"Blossoms" produced by the Flax-project

The oral history interviews not only served as a tool for communication and mutual learning, but also as an empirical basis for several research products, including a documentary of local narratives and local practices related to flax. The project also produced secondary products using various media to communicate research results to the participating schools, the local population and interested tourists visiting the Lesachtal. Media products included smartphone applications were developed through the initiative of young people who decided what was important to show tourists from their viewpoint. Other products included a documentary movie and an animated cartoon drawn by the school students.

In class, the students created a flax blog with photos and sound files all to communicate research results. One of the sound files and a video-clip was a "Flax-Rap", a song written and performed by the students. The "Flax-Rap" was performed at the opening ceremony of the renovated and re-planted cloister-garden of the monastery of Maria Luggau. In the new cloister garden students planted and harvested flax in a bed at the very front of the garden. This small flax-field received a lot of attention especially during the flowering period, when a bright blue patch of landscape helped people to imagine how the landscape looked like at times of traditional flax cultivation. All these products had the aim of communicating research results as widely as possible and in the process emphasised that increased local communication about the traditions of flax cultivation and the traditional agricultural landscape required a working co-operation with local stake-holders.

This study illustrates the connections between local knowledge, landscape and regional identity. It also provided a scientific basis for thinking of "intergenerational working together" as a way in which the future of a cultural landscape in relation to sustainable cultural development and common welfare in a region can be developed. A method of learning that connects practical exploration of the past, with elderly and young people working together, and the transfer of learning to different media products is increasingly regarded as a positive way of developing local understanding and identity. Landscape is viewed more and more by local people as both a geographical space and as a cultural concept. School pupils can gain an appreciation of the importance of local knowledge and, during the first hand research, an increased landscape awareness.

We explored the interrelationships between aspects of "learning by doing" through the cultivation and processing flax, oral history interviews and transforming the knowledge into modern media products. The results show that the children of different ages can identify with traditional local knowledge and the landscape if the actual physical landscape corresponds with their mental images of that landscape. We found that it is primarily elements of the natural and traditional cultural landscape that are able to trigger positive feelings such as identifying with a landscape and a sense of well-being. The project shows the positive emotional effect of a landscape. Landscape is not only a functional space for children, but also is an important carrier of local meaning. This opens up new approaches in promoting sustainable development.

Evaluation results

The cooperation between the schools, the region and the university was described as "mutually appreciative" and "enriching". Added value for the schools was seen through an improvement of the school's image as well as through cross-class and cross-school collaboration. Science learning benefitted from new insights in intervention research, the emphasis on experiential knowledge as well as modern forms of knowledge transfer. The people from the region listed five main areas of benefit from the project: the restoration and opening of the cloister garden in Maria Luggau; securing of the original flax seeds from Lesachtal; raising awareness through transfer and dissemination of traditional knowledge; development of the local community; and the stimulation of tourism.

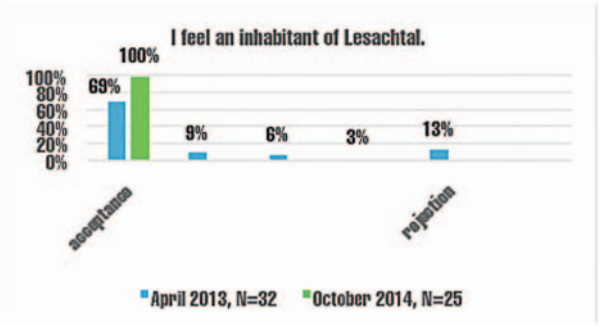
The evaluation results show that students became more aware of the interrelations between people, landscape and the socio-economic changes taking place in their region. An indicator of this was that after the project 94% of the pupils understood that in the past, local people strongly depended on the landscape because they used it for the production of food and cloth. This recreation of past agricultural practices brought people together from different ages for the purpose not only of collecting stories but also for creating a bridge between generations opening up a new world for both parties. Many of the agricultural experiences of the older generation had never been written about, so the only way to learn about them was to find a primary source. In this way "agricultural re-enactment" is an excellent learning and teaching medium for people of all ages.

Pupils helped in restoring regional knowledge about the landscape and in preserving the language associated with flax. This was achieved through oral history interviews, where pupils interviewed elderly local people who passed on issues

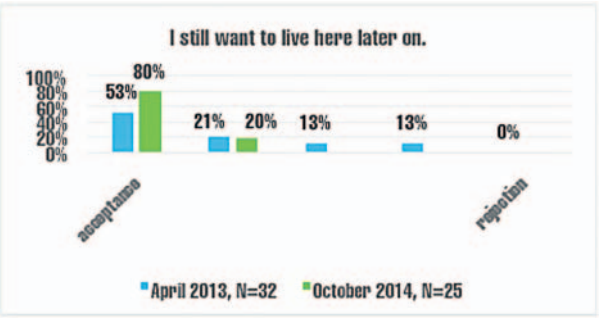
to do with contemporary life as well as living in the past, through their personal biographies. Through this form of intergenerational learning pupils generated valuable and personally relevant knowledge regarding the use of the landscape, the processing of flax and life in the past. Moreover, they were also confronted with attitudes and values that sometimes contrasted with their own, such as frugality, the enjoyment of work and the appreciation of ordinary things like food and clothes. Furthermore, the pupils contributed to the communication of scientific research results through developing different media products, such as an app, project Blog, radio broadcast, documentary film and cartoon, the "Flax-Rap" song and presentations at several events.

The questionnaire data collected from the 35 pupils who were actively involved in the project, show that the topic of flax and the project itself created an interest amongst students. They were particularly excited by the practical hands-on-activities related to flax from the cultivating and harvesting to the processing. Furthermore the historical and theoretical approach to the issue was appealing. Almost all pupils rated the project as a whole as "very good" or "good". The main characteristics of the Lesachtal from the view point of the pupils are the villages, the cultural treasures such as the basilica of Maria Luggau and its cloister garden, the mills, the locations for processing flax as well as the beauty of untouched nature. However, when looking into the future the majority the pupils believe that the Lesachtal will develop through greater urbanisation, modernisation and a growth in the population. 27% of the pupils welcome this development, whereas a similar proportion of 27% indicated that they like their region as it is.

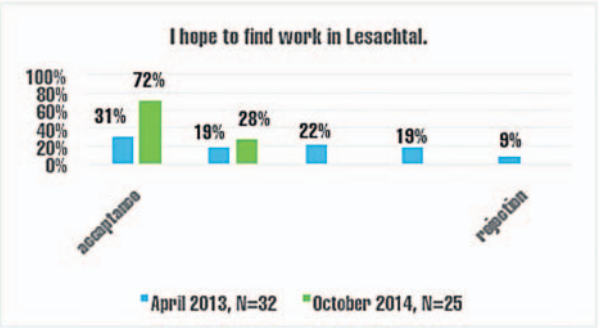
The evaluation showed that pupils identify strongly with and value their region. Figure 3 shows that pupils tended to have a slight tendency towards a strong space-related identity. Having said that it must be mentioned that in 2014 only 25 pupils (age 12-14) of the lower secondary school in Lesachtal were surveyed. Whereas in 2013 9 pupils (age 16-19) of the New Secondary School Hermagor (a town outside Lesachtal) were surveyed in addition, who do not come from Lesachtal. Furthermore, it must be remembered that these figures reflect the viewpoint of 12-18 year olds who have not lived anywhere else. Thus, the positive development towards a strong regional identity cannot be interpreted merely due to the project. The pupils probably feel deeply rooted to their region because this is the place where they were born, grew up and feel comfortable. Most pupils wish to find a job in the region in future although it is apparent that fulfilling this desire will be difficult bearing in mind the educational and job opportunities in the Lesachtal.



100% of pupils questioned in 2014 agreed with the statement: "I feel an inhabitant of Lesachtal". All of these pupils come from Lesachtal. In 2013, only 69% agree to that statement. It is probable, that those 13%, who do not agree, or agree less (3%) with the statement, do not come from Lesachtal.



In 2014 80% of the pupils strongly agreed, and 20% agreed to the statement: "I still want to live here later on". This is a significant increase compared to the 53% of strong acceptance of 2013.



Another significant increase can be seen in the acceptance of the statement: "I hope to find work in Lesachtal". Whereas in 2013 only 31% of the pupils hope to find a job in Lesachtal, in 2014 72% support this statement strongly. However on both occasions pupils mention that there are no possibilities for further education and job opportunities in Lesachtal.

Figure 3. Space-related identity of pupils

DISCUSSION AND CONCLUSION

There are fundamental differences of opinion in social and cultural sciences about the measurement of project success and impact. Some consider that research can explain specific structures and processes of change, and might communicate the results. However, it is left to others to translate the research outcomes into specific actions and practices. In the case of the Tracing Flax project, which focused on regional development, a different perspective on the evaluation of research results and their impact in and on society was chosen. The project design did not separate the research process from the practical application of research outcomes in the region.

The explanation of structures and change processes lies in the hands of both the researchers and those people and institutions in the region taking part in a project. Thus, the research results do not have to be translated into the local vernacular as they are part of the local culture and knowledge. Our goals in the project were connected with the goals defined by our participating partners with the overall joint goal being to help the region to develop into a long term sustainable self-reliant economy. The steady decline in population, although it is far from being de-population, the remoteness to industrial centres in the region, the lack of jobs in the valley, the aging population and loss in infrastructure - all need context specific solutions. The project on flax will certainly not answer all the questions of regional development, however the recreation of the flax history might help to attract some new tourists to the Lesachtal and might create some added value in terms of economy.

What the project has achieved already is to create and support a perspective of cultural sustainability (Krainer & Trattnig 2007), and to enable a community to re-value and re-define regional identity by means of a collective reflection on its own past, and consequently its own future. This perspective is very much based on specific and concrete products and processes. To re-enact a traditional work process in producing a textile fabric not only gives sense and meaning to a building ("Brechelhütte") but also relates to the cultural landscape for cultivating flax and to the complex traditional knowledge that local elderly people can provide. A sense of community and a strengthened local and regional identity are the culturally sustainable results of the project. The project received a sustainability award from the Austrian UNESCO Commission in 2014. Furthermore, the participating pupils were given the award of Sustainability Ambassadors by the federal state of Carinthia.

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A local community and waste management: the ECO-WAS Project in Traversetolo (Italy)

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ABSTRACT
The Municipality of Traversetolo (Italy), together with five other European Municipalities, was a partner in the ECO-WAS project (ECOlogic-WASte), funded by the "Europe for Citizens" Program of the European Union. The project sustains a network of communities related to the promotion of common values and strategies in waste management and fostering eco-friendly behaviours related to recycling and reuse. Within this European framework the Municipality of Traversetolo has supported a growth in relationships between the different parts of the local community, aimed at developing a shared culture of sustainability. All the schools in Traversetolo, key agents for the involvement of the community, took part in the project. A questionnaire concerning daily waste management was developed and used by students to survey local people. This survey, together with other activities that involved students of different ages, encouraged cooperation within schools and between schools and the community and provided the basis for new practices for a sustainable community.

KEYWORDS
Collaboration, Local community, Questionnaire, Schools, Waste management

INTRODUCTION
The ECO-WAS project (ECOlogic-WASte) was funded in 2012 by "Europe for Citizens", a multi-year financing programme established in 2004 by the European Commis-

sion, the European Parliament and the Council of the European Union. The purpose of the programme was to give financial support to activities and initiatives aimed at the promotion of an active European citizenship. In the years 2013-2015, the ECO-WAS project aimed to increase eco-friendly behaviour in relation to recycling and reuse through interaction and participation among European citizens. ECO-WAS also promoted opportunities for a growth in citizenship in relation to waste management, following guidelines set out by the European Parliament and the Council of European Union (2008), which put an emphasis on prevention, reuse and recycling.

Starting from the common issue of waste, ECO-WAS involved a number of different communities: Abegondo (Spain), Hasselt (Belgium), Lublin and Sosnowiec (Poland), Molndal (Sweden) and Traversetolo (Italy). The project gave people in these municipalities the opportunity to interact and actively participate in a shared plan across different European countries. It aimed to raise awareness about common problems and to seek possible strategies for the improvement of the quality of community life (both at a local and European level) in relation to waste management.

The project was also seen as a fruitful way to promote a community approach to sustainability in accordance with a recent communication of the European Commission that underlines: "the territorial approach to development is characterised as a dynamic bottom-up and long-term process based on a multi-actor and multi-sector approach, in which different local institutions and actors work together to define priorities, and plan and implement development strategies" (European Commission, 2013, p.5). Within this framework each European partner decided to elaborate a project based on specific needs of their local community.

The Municipality of Traversetolo is a village with a population of 9,460 people. It is located in the foothills belt of the Province of Parma - Po River Valley, in northern Italy and has an economy mostly based on agriculture and agri-food systems. The Municipality has a strategic environmental management priority to increase citizens' involvement in, and awareness of, waste separation and recycling and as a result of this long practical experience, elaborated the ECO-WAS project together with other European partners. Separate waste collection has been operating in Traversetolo since 1999, and in 2011 an updated strategy introduced door-to-door collection of household and commercial waste separated into: paper and cardboard, plastics, organic and residual waste. The collection of glass, vegetable waste, expired medicines and other items, is still through on-street bins, whilst hazardous materials, bulky waste, oils, batteries and so on are brought by citizens to a municipal collection-sorting centre. As a result of the ECO-WAS project, the Municipality of Traversetolo aimed to increase its already high percentage of separate waste collection (81.9%, in 2011) and to approach the community with the issues related to waste reduction and reuse to promote cultural growth toward sustainability.

A local approach to waste management could be a good way of responding to social and environmental global issues. The framework of the ECO-WAS project was that if many stakeholders work together, then significant results can be achieved and different perspectives and approaches to sustainability can become embedded in community practices.

In the light of these ideas, from the start of the project, the Municipality involved a number of relevant actors in a shared elaboration of the project methodologies and strategies. These were:

- IREN EMILIA S.p.A., Waste, energy and water management agency;
- CIREA (Italian Centre of Research and Environmental Education), Department of Life Sciences, University of Parma;
- ENVIRONMENTAL EDUCATION SERVICE, Environmental Department, Province of Parma;
- LEGAMBIENTE VALTERMINA – the local committee of an environmental non-governmental organisation.

To fully exploit the opportunity for the cultural exchange offered by the ECO-WAS Project and to bring to the attention of local communities the issues discussed between European partners, the Municipality identified schools as key actors. The involvement of schools gave the opportunity to focus the interest of the local community on waste and also allowed the promotion and support of best practices in waste reduction, reuse and recycling. This process is important for developing a shared European culture related to waste management - one that respects the environment and promotes the well-being of both present and future generations. The ECO-WAS project also enabled partners to experiment with the idea of school as a living laboratory - a way to provide genuine experiences that establish social engagement and collaboration and the involvement of children as active researchers (Barratt Hacking et al., 2013).

In addition, the participation of schools gave the opportunity to discuss with different groups of people (students, their families, teachers, for instance) their

daily habits in the management of household waste and how this can be improved. ECO-WAS also allowed schools to share these reflections with the local community and find out how different actors and institutions are able to work together implementing common plans and strategies (Glass et al., 2012).

The project has also encouraged the cultural growth of children and citizens in their community. This supports the idea that schools can only strengthen their role in future societies if they become learning networks, reflecting the needs and problems of communities they are part of (Mayer and Tschapka, 2008; Jensen, 2005; Wooltorton, 2003).

The importance of sharing a specific approach to Education for Sustainable Development (ESD) also needs to be emphasised. The ECO-WAS approach had a number of specific features. One of these was that the project started from schools and then involved people of different ages in all the contexts of their daily life. A second was a belief that education and learning is a transversal process which involves not only school disciplines but also different learning environments, formal, non-formal and informal (UNECE, 2005; UNESCO, 2005; Wals, 2010).

METHODS

In order to elaborate a collaborative proposal, the Municipality of Traversetolo organised a number of meetings to discuss the involvement of schools in the project. Despite the fact that schools do not usually work together, this phase resulted in the participation of all schools within the Municipality. The Schools involved were:

- Nursery school "Il Paoletti" (n° 170 students, 0-6 years old),
- Nursery school "Madonna di Fatima" (n° 54 students, 3-6 years old),
- Nursery school "Michelino Micheli" (n° 93 students, 3-6 years old),
- Primary school "Gabriele D'Annunzio" (n° 470 students, 6-11 years old),
- Junior high school "Alessandro Manzoni" (n° 262 students, 11-14 years old),
- Technical high school (with an economic curriculum) "Maria Laura Mainetti" (n° 70 students, 14-19 years old).

After the preliminary meetings, a participatory planning meeting was organised involving the teachers of all the schools and the local partners. In November 2013, a work plan was drafted and ideas for several activities to be developed during the 2013-2014 school year agreed.

Action 1 involved preliminary training sessions including theoretical/practical lessons by experts and peers, together with practical sessions illustrating the integrated waste cycle and the opportunities for a creative waste reuse/recycling.

Action 2 involved educational activities delivered through all school disciplines including Art, Literature and Science, all aimed at reducing the environmental impact of schools. The planned activities started at the beginning of the project (eg. recycling, reuse, fresh snacks to reduce packaging, tap water to reduce plastic bottles and composting), whilst others were spontaneously born during class activities. A significant effort was made to encourage the dissemination of students' experiences to their families, as a way to stimulate commitment and awareness on waste and to permeate the whole community with good practices. Each school decided to develop experiences and activities related to its specific needs, the students' age and so on.

Action 3 involved a questionnaire survey about daily waste management in the Municipality elaborated and conducted by students asking questions to local people and businesses.

Action 4 involved a final meeting of the project, held in November 2014, to discuss the motivational strategies related to waste management used by the different ECO-WAS European partners. During this meeting, held in Traversetolo, the educational activities and products developed were shared with the other partners. In addition, the meeting gave the Traversetolo team the opportunity to discuss and to share with both the European partners and the whole local community all the experiences developed within the project.

The survey

A survey about the daily waste management was one of the activities organised (Action 3). This was a strategic activity designed to give form to the experience of cooperation within schools and between schools and their community.

This survey aimed to analyse the behaviour and perception of waste and waste management of the inhabitants of Traversetolo. Local Administrators needed information about attitudes to recycling and as part of the ECO-WAS project decided to commission schools to produce a questionnaire for students' families and local businesses. As well as gathering information, this initiative aimed to enhance the involvement and contribution that each citizen could make to improve waste collection specifically, and in more general, improve the living environment.

Students were involved as active researchers, supported by their teachers and by a number of local partners. The research process was participatory and developed "with" students (Barratt Hacking et al., 2013), enabling them to contribute to clarifying the focus of the project, the elaboration of questionnaire, data gathering, analysis and interpretation of the results. In addition, this approach aimed to empower the students and raise their social consciousness in order to change their behaviour.

After some lessons on issues on waste management and the methodological aspects of undertaking a survey, the high school students elaborated a first draft of the questionnaire shared with the local partners before a final version was produced.

The investigation was developed around 20 items organised mainly as closed or semi-closed questions. The number of open questions was limited so that the questionnaire was easy to manage, simple to understand and didn't require too much time to complete and to elaborate the data. The questionnaire ended with a final space for free comments.

The questions invited citizens to reflect on their personal waste management and waste management in their municipality. Questions asked people how interested they were in waste management, how satisfied they were with the current process, and for their suggestions and general comments. In more detail, the questions were organised around four sections:

- Socio-demographic characteristics of the sample (questions 1 to 7);
- Daily practice of waste management (from 8 to 16) (auto-declarations);
- Perception of waste and reflection on personal waste reduction (from 17 to 20);
- Suggestions, requests, comments on waste management, addressed to the local Administrators of Traversetolo.

The test was distributed to a sample of:

a. students' families; Students, from kindergarten to high school gave the questionnaire to their parents and brought them back to school within a few days;
b. local traders; High school students asked the questionnaire to the owners of a number of businesses in the town (greengrocer, hairdresser, baker, etc.) through an interview noting down the responses.

A total number of 655 questionnaire responses were obtained - 568 from households and 87 from businesses. They were encoded in an electronic form using Lime Survey, an open-source software, and then analysed. During this process the high school students took part in the quantitative analysis of the closed questions, whilst the open questions were analysed by the partners thanks using a qualitative methodology, through an ex-post encoding of the responses obtained.

RESULTS AND DISCUSSION

The results were processed and discussed by the local high school students, supported by their teachers and a number of project partners (CIREA/University of Parma, Environmental Education Service/Province of Parma and Environmental Department/Municipality of Traversetolo).

The key socio-demographic characteristics of the sample were:

- 87% were households (students' parents) and 13% local businesses;
- 80% were between 31 and 50 years old;
- 75% were female;
- 85% were Italian;
- 78% had lived in Traversetolo for more than 5 years.

98% of those interviewed declared that they "usually practice separate waste collection". The motivations for this are shown in Fig. 1: 79% of them attributed a "value" to this practice ("it's important for the environment", "it's important for my town" or simply "it's a right thing"); a few (16%) mention that it is "mandatory by law" and 5% consider separate waste collection to be "easy".

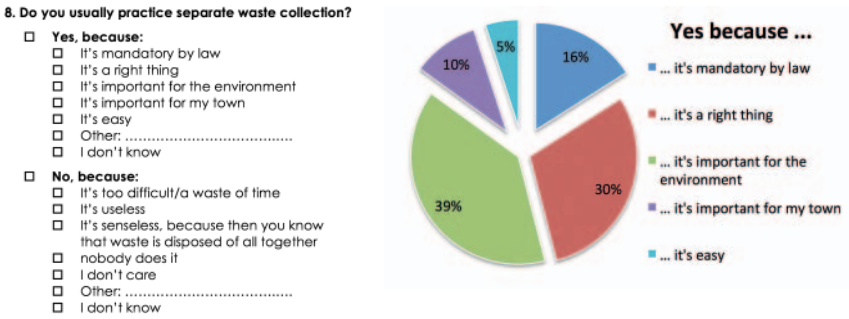

Figure 1. Question 8 - Factors that motivate the separation of waste for collection.

It is interesting that 73% of the interviewees said that if they saw someone who didn't respect the waste collection rules, they would intervene: 57% would try to explain what should be done and 16% would rebuke the other person (Fig. 2).

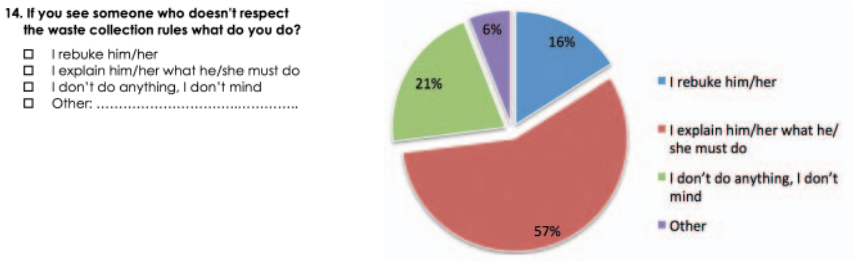

Figure 2. Question 14 and related responses.

A further confirmation about the awareness of citizens and their involvement in waste management is shown in Fig.3. Only 21% of the interviewees declared that waste ceased to be a concern for them after it had been correctly disposed of.

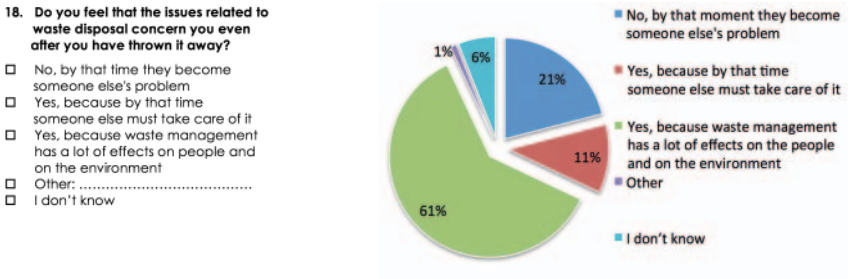

Figure 3. Question 18 and related responses.

In the light of these results, it seems that a large proportion of the people of Traversetolo are aware of at least some of the links between people, the environment and its management. This is confirmed by the responses to question 19 where 92% of the interviewees consider the reduction of waste to be very important.

In contrast with this awareness, only 35% of the sample knows that they can "do something to reduce waste" (Fig. 4), with prevention and attention to purchases being most often mentioned. The remaining 41% of the sample claim they don't know

how to act and 24% think that it is not possible to reduce the production of waste. This data suggests that there is work to do to improve people's understanding and competencies related to the whole waste cycle.

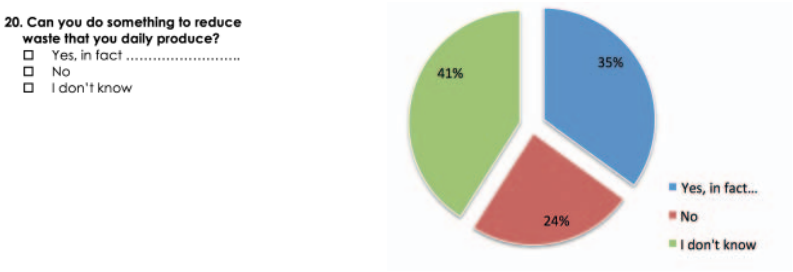

Figure 4. Question 20 and related responses.

This idea was also confirmed by the 20% of citizens involved in the survey who through the final open question, asked for more support from local Administration, including controls (with related fines and penalties), a reduction of costs and also educational and informative initiatives.

It is obvious from these results that Traversetolo is characterised by a wide awareness and participation of the community in environmental issues such as waste management. The project therefore has helped to identify the key factors that should be kept in mind when reflecting on and planning collaboration between a local community and different actors, including schools. These include some fundamental characteristics of the community such as participation, awareness, attention to waste management and commitment to the environment (Espinet and Marquez, 2014). These points have been taken into account during the global evaluation of ECO-WAS in Traversetolo.

The involvement and cooperation between different stakeholders such as the University, Town Council, the waste management Agency, Non-Governmental Organisations and schools, gave rise to some unexplored relations between stakeholders, enabling them to share common challenges. These relations required time to manage and nurture so as to build a common language before identifying shared aims between partners. In addition, this process required the integration of the specific roles of each actor. So for example, the advisory and consultancy role often associated with the University and the waste management Agency, were

enriched with the support given for project implementation by the town Council of Traversetolo and by the services and volunteer staff provided by Legambiente Valtermina.

To ensure the success of these relationships among the external actors and the schools, a number of collaboration methods were important. First of all, strong attention was paid to communication between the actors through regular meetings, school committees and informal round tables promoted and supported by the Municipality of Traversetolo. These helped to give form to an inclusive environment for all the partners and to develop a "win-win" situation for everyone involved. Thanks to this inclusive approach it was possible to tackle the disconnection between schools' teaching and learning and the daily life of the community and the resulting lack of integration between schools and community.

The shared knowledge and expertise of the project partners allowed students to experience meaningful learning opportunities and enabled them to develop a sense of belonging and an awareness of being actors within their community. Throughout this process, the motivation and enthusiasm of school managers who provided support to school staff in general and teachers in particular, needs to be underlined.

CONCLUSION

The value of the school-community collaboration was an important aspect of the evaluation of the ECO-WAS project in Traversetolo. From the evaluation it was clear that the promotion of community-based learning had a positive impact in addressing environmental and sustainable development issues. In more detail, the collaboration with the local Administration was a factor of success in terms of project consolidation. The schools involved in a project saw that it was not just an educational activity but also useful for the community. This approach contributed to a fostering of new values and a new culture in schools - a culture of solidarity, commitment, trust and shared responsibility (Espinet and Marquez, 2014). It also contributed towards breaking the boundaries between formal and non-formal education, suggesting that the commonly shared notion of learning in just happening formal contexts needs to be revised. Society today requires hybridisation and synergy between multiple actors and as a consequence the blurring of the division between formal and non-formal contexts of education that this project provided (Wals, 2010). So, the project in action in Traversetolo can be seen as an opportunity for this type of expanded learning weaving together sectors, school disciplines and institutions.

As well as these positive results there were also some weaknesses in the project. First of all, the involvement of the teaching staff was voluntary and sometimes this affected both motivation and participation. As a result, some teachers left the project leading to an increased complexity in the collaboration processes. The gap between school and project timetables also sometimes restricted opportunities such as peer to peer learning and tutoring activities between schools. It would have been useful to consider these issues in project planning. The involvement of citizens to help disseminate and discuss the project results is an action in progress and will add value and raise opportunities for the future.

The project is not yet completed and so it's not possible to fully evaluate its impact on the community over time. In spite of this, one of the most important hopes for the future is the development of other educational projects for sustainability in the local community of Traversetolo building on the results of ECO-WAS. The aim would be to foster greater participation among citizens and other actors within the community, and to give form to an educational community based on sustainability. The project ECO-WAS is a stimulating case study of the development of an educational community based on school involvement and an aware and active citizenship.

In addition, ECO-WAS being a European project, enabled the comparison of the different policies, practices and traditions related to waste management of the other European partners, all of which belonged to different cultural areas. Some of the European partners were like Traversetolo and had practiced separate waste management for a significant time, whilst others had only just started on this journey. The debate between partners allowed experiences to be exchanged and provided ideas for the implementation of waste management in other contexts, giving due consideration not only to the technical aspects of waste management but also to the cultural perspectives.

This European dimension of ECO-WAS has given the partners the opportunity to share and highlight the values of the project, which is working towards common goals and having an impact on the different local communities for a shared European culture related to waste management – one that is respectful of the environment and the well-being of both present and future generations.

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PART II.

Exploring critical characteristics in Education for Sustainable Development

You can't have taught them properly - or what happens when Education for Sustainable Development doesn't produce the results we expect

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ABSTRACT
This reflective chapter describes a case study in which sustainability issues were taught as part of a geography course in a secondary school in England. It firstly describes a decision making activity undertaken with 16/17 year old students that examined the topic of fracking. It then describes the reaction of education for sustainable development (ESD) practitioners to the outcome of this activity. After considering all the evidence the students decided to support fracking and the ESD practitioners were horrified by this outcome. The third part of this chapter reflects on the implications of this reaction and considers whether ESD practitioners are only committed promoting student centred approaches when it brings about the specific lifestyle and behaviour considered to be sustainable by the ESD practitioners themselves. In other words, unthinking behaviour management is really at the heart of much ESD rather than education and thinking critically.

KEYWORDS
Bias, Controversy, Fracking, Geography, Transformative

INTRODUCTION
The author of this reflective chapter is a Geography teacher of students aged 14-18 and like many teachers throughout Europe is more than slightly constricted by the demands of an examination orientated curriculum. In England this is the General Certificate of Secondary Education (GCSE) taken by students aged 16, and the AS and A2 levels taken by students aged 17 and 18. Five or more GCSE's at grades A-C are usually required for acceptance on an A Level course, and A Levels are required for entrance to University. They are important examinations for students to pass at the required grades and hence student and parental expectations are understandably high. Partly because of this, opportunities for curriculum flexibility and innovation are relatively low as teaching time is limited and in the eyes of some "not to be wasted" by taking too much time teaching a topic.

Despite this expectation, learning and thinking about sustainability is integrated into the teaching of different topics as much as possible. And being fair, the Geography curriculum does give a good number of opportunities to do so, especially in modules such as Energy, Population and Development and Globalisation. Having said that, the syllabus also takes a relatively conservative approach to sustainability and development and follows the common approach of "business as usual but greener" rather than giving any real intellectual challenge to the current way of doing things. Answers to examination questions, however, do require students to discuss and evaluate and be critical, and so there are opportunities to engage students in some difficult and controversial issues. That is the background to the activity described in this chapter related to the module on Energy for the AS Geography syllabus and aimed at 16/17 year old students.

THE CASE OF FRACKING
One requirement of the module is that students look at the "environmental impacts of energy use" and within this they have to consider at the "effects of extracting energy raw materials" (AQA, 2009). The syllabus gives the teacher freedom to deliver this concept in any appropriate way and so a unit was devised to enable to students to cover the concepts through looking at the issue of fracking (Stephenson, 2015). This was chosen because globally, fracking is very much in the news being credited with the fall in oil prices that has taken place over the past years. Fracking is also a hugely controversial issue in the UK with most communities being opposed to the idea but the government and business seriously considering allowing it. Hence the topic allowed students to be introduced to aspects of the economics and geopolitics of energy – both other concepts that are on the curriculum.

The activity involved the ten students being divided into five groups and provided with data about the fracking process from different sources, some 'for' and some 'against'. They were also given information about the need for energy, where it might come from, together with global development and geopolitical issues. In addition there was time for them to search for other data on the web. After studying the data the groups of students had to play different roles using the same data, and each group had to produce a two page report on the advantages and disadvantages of fracking, their recommendations and a short power point presentation. The groups represented a local community council, a national environmental non-governmental organisation (NGO), a team of energy experts from a University, an energy company wanting to undertake fracking and a group of young people (being themselves!). The groups were given two hours of lesson time to prepare their report

and presentation and in the third lesson, present their reports. Two parents involved in the energy business were invited to read the reports, listen to the presentations and make comments. One parent is involved in the fracking business through manufacturing the clay liquid used to bring the gas to the surface, whilst the other is involved in the renewable energy business, largely through selling solar panels. So – what happened? In the research lessons the students were left very much to their own devices and asked for support only when they needed clarification or explanation of the information they had been given or found for themselves on the web. In the presentation and debate the groups were judged by the parents, by their teacher and by each other using different criteria. The results were interesting. All the groups except the national environmental organisation were generally in favour of fracking but for different reasons and to different degrees. Table 1 provides an overview of the results of the assignment.

National Environmental NGO	*Were against on the grounds of possible pollution to water sources and destruction of the countryside to extract the gas. Recommended more investment in renewable energy.*
University Energy Experts	*Were on balance, for fracking, though there were disagreements. They considered that from a scientific point of view there were risks but they were the same as other energy sources, and could be made safe. They also recommended that more investment in renewable energy was a better long term solution.*
Energy Company	*Were for on the grounds that the UK needs cheap energy and that it would generate local and national income and support local economies.*
Local Community	*Were for because they believed that the development would bring employment generally the UK and the area and provide cheaper electricity. Assurances had been given about pollution and the government had promised financial support to local communities that agreed to fracking.*
Young People	*Were for fracking. Although they recognized the dangers they agreed with the scientists that they could be overcome. Interestingly they also thought that globally cheap energy was a good idea especially for poor countries in Africa that needed to import oil to develop.*

Table 1. Outcomes of the student assignment

The discussions of the view points and presentations were heated at times but there was no doubt that the overall conclusion was that fracking should go ahead under some form of strict control and that the government should make more efforts in encouraging energy efficiency and invest more in renewable energy at the same time. This was a surprising result as the expectation was that the students would probably disagree with fracking. Wals (2010) described a case that deconstructed a meal of a popular fast food chain, with one of the outcomes being that the students had profound concerns about the sustainability of providing food in this way (Wals, 2010; Sriskandarajah et al., 2010). A similar reaction was expected to fracking!

ESD GONE WRONG

The author took the opportunity to describe this activity as part of a panel discussion at the final CoDeS Conference and was astounded by the reaction. One of the panel presenters came up with the statement that if the students agreed with fracking then "You can't have taught them properly" or words to that effect. Apparently, according to the University Professor critic, after doing an activity about fracking, the students should end up disagreeing with fracking and as these students ended up supporting the process then the teaching had obviously failed. This comment and reaction led to an exciting few moments of further debate about a number of critically important issues for ESD.

The author was astounded for a number of reasons.

The first was that the Professor seemed to have the view that teachers just "teach". Of course, sometimes just "teaching" takes place, if by teaching is meant controlling the knowledge, understanding, skills and values that students have to then "learn". Depending on the topic, if students don't know about something then it is taught to them. But "teaching" is also about structuring the learning process of discovery and that's what this lesson was all about. The 17/18 year old students consulted during the process for clarification and explanation when needed but generally had the skills to construct their own learning about the topic (Wals, 2010). The general conclusion was that they did this pretty successfully and the two expert parents were also impressed with the level of knowledge that the students showed in their reports and presentations.

Secondly, there was the implication that somehow teaching should have the purpose of ensuring that students disagreed with fracking. This assumption is an especially worrying one not just because of the implication that an ESD University

Professor and the ESD community at large are the guardians of "right" knowledge, but that teaching should be designed, not to help students learn about a controversial issue and make up their own minds, but manipulate them into making a particular decision. When reviewing this activity against the eight ESD competences described by Sterling (1999) and the OECD (Stevens, 2014) it seems that the lesson touched on most of them: interdependence, citizenship, diversity, the needs of future generations, quality of life, uncertainty were all covered within the context of what was thought by all those involved to be a pretty good decision making activity (Sterling 1999; Stevens 2014). What more could have been done? Thankfully, there is no competence which says "Listen to your teacher and agree with his viewpoint" though maybe that's what some of the critics really wanted.

But perhaps the discussion highlights a difference between the purpose of education, learning and the role of the teacher in a school and at a University. A University Professor (and NGOs come to that) can bias their learning towards a particular outcome quite happily – and often do. It is expected that the Worldwide Fund for Nature (WWF), Greenpeace and other NGO's will disagree with fracking. To some extent it could be argued that that's their job. Students at University usually have the maturity and confidence to disagree with lecturers. Teachers working with younger students especially on controversial topics have a different set of responsibilities and hence a different way of approaching learning. Students often believe what their teachers are telling them because despite all the progress and innovative in learning, this is still the general approach. This topic could quite easily have involved power point presentation and some notes on fracking considering the pros and the cons and then coming to the conclusion that fracking is wrong. No doubt most of them would have then adopted this viewpoint to a greater or lesser extent. However, in this activity the role of the teacher was different. It was to honestly introduce students to a broad range of ideas and support them in becoming "critical thinkers", because it is critical thinkers that the world will need if we are to live sustainably in the future.

At this point it is worth the author confessing a personal disappointment that the students agreed with fracking, but also being thrilled at the level of thinking that some showed in making their decision. To be able to see the relationship between oil prices and the ability of countries in Africa to take advantage of lower oil prices to develop more effectively is a high level of thinking. One student even said that "lower oil prices are for better at encouraging sustainable development in Africa than an increase in aid budgets". From a 17 year, that's not a bad analysis.

So the activity raised concern about the ESD community's honest commitment to student centered learning, but it also raised another worry, and that is about the content and approach of ESD and in particular, the apparent dislike of new technology and technological change as a way of bringing about sustainability. More emphasis is placed on changes in values that lead to changes in behaviour and reducing consumption as the way forward. Much of the energy of ESD practitioners is placed on developing resources and campaigns that aim to do just that. This emphasis is worrying not least because of the double standards that ESD often displays. For example, we are all happy to use our tablets and other communication wizardry despite the fact that we know for certain that the planet is being destroyed through the metals used in their making and possibly lives are destroyed in the factories that make them. We are happy to fly to conferences to listen to lectures on climate change. Yet we are not happy about a technology that has the potential to open energy reserves to communities not just in rich western countries but also low income countries as well. Had ESD been around during the industrial revolution two hundred years ago perhaps we would have been against that as well and then where would be now? This is somewhat of a rant and a hobby horse, but there must be a grain of truth somewhere in all this thinking? If the management maxim that "we do what we see our leaders doing and not what we hear them saying" is true then ESD needs to give itself a critical dust down in terms of our approach to sustainability as well as approaches to learning.

ENCOURAGING STUDENTS

So what should be done to help students think more sustainably and achieve a sustainable world?

Well, one option would be just to tell them what's right and wrong, assuming teachers know this. This is probably not an acceptable option. The author believes that the first key task is to encourage students to constantly challenge thinking and encourage them to constantly ask questions when presented within information:

- Where did this information come from?
- Is this true?
- How trustworthy is it?
- Is it true but not the full picture?
- How can I find out?

And then when students come to their own conclusions, challenge these as well. Students should especially challenge information when it comes from a source with

a specific view to promote be that business or the environment. A younger group of students have recently completed a module on the clothing industry and hardly any of the information from NGOs say anything positive about the conditions in clothing factories in China. Reading other books on the topic however, it seems that many of the girls moving from villages to work in these factories feel that their quality of life is much better than it was in rural China and that many companies are making real efforts to make things better. Eco fashion is all well and good but 15 year old girls don't wear woolen shawls hand-knitted by a women's cooperative in Peru. They go to low cost fashion chains to buy T shirts for 5 EURO. Challenging the data and coming up with alternative questions and viewpoints is something that ESD should enable all students to do.

And secondly, this challenging needs to be done within the context of a positive future. One of the issues facing young people is an understanding that they don't know what the future will be like. The great problem is that most people tend to think that the future is going to be like a bigger and possibly better version of the present. However, history tells us that this is rarely ever the case. The future to some extent is unpredictable, uncertain and potentially dangerous, exciting and full of opportunity all at the same time. We are preparing students to live in this world in a sustainable way and so it is precisely these critical and creative thinking skills that will bring about sustainability. I am always motivated by the fact that a positive view of the future is the way forward for change rather than a negative one and I believe that this is where ESD has been going wrong and to be honest – where the Decade of Education for Sustainable Development (DESD) has gone wrong.

In particular there is a need to be more positive about technologies and welcome more of them. As has been said, the ESD community seems to have a great dislike of technology and the reliance people place on it to solve our sustainability challenges. At the back of many people's minds is a love of small rural communities, despite the fact that most educators don't live in places like this. Now whilst in principle it is right that we should not knowingly live unsustainable lifestyles and then just hope that technology will solve the problems, properly designed technologies are making and will continue to make the world a better place. Let's face facts, everyone reading this will have a smart phone or one kind or other, one of the most environmentally destructive technologies on this planet, and live relatively comfortable lives surrounded by all those technologies that we love to challenge.

So overall, despite agreeing with fracking, the author firmly believes that the students who went through this learning process are better prepared for the future than students who maybe unthinkingly disagree with fracking and just toe the conventional ESD line!

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A Pedagogy for Uncertain Times

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ABSTRACT
Many scholars agree that it is essential in our rapidly changing world for young people to develop 'uncertainty competences' comprising specific sets of skills, knowledge, attitudes and capabilities needed to deal with uncertainty, ambiguity and complexity in diverse contexts. Learning to handle knowledge uncertainty requires learning environments tolerating, even inviting, uncertainty into the learning process. Terms describing this need have been used by Gordon ('welcoming confusion, embracing uncertainty in learning'), Barnett ('pedagogy for supercomplexity'), English ('need for discontinuity in learning') and Buckingham ('need for optimally productive measure of epistemological chaos') amongst others. Education for Sustainability (EfS) features subject areas such as 'climate change' hallmarked by complexity and uncertainty. Such topics can be difficult to deal with in the subject-delineated world of formal education. What does the ideal learning environment and teaching approach for the development of these competences look like? This paper will critically examine the literature and explore the dearth of coherent EfS-based empirical studies.

KEYWORDS
education for sustainability, knowledge uncertainty, uncertainty, uncertainty competences, 21st Century education

INTRODUCTION

21st Century: Age of Uncertainty

One of the urgent challenges facing society is related to the way in which humans address the ubiquitous nature, as well as the sheer amount of uncertain and ambiguous information about the state of our environment. This information is often incomplete, inconsistent and regularly contradictory. Influential bodies for example the IUCN (International Union for Conservation of Nature) and IPCC (Intergovernmental Panel on Climate Change) publish extensive reports about the severity and impact of habitat destruction (Baillie and Butcher, 2012) and the detrimental effects of 'climate change' (IPCC, 2014), based on state of the art scientific literature. Nonetheless, there remain many unanswered questions about these complex processes. It is difficult for lay people, who may not speak the scientific language of probabilities and models, to know which expert to believe. Knowing how to deal with 'knowledge uncertainty' surrounding complex environmental challenges, and making value-based decisions, has never been more urgent (Goverse, 2013). Illustrations that humanity is entering 'post-normal times' filled with uncertainty, contested (scientific) knowledge, overwhelming complexity, and the need for re-assessment of our values (Funtowicz and Ravetz, 1993) pop-up from time to time in crisis headlines in the media. Education should foster the development of humans who when faced with uncertainty do not become paralysed, but on the contrary can act responsibly and constructively. Students should be prepared for making provisional decisions that are based on incomplete information, either because of the pressure of time or because insufficient evidence is to hand to fully warrant any particular decision, or because the outcomes are unpredictable (Barnett, 2012).

In discussing this so called 'Age of Uncertainty', Barnett (2012) makes a distinction between the concepts 'complexity' and 'supercomplexity'. With the former he points at the nature of systems, saying that the "interactions between their elements are unclear, uncertain and unpredictable" (ibid, pp.67-68). Although the challenge of fully understanding a system could in theory be resolved, in practice there is often too little time and too few resources. At the same time Barnett introduces another somewhat unsettling concept, namely that of 'supercomplexity'. He argues that the challenges of supercomplexity can never be completely resolved because of people's multiple and incompatible differences in interpreting the world. There is no one right answer to the complex questions of our time and therefore people need to accept that not everything is fully knowable. From his viewpoint, the world is not just radically unknowable, but is indescribable as well (ibid). It then becomes clear that students need to learn how to cope with uncertainty, ambiguity and indefinite questions (Bolhuis, 2003). Preparing young people for complex and supercomplex decision-making therefore requires developing 'uncertainty competences' that include specific sets of skills, knowledge, attitudes and capabilities needed to handle uncertainty, ambiguity and complexity in diverse contexts (Tauritz, 2012a). Being able to handle complex and uncertain knowledge is often seen as a premise for sustainable development (Mayer and Tschapka, 2008; Remmers, 2007), but experts generally offer limited guidance regarding how this can be achieved.

Scottish Curriculum for Excellence

In many countries schools focus on standardized testing (Longo, 2010). This approach often leads to teachers teaching to the test. The teachers feel time pressure

when working to a strictly standardized curriculum and so often skim over materials (Moon et al., 2007). This results in less time for learners to learn how to critically and creatively analyse content. Test-driven education focuses on students giving the right answer and can be said to be based on the existence of certainties. Teachers in test-driven systems often avoid an open teaching process in which there are multiple 'right' answers. There are, however, a few countries such as Scotland where efforts are being made to move away from an absolute focus on test-driven education and redesign the educational system.

In 2004 the Scottish government published a document titled 'A Curriculum for Excellence' (Scottish Executive, 2004), with the intention to provide all learners between the ages of 3 and 18 with the education needed to prepare them for the 21st Century. This document identified the following four key purposes of education, often referred to as the four capacities, which should enable each child and young person "to be a successful learner, a confident individual, a responsible citizen and an effective contributor" (ibid, p.12). Instead of a more contemporary content driven curriculum, the Scottish government aimed and continues to aim for a curriculum that ensures the development of the knowledge, skills, attributes and capabilities needed to flourish in life, both privately and professionally.

UNCERTAINTY COMPETENCES

Teaching beyond content-knowledge

The importance of the development of attributes and capabilities, rather than focussing primarily on content knowledge, is recognised by many contemporary scholars. Some assert that in order to handle our complex and uncertain world, learners need to develop the ability to creatively and spontaneously use uncertain information (Langer et al., 1989). Others variously describe the need for:

- strategies and skills for dealing with uncertainty (Hall, 2010);
- reflective thinking skills (English, 2013);
- capabilities – the ability to adapt to change, generate new knowledge, and continuously improve performance (Fraser and Greenhalgh, 2001);
- critical thinking skills and moral fortitude (Gordon, 2006);
- integrated thinking, problem solving, and personal and social skills (Higgins, 2001);
- an authentic identity, a capacity to choose from conflicting evidence and a preparedness to revise in light of new insights (Kreber, 2009);
- dispositions – durable determination to work things out in one's own way, and qualities – the form those dispositions take (Barnett, 2007; 2012);
- uncertainty competences (Tauritz, 2012a).

There are a myriad of definitions regarding competences, skills, abilities and capabilities, attributes and dispositions in the literature. For practical reasons 'uncertainty competences' is used here as an umbrella term encompassing competences, (generic and specific) skills, strategies, knowledge, attitudes and capabilities needed to manage knowledge uncertainty.

Overview of uncertainty competences

Uncertainty competences are competences needed to support learning about and managing uncertain information and situations. While not being exclusive to the context of uncertainty, they are vital to handling complex and uncertain knowledge. There is an increasing imperative that primary, secondary and tertiary education institutions not only acknowledge the significance of acquiring such competences, but also take action in order to incorporate them appropriately into their practices. It is encouraging to see that there are governments, such as the Scottish Government, that stimulate and support schools (at least in the 'Broad General Education' phase – 5 to 13) in their efforts to focus on competence development for the 21st century. Although uncertainty competences are not specifically mentioned in the list of the four capacities, they are referred to using other words, such as 'link and apply different kinds of learning in new situations', 'assess risk and make informed decisions', 'understand different beliefs and cultures' and 'develop informed, ethical views of complex issues' (Scottish Executive, 2004).

Uncertainty competences can be divided into three categories: the competences needed to cherish, to tolerate and to reduce uncertainty and ambiguity. An extensive list of the competences (Tauritz, 2012a) is provided in Table 1.

Learning to cherish uncertainty

1. Being able to use uncertainty as a catalyst for creative action
2. Being able to empathise with people with different perspectives
3. Being able to 'entertain' an enquiring mind

Learning to tolerate uncertainty

4. Being able to accept not knowing what will happen
5. Being able to reflect on and change one's beliefs regarding uncertainty
6. Being able to employ lateral thinking

Learning to reduce uncertainty

7. Being able to prioritise ('triage') among many urgent issues
8. Being able to find, evaluate and utilise information (specific knowledge)
9. Being able to judge the credibility and cognitive authority of information sources
10. Being able to reason (inductive and deductive reasoning)
11. Being able to respond in accordance with the underlying probabilities
12. Being able to employ previous experience
13. Being able to assess one's own ability to achieve a desired outcome
14. Being able to engage a supportive network
15. Being able to formulate a plan of action to deal with uncertainty
16. Being able to work in, and contribute to, teams with mixed skills and experience
17. Being able to use one's intuition as a source of information

Table 1: Uncertainty competences (Adapted from Tauritz, 2012a)

A PEDAGOGY FOR UNCERTAIN TIMES

Education for Sustainability: The playground of uncertainty

Learning to handle knowledge uncertainty and developing the necessary competences requires a learning environment tolerating and even inviting uncertainty into the learning process. So what does the ideal learning environment and teaching approach for the development of these competences look like? Gordon (2007) promotes embracing rather than minimising the complexities, ambiguities, and risks that are inherent in the field of education. Terms describing this need have been used by, amongst others, Gordon (2006) who writes about 'welcoming confusion, embracing uncertainty in learning', Schwartz (2011) who stresses the importance of 'productive stupidity', Hall (2010) who refers to a 'pedagogy of uncertainty' and 'a state of liminality' (2014), Barnett (2012) who coined the term 'pedagogy for super-complexity', English (2013) who speaks of the 'need for discontinuity in learning' and Buckingham (2014) who suggests the 'need for an optimally productive measure of epistemological chaos'.

Education for Sustainability (EfS) offers interesting possibilities as 'a playground of uncertainty'. It "seeks to enable citizens around the globe to deal with the complexities, controversies and inequities rising out of issues relevant to environment, natural heritage, culture, society and economy" (Wals, 2012; p.10). The topics explored in EfS tend to involve many complex and uncertain earth system processes, as well as multiple actors with diverging interests, values and perspectives (Wals, 2003; Rebich and Gautier, 2005; Hall, 2010). In addition, learners are often unable to comprehend the significance of their own actions and the degree to which changing their behaviour will have any substantial effect on these complex issues (Higgins, 2010). Examples of suitable topics include: the effects of climate change, the loss of biodiversity, the risks of using nuclear power and the potential dangers of fracking. Even though several EfS researchers have mentioned the confrontation with uncertainty and pluralism within the context of EfS (e.g. Higgins, 2009; Sterling, 2010; Wals, 2010), there has been very little empirical research to date that aims to further explicate the concept of teaching students how to handle this uncertainty in EfS. Hall (2006; 2010) comes closest with his analysis of climate change education at academic institutions. He uses Perkins' (1999) theories of troublesome knowledge and Meyer and Land's (2003) theories of threshold concepts to discuss the implications of uncertainty for teaching and learning. He posits a pedagogy for teaching uncertainty whereby the concept of uncertainty is taught explicitly through student-centred approaches.

The following paragraph discusses some of the general design principles found in the education literature regarding teaching learners how to handle uncertainty.

General design principles for a pedagogy for uncertain times

Various authors have listed and described design principles for an educational approach that acknowledges uncertainty as an essential driving force in teaching, that creates a space for perplexity and uncertainty, one where students can explore new possibilities for thought and action with the goal of fostering citizens able to

cope in an uncertain world (Floden and Buchmann, 1993; Gordon, 2006; English, 2013). This 'space' is referred to as the 'twilight zone of inquiry' by Dewey (1916) and the 'in-between realm of experience and learning' by English (2013). English describes experiencing doubt as a break between the past and the present, where one's previously held knowledge and experience no longer suffice to deal with the present situation. She refers to this interruption as a 'discontinuity in experience'. This discontinuity can create a 'prereflective beginning' to learning. When learners view the interruption as an issue to be addressed they can then choose to transform it into a 'reflective experience' stimulating reconsideration of previously held beliefs, knowledge and actions.

The design principles found in the literature can be divided into three main groups (see Table 2):

1. Prerequisite for uncertainty in the learning process
2. Allowing uncertainty into the learning process
3. Making uncertainty negotiable in the learning process.

- **Prerequisite for uncertainty in the learning process**

In focussing on uncertainty in the learning process teachers are confronted with a conundrum: the seemingly unsolvable antithesis of a safe learning environment versus an uncertain learning environment. A learning environment in this context refers to the totality of the physical (or virtual) setting, in which a learner finds him- or herself trying to make sense out of things. Learners working together are both affected by and receive support from their co-learners. They are influenced by, and under the active facilitation of a teacher as well as being guided by institutions such as cultural routines. All this takes place in the pursuit of individual or group learning goals within an organized and co-designed learning process (Tauritz, 2012b). A safe learning environment is one in which the individual learners can discuss different perspectives, is tolerant to students holding different views and opinions, and where judgment both by teachers and students regarding these clashing views is suspended. In such an environment, students can experience a sufficient degree of safety to learn and change their ideas and perspectives. In the presence of uncertainty, learners need to feel safe enough to take part fully and permit themselves to share their perspectives, enter into conflicts, display vulnerability and develop uncertainty competences (Forrest et al., 2012). The teacher's presence, guidance and reflection on the teaching process are critical. There is another prerequisite for developing uncertainty competences and that is the openness and willingness of the teacher as well as the learner to overtly accept the concept of uncertainty (Hall, 2014).

1. Prerequisite for uncertainty in the learning process
Safe learning environment
Teacher's and learner's openness and willingness to accept the concept of uncertainty

2. Allowing uncertainty into the learning process
Process-oriented /open-ended/student-centred teaching approach
Dynamic and emergent curriculum
Inter-disciplinary/holistic topics
Problem based education approach
Scaffolding change within the context of uncertainty
Teachers and students willing contextually to reverse roles
Increased student responsibility for the learning/teaching process
Expose students to conflicting frames of reference
Teamwork in small groups
Stimulating students to clarify, elaborate, extrapolate and explain their ideas
Active student participation

3. Making uncertainty negotiable in the learning process
Recognise uncertainty explicitly
Identify and capture the variation among students' personal conceptions of uncertainty
Teachers use conditional instruction
Model to students that uncertainty needs to be embraced
Communicate how to effectively deal with uncertainty

Table 2: Design principles for 'a pedagogy for uncertain times'

- **Allowing uncertainty into the learning process**

There are various design principles that allow uncertainty to enter the learning environment. A teaching approach that is not focussed on narrow learning outcomes (content-orientated), but rather emphasises the learning process of the students, creates space for uncertainty on the part of the teacher as well as the learner (Bolhuis, 2003). A dynamic and emergent curriculum is one in which the teacher responds to input from the learner as it emerges during the evolving teaching process (Morrison, 2008). As teachers don't always know how leaners will respond, they

have to deal with a substantive amount of uncertainty themselves (Shulman, 2005). Raab (2004) discusses the virtue of the teacher resisting giving all the answers and instead becoming 'an expert in not knowing' and trusting that more valuable insights and conceptualisations will emerge from the group of learners. The teacher will have to combat his or her own feelings of anxiety about the open-endedness of the teaching process.

Problem-based learning can further stimulate the development of coping with uncertainty (Koh et al., 2008). Effective facilitators can help learners realise that by holding on to current ideas, models and theories, they are in effect avoiding uncertainty and change (Nel et al., 2008).

Teaching how to deal with complex problems requires an inter-disciplinary and holistic education process (Morrison, 2008; Hall, 2014). An inter-disciplinary approach implies looking at separate subjects and subsequently uniting them; integrating knowledge is necessary to provide answers to complex problems. A holistic approach refers to the experience of the topic in its totality. This shift in thinking encourages incorporating many sources of knowledge including creativity and intuition.

Maintaining a 'healthy' and ethical level of uncertainty in the educational process requires the introduction of scaffolding, in other words gradual changes in the level of uncertainty creating conditions for the learner's uncertainty competences and experience to develop (Morrison, 2008; Forrest et al., 2012). As the roles of teachers and learners alternate, teachers become learners and learners become teachers. The responsibility of the learners in the educational process increases, confronting them with opportunities to enhance their uncertainty competences. However, teachers must never abdicate their responsibility in facilitating the learning process of the students (Raab, 2004; Shulman, 2005).

It is important for learners to be exposed to conflicting frames of references (Kreber, 2009) and the realisation that for most complex problems there is no one right answer. Through working in small groups learners are further confronted with differing ideas and perspectives. Learners should be stimulated to clarify, doubt, evaluate, extrapolate, explain their ideas and re-examine their beliefs in order to gain genuine knowledge (Shulman, 2005; Gordon, 2006). Through a process of active participation and communication learners are not only made accountable to their teacher, but also to their peers.

- **Making uncertainty negotiable in the learning process**

In general the concept of uncertainty is not made explicit in teaching multi-disciplinary topics, such as the effects of climate change. Hall (2010; 2014) suggests that this comes about either because the concept of uncertainty is complex and difficult to teach and is therefore avoided, or simply because it is seen as intrinsic to the discussion of multi-disciplinary topics. For a sound understanding of the concept of uncertainty, however, it is essential to make it clearly visible in the educational context (Forrest et al., 2012; Hall, 2010).

Hall (2010) asserts the importance of identifying the students' personal concept of uncertainty by encouraging them to reflect on their own conceptions and to discuss these explicitly with their peers. It may be necessary to revisit the concept of uncertainty frequently during the teaching process in order for students to become comfortable with it.

Further, teachers should employ conditional instruction, in other words what is generally regarded as a fact is presented as a probability statement, rather than an absolute truth (Langer, 1989). Information presented in this way leads to an enhanced willingness to remain open to alternative interpretations, and when on a later date the circumstances change, to be able to question the information, and use it creatively and mindfully. Some argue that learners become insecure when confronted with an uncertain world that does not follow strict 'Newtonian rules'. One could also argue that children who are used to being taught conditionally actually feel more secure as they are better prepared for an uncertain and ambiguous world. When a confident teacher employs conditional language it implies that uncertainty is an attribute of the information and not an attribute of the teacher (ibid). It sends the message that a person can remain confident when faced with knowledge uncertainty.

To be able to use uncertainty as an instigator of learning it is important to learn to cherish uncertainty. Gordon (2006) talks about embracing uncertainty, confusion and doubt as it may result in a deeper understanding of oneself and the world we are part of. Buckingham (2014) coined the term 'epistemological chaos' referring to an educational context in which knowing and not-knowing, and certainty and uncertainty swirl around each other chaotically. He asserts that teaching shouldn't be about eliminating this chaos, but should instead focus on communicating how to handle uncertainty and use it effectively. How to accomplish handling uncertainty effectively needs far more attention from researchers.

Barnett's framework for transformational education

In this final paragraph the need for developing different uncertainty competences will be reflected upon using Barnett's framework for transformational education (2012). Barnett constructed a two-axes framework that distinguishes between four different educational approaches and the potential educational 'outcomes' they produce. The horizontal axis represents a design that ranges from 'no risk' (negligible amount of uncertainty) to 'high risk' (ample amount of uncertainty). The vertical axis ranges from education that emphases educational development to transformational education.

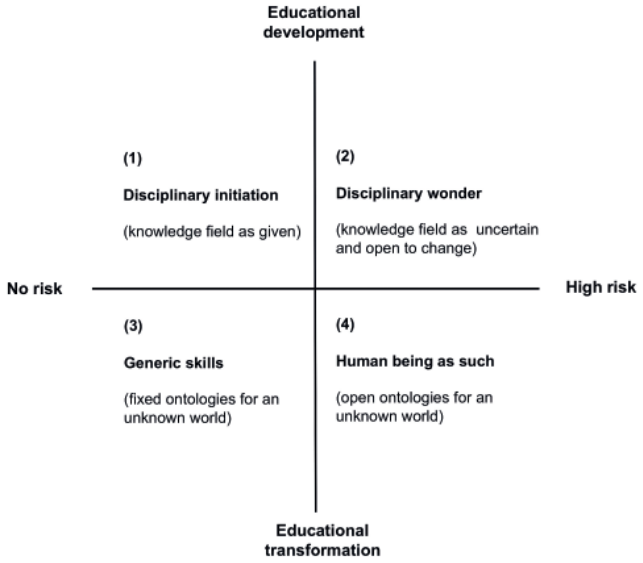

Figure 1: Barnett's framework for transformation education (2012)

Quadrant 1 is characterised by pre-existing aims and objectives. Uncertainties are kept to a minimum. Students develop understanding and specific skills. **Quadrant 2** is characterised by uncertainty and imaginative curricula designed to prepare students for a complex world. **Quadrant 3** focuses on the development of specified (generic) skills and transforming students into people who are more adequately equipped for an uncertain world. However, these learning environments are relatively risk-free, and therefore limited in their capacity to teach learners how to handle high-risk situations full of uncertainty. **Quadrant 4** represents education that is both high-risk and transformational in order to prepare learners for an unknown world, what Barnett refers to as 'transformation of human being'. Central to this quadrant is living and working in a supercomplex world. People are confronted with multiple descriptions of the world and a confrontation with previously unknown dilemmas and uncertainties. Current knowledge and skills are not adequate for handling these situations and therefore require humans that have, for example, the ability and willingness to continuously learn, show empathy, engagement, and can handle and perhaps even celebrate uncertainty.

Barnett emphasises the importance of education that is appropriate to Quadrant 4, as it is his belief that predetermined learning outcomes are not sufficient for dealing with 'the unknown'. However, it seems irresponsible to frame the development of specific skills and competences as being inferior to the development of dispositions and qualities as discussed by Barnett. Education should ensure the development of the broad spectrum of uncertainty competences discussed in this chapter. Nonetheless, Barnett's framework is useful as a reflective tool.

Referring to Table 1 we can see how particular uncertainty competences can be placed in Barnett's quadrants. For example, 'Being able to judge the credibility and cognitive authority of information sources' fits into Quadrant 1. 'Being able to respond in accordance with the underlying probabilities' fits into Quadrant 2. 'Being able to reason' fits into Quadrant 3. Finally, there are uncertainty competences that are not typically emphasised by educators, but which are critical for handling uncertain knowledge and fit clearly into Barnett's essential Quadrant 4: 'Being able to accept not knowing what will happen', 'Being able to use uncertainty as a catalyst for creative action' and 'Being able to use one's intuition as a source of information'. Barnett's framework emphasises the different kinds of learning environments required during an educational career to develop all the 'uncertainty competences' that will assist people in navigating our uncertain and (super)complex world.

CONCLUSION

If we want to be able to provide our children and young people with an education that prepares them for a successful life in the 21st Century, we will need a radical change to the way we engage them pedagogically. Scotland is one of the countries that is, on a political level, starting to acknowledge the significance of this notion. However, the changes needed to our education system are immense and we have barely made a beginning. Research into the teaching of uncertainty competences is still in its infancy. We know very little about the ways in which teachers can improve their students' competences for handling uncertainty and (super)com-

plexity. This is even more so with regard to learners in primary and secondary education. Furthermore, guidance from what we do know is often not implemented. Some key issues that should be addressed by researchers in cooperation with the educational sector are: How should teachers communicate about uncertainty in a developmentally appropriate manner? What do concrete, age-appropriate and effective teaching methods for teaching specific uncertainty competences look like? Do outdoor education and education for sustainability offer specific opportunities for the development of uncertainty competences in relation to environmental challenges? And what are useful instruments to assess the development of uncertainty competences?

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School community collaboration in remote communities: challenges for future teacher education

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ABSTRACT
Schools are essential for the revitalisation of the remote communities since they can build capacity for local sustainable development. If remote schools are to play this strategic role in community development, they need to reconsider their relations to the community and create learning opportunities that contribute to increasing community engagement in finding sustainable solutions. However, teachers seem to be ill prepared for living and teaching in remote communities and for addressing the distinctive educational needs of these settings. Teacher education institutions should introduce innovative approaches that encourage teachers to engage local human and natural resources in their teaching and provide an appropriate pedagogical context to develop school-community collaboration with mutual benefits. Place-based and place-conscious pedagogies provide such an approach. This chapter explores both theoretical and practical aspects of these concepts in the international literature and reflects on relevant practices of the Pedagogical Department of Primary Education at the University of the Aegean in Greece. Several suggestions are provided with regard to teacher education focusing on the curriculum, practicum, networking and the role of ICT.

KEYWORDS
place-based pedagogies, pre-service teacher training, remote communities, sustainable development

INTRODUCTION
All over the world remote communities are beset with serious problems. Demographic and socio-economic issues such as declining population, failing traditional industries, decreasing incomes and services as well as increasing local unemployment, challenge their sustainability. To address these problems there is a need to undertake common projects where young people, professionals and local authorities share their ideas and know-how to plan and implement sustainable development initiatives.

Many researchers argue that remote schools are essential for the sustainability of local communities, since they can build capacity in these communities, both at a systematic level including economic development, and at the level of personal empowerment (Kilpatrick et al, 2002; White and Reid, 2008; Kinash and Hoffman, 2009; Wildy and Clarke, 2010). Unlike urban schools, a rural or remote school is more "visible" to inhabitants as well as the "backbone" for local life. According to Eppley (2015), in rural areas school-community boundaries function less clearly or differently than in other settings. The school is not only an important part of the community but a social center constitutive of the community. Because such a school is often the only major organization or government service remaining in remote areas, its role in the community needs to be reconsidered. In addition to meeting the educational needs of its students, it should also contribute to a local community development in a more direct way. Remote schools should become "the focal point of external economic and social influences, as well as political requirements for change and renewal" (White and Reid, 2008, p.2). However if remote schools are to play a strategic role in community development, they need to reconsider their relations to the community and build strong linkages for mutual support. They have to restructure elements of schooling to provide educational experiences which serve both educational needs and community sustainable development goals.

This new role for schools in remote areas requires the development of meaningful partnerships and joint projects. Different stakeholders and sectors need to be involved to create collective learning activities that respond to community needs. School and community resources need to be mobilized and teamwork and network building become an essential part of school and community culture. In this way remote schools can act as a catalyst for the development of local communities as learning communities which explicitly use learning for promoting sustainability (Kilpatrick et al, 2003).

Although the importance of school community collaboration has been stressed since the 1990's (Miller, 1993; 1995), developing such collaboration in remote areas isn't yet common practice. On the contrary, it seems that collaboration is still a

challenge. The conclusions of a themed issue on rural schools published by the International Journal of Educational Research in 2009, generally suggest that approaches to teaching and learning that include local stakeholders are needed. Tompkins (2008) goes even further and mentions a longstanding mistrust between rural communities and their schools. The reasons for this mistrust are that "schools are perceived by community activists as engines of talent removal or of cultural destruction (e.g., in Native places), and 'community' is viewed by school officials as something to liberate children from" (Tompkins, 2008, p. 180). Between the factors that have been identified in the literature to explain this lack of collaboration are the failure to recognize that a serious problem exists in a community, the ongoing professionalisation and centralisation of schools, the rapid turnover of teachers in remote schools, the reluctance of educators to promote schools as a resource for community development efforts, limited time and resources, the fact that this practice isn't included in the traditional approach of schooling and institutional inertia etc (Miller, 1993; Liarakou et al., 2014).

ARE TEACHERS WELL PREPARED FOR LIVING AND TEACHING IN REMOTE AREAS?

Most of the factors mentioned earlier emphasize that although teachers play a critical role in promoting school-community collaboration they are not well-prepared to address the distinctive educational needs of remote communities. The lack of focus on the specificity of remote schools in teacher preparation has been stressed by many researchers (e.g. Down and Wooltorton, 2004; White and Reid, 2008; Kline et al., 2013). Difficulties are associated not only with professional but also with personal, social and cultural factors. With regard to instructional and logistical issues, deficiencies and concerns about various topics have been reported in the literature, such as specific rural teaching strategies, organization and administration of small schools, multi-grade and multi-age techniques, curriculum planning, access to resources, lack of access to experienced teachers, language, administrative work and extra duties teachers have to carry out (Gibson, 1994; Sharplin, 2002; Kizilaslan 2012). A critical point arising from the findings of the relevant studies is the deficiency of connectedness between teachers and the community. Teachers can hardly become familiar with the way of life in remote settings. According to Gibson (1994) who explored perceptions of newly appointed teachers to rural Queensland schools, pre-service preparation and in-service or induction programs fail to raise awareness of existing community problems and expectations, community involvement strategies etc. Recent studies confirm and enrich the list of these challenges. For example, Sharplin (2002), studying the expectations and concerns held by Australian pre-service teachers about rural and remote teaching, listed among the most critical

ones several social-personal issues, e.g. lack of familiarity with students' cultural background, uncertainty about the experience of socialization into the community, dislocation from family and friends, developing new support networks, isolation, loss of anonymity in small community. Even in different rural settings, such as in Turkey, similar difficulties have also been reported (Kizilaslan, 2012): concerns about parents' attitudes and indifference of the rural community to education, teachers' lack of experience about life in rural areas etc. Without being able to immerse into the place, teachers usually feel they are foreigners, temporary visitors of these communities and are not interested in developing any school community collaboration. Several questions arise about the way teacher education curricula currently prepare teachers for the realities of remote communities. The dominant educational policies focus on standards and testing which result in a classroom-based pedagogy. Furthermore a centralised state educational system that leads to a standardized curriculum for all schools, regardless of their specific characteristics and locations, such as the differences between urban and rural schools. As Gruenewald (2003) notes, current educational discourse aims at standardizing the experience of students from different geographical and cultural places so that they can compete in the global economy.

These tendencies are reflected in pre-service as well as in-service teacher education. Even in countries with many remote areas teacher education curricula rarely include remote educational needs and aren't effective in building pre-service teachers' ability to recognize the differences across social, cultural and geographical domains. White and Reid (2008) characterize this dominant teacher education approach as 'metro-centric'. This view results in teachers who are ill equipped to deal with the challenges of teaching and living in remote communities. The turnover increases and so does the distance between school and community.

PLACE CONSCIOUSNESS: A NEW CHALLENGE FOR FUTURE TEACHER'S EDUCATION

Existing literature acknowledges the need for specialized preparation for pre-service teachers that includes both social and professional aspects of teaching and living in rural contexts (Boylan, 2003; Hudson and Hudson, 2008; Beutel et al., 2011; Eppley, 2015). Teacher education institutions should equip students with the skills and knowledge that would enable them to develop actions towards sustainable development that involve the whole community. This requires an emphasis on both pedagogy and sustainable development. Place-based and place-conscious pedagogies could provide the framework for this innovative approach (Gruenewald, 2003; White and Reid, 2008; Comber et al, 2007; Gruenewald and Smith, 2008).

Place pedagogies highlight the importance of a situated context and emphasize the local and the known. They help teachers develop learning opportunities that are both meaningful and relevant to students because they are connected to their own communities. It is important to note that place-based pedagogy is not limited to outdoor activities. It aims to evaluate the appropriateness of our relationships to a specific socio-ecological place and this is what makes it so vital for community's sustainable development. As Gruenewald (2003, p. 7) notes "a critical pedagogy of place encourages teachers and students to re-inhabit their places, that is to pursue the kind of social action that improves the social and ecological life of places, near and far, now and in the future". Place-based and place-conscious pedagogies encourage teachers to engage local human and natural resources in their teaching and provide an appropriate pedagogical context to develop school-community collaboration with mutual benefits.

Such an approach needs considerable changes to the traditional teacher education curriculum. Pre-service training should include subjects and activities that help teachers to link their teaching and learning practices with the social and ecological dimensions of 'place' and particularly of remote communities. Initiating student-teachers into multi-grade classrooms and multi-age settings, including adults, would be an important dimension of the teacher education curriculum. Furthermore the teaching focus should move from the classroom-based to a new perspective that places the teacher in the broader community. This means helping teachers to understand the links between the classroom, the school and the community and develop community-oriented teaching and learning. As Halsey (2005) notes, pre-service teachers need the opportunity to contemplate how to participate and respond in terms of pedagogy and as a member of a community. Managing curriculum integration as well as developing teaching approaches and learning opportunities with content relevant to the local needs and interests are fundamental competences for a teacher intending to develop meaningful partnerships between school and community. These educational competences are coupled with research and negotiation skills. The dynamic model of ESD competences, proposed by the ENSI as a result of the CSCT project (Curriculum, Sustainable development, Competences, Teacher training), provides a basis for an innovative curriculum of teacher education for rural and remote settings. The competences proposed cover three levels of teacher's role; as a guide of learning processes, as a member of the school and the educational community, as a member of the society. This model acknowledges the context dependency of competences given that action takes place in specific and various social and socio-cultural fields (Sleurs, 2008, p. 40).

Recently, a similar model of competences has also been developed by the UNECE (2012). It should be stressed that these kinds of competences are valuable not only for remote schools but also for urban ones. The difference is that in remote settings such competences are crucial for the revitalization and in some cases even for the survival of both remote schools and communities.

INITIATIVES TO BETTER PREPARE FUTURE TEACHERS FOR REMOTE SETTINGS

Roberts (2004, p.36) suggests four ways through which initial teacher education institutions can better prepare graduates, both professionally and personally, to teach in rural and remote areas: (a) specific courses relating to working (and living) in rural and remote settings, (b) providing and supporting practicums and internships in rural and remote settings, (c) recruiting trainee teachers from rural and remote settings, and (d) bonded teacher training scholarships. With regard to specific courses, studies from different countries conclude that there is not a "one best" model of teacher education, a generic one-size-fits-all program for every location (Eppley, 2015; Green and Reid, 2004). This is due to the variability of schools and communities characterized as rural and remote. Each one has distinctive geographic, sociocultural and socioeconomic characteristics that largely differ from those of urban and suburban schools and communities (Eppley, 2015). Such variability offers a reasonable explanation of why literature doesn't provide specific and exemplary curriculum cases from teacher education institutions on remote settings.

On the contrary there are several practicum projects supplementing the preparation of pre-service teachers for rural and remote settings. According to Halsey (2005) practicum placements in remote areas for pre-service teachers offer numerous advantages for students, schools and communities. Practicum provides students with a first-hand experience of the teaching and social conditions that an appointed teacher faces as well as a smooth transition between university and work in a remote school. Halsey (2005) has also emphasized the critical role that partnerships between universities, rural schools and community should play. Indeed, several interesting examples have been reported which are usually organized by teacher education institutions in collaboration with teachers' authorities and the local communities, e.g.: 'Remote Rural Practicum' in Alaska (Munsch and Boylan, 2008; Jones, 2011), the 'Student Teacher Rural Experience Program' (STREP – today RTPP - Rural Teaching Practicum Program) in West Australia (Lock, 2008), 'Beyond the Line', an award winning program providing pre-service teachers of various universities with first-hand experience in teaching and living in a rural community of NSW, Australia (Gregson et al., 2006; Beutel et al., 2011), the 'Over the Hill' in Queensland, Australia

(Hudson and Hudson, 2008; Hudson and Millwater, 2009; Beutel et al., 2011).
All these university-based initiatives try to foster positive feelings about remote communities especially for city-based future-teachers. White and Reid (2008, p. 6-8) however wonder whether such practicum programs can help student teachers to understand the links between the classroom, the school and the wider rural community since "they don't prepare them to participate and respond in terms of pedagogy and as a member of a rural community". They argue that, by working with the notions of place-based and place-conscious pedagogies, a practicum should focus on developing a positive feeling about country life, with both its challenges and its possibilities for a lifelong teaching career. Such rural and remote experience programs help students to understand a particular rural place, in a way that allows them to feel more at home and confident. In this regard they present a practicum program, the 'Apple' experience, developed in 2005 and 2006 for future teachers at Deakin University in Australia, through which students developed a sense of place-consciousness. During this project three key issues i.e. funds of knowledge, multiple learning spaces and knowledge production teams were used to support students to relate to a remote community in a sustaining manner. Student teachers worked as co-researchers to document the funds of knowledge, i.e. knowledge and social practices of children's everyday lives in the small remote community. Student teachers and children became buddies by exchanging letters. Children talked about their families, interests etc. So during their two-days field trip in the village to meet their buddies, student teachers were already familiar with pupils' lifeworlds. The multiple learning space approach was also used in this program. Student teachers engaged with various learning spaces, such as university lectures, workshops, school classrooms, farms, rural community, on-line forum, e-mail communications with the school students, school's website to learn about school's life and infrastructure etc. Thus, during their field trip they had the opportunity to experience what they had already known virtually. Finally this program involved the student teachers working in knowledge producing teams. All participants (student teachers, children, teachers, teacher educators) worked collaboratively in small groups to develop multi-age resources on a theme of mutual interesting, i.e. the environment. These resources were used in multi-age groups during the field trip.

THE UNIVERSITY OF THE AEGEAN AS A CASE STUDY

The University of the Aegean is a quite new, public and a medium sized Greek University. Its schools and departments are located on six relatively big islands (area: 80 – 1,600 km^2, population: 21,000 - 115,000 inhabitants) of the Aegean Sea. The School of Humanities including the Departments of Pre-school and Primary Education is located in the town of Rhodes, the capital of the island of Rhodes and the Dodecanese, one of the seven groups of islands of the Aegean Sea. The Dodecanese comprises about 160 islands, of which 26 are inhabited. The populations of these islands vary from one family to 115,000 inhabitants. There are about 220 kindergarten and primary schools and 102 secondary schools (High School and Lyceum) distributed on 17 and 15 islands respectively. It should be noted however that the strong majority of these schools (about 90%) are located on six main islands (Rhodes, Kos, Kalymnos, Karpathos, Leros and Patmos). Some schools have extremely small numbers of students and teachers. For example, the secondary school of Olympos on the island of Karpathos has only 15 students. Several schools also experience high teacher turnover.

About 250 undergraduate and 25 postgraduate students register every year at the Pedagogical Department of Primary Education (PDPE). Students come from different regions of Greece such as metropolitan, urban, rural, insular, mountainous, lowland, sparsely and not sparsely populated, bearing various specific cultural characteristics and traditions. It is interesting to note that one fifth of PDPE students come from the Dodecanese islands. Despite its special geographic circumstances and the close proximity to small and isolated islands, the Department doesn't offer any specialization on teaching and learning in remote communities. However some dimensions of the place-based pedagogy that could produce a sense of remote place-consciousness among student teachers have been integrated in several courses such as environmental, cultural and art studies.

Within environmental studies students are asked to investigate local environmental topics and issues, such as endemic and endangered species, water and waste management systems, energy sources and use and so on. Besides the literature review of the topic students often participate in field studies to collect data, come in contact with local authorities and other professionals involved with the topic to analyse processes and policy priorities, interview local people to reveal their attitudes. Through this process students explore the various socio-political and economic mechanisms that affect the natural environment in the islands. They are encouraged to adopt a critical approach that is to recognize disruption, detect its causes and propose ways to address them. Through this inquiry many students coming from remote communities of the region increase their awareness of their own place and evaluate the appropriateness of local people's relationships to its socio-ecological dimensions. For instance, students coming from the island of Milos investigated the unsuccessful efforts in 80's to exploit the geothermal sources of

the island. They found out that local people are still very negative towards geothermal energy and concluded that such attitudes should change by considering the successful use of this renewable energy source in other areas of the world. Other students, and especially those coming from urban settings, come to know a remote community and familiarize themselves with the ecological and social dimensions of this setting. Through such an approach students acknowledge the pedagogical value of becoming involved in local contexts, collaborating with local people and developing a place consciousness.

Students are also involved in developing learning activities based on local environmental issues. They learn to use role playing, ethical dilemmas and other techniques for negotiating local socio-ecological topics. The data, information and material needed to organise these techniques stem from the environmental inquiries mentioned earlier. Furthermore they are initiated into teaching and learning approaches that could help them to build learning opportunities involving the whole community. For instance students learn how to make parish/community maps, a bottom-up initiative encouraging students and local people to map elements (natural or cultural) of the place valued by the community. They also become familiar with the forum theater, a technique that could help people to imagine common responses to community problems. Such approaches could enable future teachers to work with multi-age groups and develop school-community partnerships so that local issues can be addressed and future sustainability plans can be planned in common.

In cultural and art studies students are introduced in the cultural heritage of the region. Using an inquiry-based learning as teaching methodology, students discover the local cultural architecture, realize the value of the conservation of traditional settlements, discover local dialects and register local customs and fairytales. For instance they get familiar with life story interviewing, a qualitative research method for gathering information on the social tacit knowledge in rural and remote settings. Future students gather life stories from elderly persons to highlight various local topics, such as folklore, social practices, local history etc. They also get involved in interdisciplinary projects offering learning opportunities about the community life in rural and remote settings. For example a project named “Scarecrows in the land of Asclepius” was implemented some years ago within the frame of the ‘Art education - sustainability’ course. Asclepio is a picturesque village in the southern part of the island of Rhodes where the various cultural stratigraphy of the island is vigorously alive. Students, primary education pupils, teachers, professors, representatives from the local authorities and people from several communities participated in this project. Through the lens of this interdisciplinary, experiential, collaborative project, they approached the land of Asclepius in order to learn about its historical and the cultural background and its current financial profile, to locate its problems, advantages and disadvantages and to intervene artistically through a holistic aesthetic proposal (happenings, exhibitions, festival).

Students of PDPE are also introduced in distance learning. Distance learning plays a critical role in remote schools. E-learning can be an important tool to support the learning procedure, to upgrade educational quality, and hence to meet educational as well as social targets. In particular students become familiar with e-learning platforms and tools which can be used in the future to develop learning opportunities both for pupils and people from local communities even the most remote ones. Such tools can also support the communication and collaboration of remote schools and communities. PDPE was partner of ‘NEtwork Multigrade Education’ (NEMED) project, a Comenius network of remote schools from ten European countries, aiming at improving multi-grade teaching and learning. [2] NEMED constitutes a virtual community of practice for rural and remote school teachers. Although the project lasted formally until 2007 and continued its activities through the project ‘Rural Wings’ (European Commission, VI Framework Programme) until 2009, it informally continued to bridging teachers during the next years. Within NEMED, an educational platform called Virtual Rural School was created, including training activities and spaces (forums, chats etc.) for exchanging opinions and ideas among students (multigrade teachers), teachers and tutors. The Virtual Rural School helped teachers to design a collaborative telematic project for subsequent creation and application among the schools. According to Barajas et al (2007) this project allowed teachers from different remote communities to know each other, communicate as well as to escape the isolation of the rural environment through the establishment of a large virtual community.

Finally research in PDPE attempts to foster innovative strategies for school-community collaboration in remote islands. That is for instance the case of a Ph.D. focusing on traditional art, as a means to construct sustainable development on a remote island through an intergenerational partnership. In this qualitative study, two theoretical frameworks that of critical place based education (Gruenewald,

2 For more information about the NEMED project, see:
http://www.ub.edu/euelearning/nemed/indexeng.htm
For more information about the ‘Rural Wings’ project, see:
http://www.ruralwings-project.net/RW/index.html

2003) with that of cultural ecology (Dillon, 2012) are merged in order to research how an arts-based partnership, a cultural niche of all stakeholders on the remote rural island of Lipsi, may lead to 'locative meaning-making', learning for sustainable development and ultimately sustainable development of both the school and the community.

DISCUSSION

We have already described some approaches and activities through which the PDPE at the University of the Aegean attempts to prepare student teachers with regard to remote communities. These approaches and activities however are mostly developed separately. The dominant disciplinary approach of the Greek University doesn't encourage the development of an integrated and coherent curriculum under which all these elements could converge towards a common purpose. However, in order for a teacher education institution, in Greece and anywhere, to achieve a place-based pedagogy which favours the preparation of future teachers not only to live and teach in remote schools but also to cultivate collaboration with local communities towards sustainable development, the whole program should focus on multidisciplinary, experiential and intergenerational approaches. Student teachers should become curriculum creators and be able to develop teaching and learning activities specific to particular locales. To create such curricula they should understand the distinctive characteristics of local settings and become researchers in documenting the knowledge and social practices of the community. Smith (2002) offers five approaches to place-based learning that can focus educational research into place-based practices: (a) local cultural studies, (b) local nature studies, (c) community issue-investigation and problem-solving, (d) local internships and entrepreneurial opportunities, and (e) induction into community decision making. A critical aspect that these approaches should also encompass is the inclusion of practices that help student teachers to understand the rationale of school-community collaboration and systematically equip them with strategies and tools to initiate and maintain such collaboration.

In this respect teachers education curricula should further integrate the socio-cultural and environmental aspects of local communities. Given that the Universities are located in different regions each one can take advantage of its surroundings to develop curricula focused on the specific characteristics of these regions. In Greece for instance the University of the Aegean can focus on the insular contexts, including the insular remote areas. In terms of research this (re)orientation asks for more relevant approaches such as field studies. In terms of teaching and learning, the courses should prepare the students to use techniques and methods that encourage the exploration of locales as well as to provide them with the appropriate competences to develop collaboration with local people and engage the whole community. Although techniques such as those mentioned earlier (e.g. parish mapping, forum theatre) have already been used in some departments, such as the PDPE, they should further be infused in the whole curriculum.

Teaching should also further invest in exploring collaboration dimensions and fostering collaboration competences. If future teachers are to develop school community collaboration especially in remote settings they need to know, for example, how to communicate with locals, cultivate mutual trust, inspire students and citizens, plan collaboration, coordinate such projects and so on. Considering that all these activities (e.g. creating curricula, developing partnerships) are both innovative and open in terms of goals, planning, duration and results, future teachers should take advantage of research methods that will help them to understand and to improve the actions undertaken. For instance action research provides teachers with the tools needed to reflect on learning activities and improve their own practice. The ENSI-CoDeS project has already developed several resources regarding the theoretical framework, tools, good practices etc. for school-community collaboration for sustainability in various settings, including remote communities. The curricula of teacher education institutions may take advantage of these resources to develop new courses or enrich existing ones in order to equip students with knowledge and competences needed to develop school-community collaboration.

The internship program is certainly another useful tool to prepare students for a place based approach. According to Kline et al. (2013) the professional remote-based experience is a critical component for gaining confidence to work in these settings. However incentive schemes that encourage future teachers to work in rural areas are largely unknown or underutilized by the Universities (White and Reid, 2008). The experience of the particular case already analysed above (i.e. the PDPE) confirms this argument. So far the internship program of the PDPE takes place in the urban context of the town of Rhodes. Economic and practical reasons such as the cost of transfer to distant schools and the accommodation as well as the lack of a relevant policy have limited the collaboration with schools being in and around the town of Rhodes. Hence the students don't have the opportunity to become aware of different school contexts such as those in remote schools either of the island of Rhodes or the neighboring small islands. In order for these students to become familiar with their future work context, the internship program should be extended beyond

the urban zone. It should also take advantage of the opportunities and challenges stemming from remote communities. The student teachers and especially those coming from these islands and are willing to do their internship in this context should be encouraged to do so. In this respect the University should formulate a new internship policy focused on this kind of communities.

However in what ways the University could overcome the economic/practical barriers? Possible solutions may be linked with collaboration with local authorities and local people. By developing such collaboration, the students can ensure lodging by local families and possible financing from local municipalities. Local cooperatives, enterprises and associations might also contribute to such collaboration in different ways. For example a women's cooperative or a local hotel can provide students with room and board, and local cultural / environmental associations can help them to value local assets. In this way students' integration in the local community can be easier, while in parallel place consciousness can be cultivated. In addition, such a policy must include mentoring, that is inspiring, preparing and supporting teachers appointed in such communities to become mentors of student teachers. The experience reported in literature regarding practicum in remote areas and especially practicum using a place-based approach (White and Reid, 2008) can inspire practicum planners. Moreover, the 'Renewing Rural and Regional Teacher Education Curriculum' (RRRTEC) project, organized by a group of teacher education faculties in Australia, provides a useful tool to support the implementation of the practicum in rural areas (Kline et al, 2012; White, 2011). RRRTEC is based on a website [3] which includes a collection of resources, such as rural education research publications, case studies, DVDs and photos, advices from teachers about their experiences working in rural locations and stories of pre-service teachers who have been placed in such schools. It also includes potential modules for teacher education courses (such as understanding rurality, getting to know rural students' lives and preparing for rural professional experience). This application constitutes a good practice that could inspire teacher education institutions.

Furthermore, in order to support students and teachers-mentors participating in the internship program as well as the teachers who already work in remote communities networking should be enhanced. Enhanced support networks could lead to the integration of teachers and remote communities and mitigate the impact of geographical isolation. Networking could positively affect different levels. Professional connectivity is very important for teachers, especially the newly qualified ones who need the support of their experienced colleagues to address the challenges of being a teacher in a remote school and developing initiatives towards sustainable development. Mutual teacher support, mentoring but also peer-networking might be effective strategies for empowering teachers to better plan and implement such projects (Kadji-Beltran et al., 2013). Dissemination of best practice is also vital. Educational institutions and universities should play a key role in collecting and disseminating successful examples of teaching and learning in remote schools and developing networking between teachers and schools, not only from the same area but also from other remote communities of the world.

There is a general consensus in relevant literature that ICT could be very beneficial for remote schools (e.g. Davidson et al., 2007; Wildy and Clarke, 2010; Redding and Walberg, 2012). The use of distance learning technology enables small schools in remote locations to expand and supplement their curriculum while ICT facilitates teachers' interaction and networking. However, although young people have access to digital technology in their everyday lives, it seems to be still peripheral to the learning process in the classroom in remote areas (Davidson et al., 2007). Certainly there are several European projects that aim at the design and implementation of ICT based distance learning frameworks (e.g. REVIT, 2011) but there is still much to do in this area. In addition teachers might use ICT for social networking but there are not many professional networks for remote teachers that could support them in their everyday work. Building communities of practices within teachers can mutually interact, exchange ideas and create common projects through Web 2.0 tools could be an effective strategy for empowering teachers in remote schools.

3 For more information about the RRRTEC project, see: www.rrrtec.net.au

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Possibilities and practices of competences for sustainable development in higher education

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ABSTRACT
Within different frameworks of Education for Sustainable Development the focus is often set on competences for sustainable development. Also within higher education, the aim is (or should be) for students to acquire necessary competences in order to cope with future (sustainability) issues. This chapter discusses several possibilities and practices in the field of competences for sustainable development in higher education. First, a general introduction is given in the topic of higher education for sustainable development. Second, an overview of competences is given, including the many possibilities for higher education this specific concept provides. Third, a number of frameworks and models are discussed, specifically highlighting the consequences for the curriculum. Fourth, practices in integrating competences for sustainable development are highlighted, more specifically the connection with research and entrepreneurial competences. The chapter concludes with specific recommendations to guide further initiatives and research in this field.

KEYWORDS
Competences for sustainable development, education for sustainable development, higher education, research competences, sustainability

INTRODUCTION
Society today is characterised by numerous reports of economic problems, political crises, humanitarian disasters and climate change. Furthermore, when it comes to social issues, there is a growing awareness of the gap between those who have (often financial) possibilities and those who have difficulties to meet social demands of society, often based on financial requirements. But the world is changing, and more and more critical voices point toward the flaws in our economic, political, societal systems, and their inability to tackle complex and uncertain issues. These issues are referred to as 'wicked problems' (Wiek et al., 2011), as they go far beyond the systems, structures and capacities of today's society. Other ways to organise,

produce, consume, lead and live in society are needed to address the wicked problems and foster a sustainable society. There are examples of different societal actors starting to do this: companies are trying to shape their social responsibility, social actors are participating in transition arenas, individual consumers are opting for socially and environmentally responsible products. It goes without saying that higher education should also contribute to the transition to a sustainable society; it belongs to its social role (De Cort and Lambrechts, 2014).

Higher education needs to answer to this societal appeal, and it is within this context that the concept Higher Education for Sustainable Development (HESD), or Sustainable Higher Education (SHE) emerges. HESD can be defined as education that prepares students for an active role in society, with the purpose of fostering a transition process towards sustainable societies. In order to do this, higher education needs to provide students with competences that enables them to cope with, and formulate answers to, the complex challenges of the future. In addition, higher education must lead by example and integrate sustainability within its research, societal outreach activities and campus operations (Lambrechts et al., 2009). Within this context, the definition and integration of so called competences for sustainable development, is seen as an important step in the process of realising HESD.

This chapter discusses the issue of integrating competences for sustainable development (SD). The definition of these competences is highlighted in section 2. Section 3 focuses on a number of frameworks and models developed to ensure the integration of competences for SD in the curriculum. Section 4 provides insights into the possibilities of connecting competences for SD with other competence concepts in higher education. Section 5 concludes this chapter with critical reflections and recommendations for further initiatives and research in this field.

DEFINING COMPETENCES FOR SD

Over the past years particular attention has been given to competence-based and competence-oriented education. Different policy frameworks have been developed, such as the European Qualification Framework (EQF), and competences defined, translated and integrated into higher education programs. There is much discussion about the definition of competences, however it seems that a general consensus has been reached about the main characteristic of competence-oriented education, i.e. the integration of knowledge, skills, values and attitudes (Rychen and Salganik, 2003). The concept is therefore strongly opposed to classical forms of education, focusing on transfer of knowledge and hierarchical teacher-student relations.

Competences for SD were defined, starting from the idea that the complexity of current and future societal problems cannot be addressed using classical education models, which focus on mere knowledge transfer (Wiek et al., 2011). Many authors have definined and selected competences for SD, in which knowledge, skills, values and attitudes are presented. De Haan (2006), Rieckmann (2012) and Roorda (2010) defined lists of rather general key competences for SD, applicable for all disciplines and study programs. De Haan (2006) developed a 'Gestaltungskompetenz'-based model for education for sustainable development (ESD), comprising competences in foresighted thinking; interdisciplinary work; cosmopolitan perception, transcultural understanding and cooperation; learning participatory skills; planning and implementation skills; empathy, compassion and solidarity; self-motivation and motivating others; and in distance reflection on individual and cultural models. Roorda (2010) defined several competences for SD in six clusters: Responsibility; Emotional intelligence; Systems thinking; Future thinking; Personal involvement and Action skills. Rieckmann (2012), in a comprehensive Delphi-method participatory process, developed a list of key competences for SD. Table 1 provides an overview of the competences for SD, including a description.

The considerable attention to competence-based higher education and competences for SD has led to a debate on the way competences for SD can, could or should be integrated in higher education, and acquired by students. All models of key competences for SD are defined at a general level, applicable in every higher education study program and for every student. As many authors point out (De Haan, 2006; Rieckmann, 2012; Roorda, 2010; Wiek et al., 2011), there should be a strong emphasis on systems thinking, foresighted thinking and the ability to deal with uncertainties. Roorda (2010) also foresees a disciplinary translation of these general competences. Such a translation is already being made in a number of disciplines, e.g. teacher training (Sleurs, 2008), social work (Peeters, 2012), engineering (Mulder et al., 2012), ecodesign (Verhulst and Van Doorsselaer, 2015, in press) and marketing (De Cort and Lambrechts, 2014).

The way competences for SD are integrated was examined and described in different settings and different study programs (e.g. Cortès et al., 2010; Lambrechts et al., 2010, 2013; Segalàs et al., 2009). Within Leuven University College (KHLeuven), all study programs have been analysed in order to discover the way competences for SD have been integrated. The competence schemes of all study programs have been analysed in depth, using a framework of competences for SD, as developed and described by Roorda (2010). The results of the analysis show that some competences

Competence	*Description*
Systemic thinking and handling of complexity	*ability to identify and understand connections; think connectively; be able to deal with uncertainty*
Anticipatory thinking	*develop visions, apply precautionary principle, and predict flows of (re-)action; be able to deal with risks and changes*
Critical thinking	*ability to look at the world, challenge norms, practices, and opinions; reflect on one's own values and actions; give opinions to others; understand external perspectives.*
Acting fairly and ecologically	*know alternative actions; be able to orientate oneself in regards to justice, solidarity, and conservation values; reflect on possible outcomes of one's actions; take responsibility for one's actions*
Cooperation in (heterogeneous) groups	*ability to deal with conflicts; to learn from others; be able to show understanding/sympathy*
Participation	*ability to identify scopes of creativity and participation; be able to participate in the creation of initiatives*
Empathy and change of perspective	*Ability to identify onesown external perspectives; to deal with onesown and external value orientation; to put oneself in someone else's position; be able to accept diversity*
Interdisciplinary work	*ability to deal with knowledge and methods of different disciplines and be able to work on complex problems in interdisciplinary contexts*
Communication and use of media	*ability to communicate in intercultural contexts; to deal with IT; to be able to pass criticism on media*
Planning and realising innovative projects	*develop ideas and strategies; plan and execute projects; show willingness to learn for innovation; ability to deal with, and reflect on possible risks*
Evaluation	*ability to elaborate evaluation standards and carry out independent evaluations with respect to conflicts of interest and goals, uncertain knowledge, and contradictions*
Ambiguity and frustration tolerance	*conflicts, competing goals and interests, contradictions, and setbacks*

Table 1. Competences for SD (Source: adapted from Rieckmann, 2012; cited in Stough et al., 2013)

for SD are already present within the study programs, mainly competences related to responsibility and emotional intelligence. Other competences, related to system thinking, future thinking, personal commitment and taking action were virtually absent within the competence schemes. Furthermore, the analysis showed that

many competences for SD were integrated in an implicit and fragmented way, thus not covering the combination of knowledge, skills, values and attitudes. This results in a situation in which a holistic approach, essential for SD, is impossible (Lambrechts et al., 2013).

FRAMEWORKS AND MODELS

Methods and techniques to develop and acquire competences for SD have been developed and presented by a number of authors. ESD requires a methodological re-orientation of teaching and learning, as traditional teaching, based on passive knowledge acquisition, is insufficient. In order to succesfully integrate competences for SD, the learning process has to become interdisciplinary, trans-disciplinary, problem based and self-regulated by the learner (Steiner and Posch, 2006). Ensuring such a dynamic learning process enables students to acquire competences for SD, hence become change agents in society (Pittman, 2004).

In order to foster the transition towards ESD, several competence frameworks and implementation models have been developed, oriented on both theoretical and practical aspects of learning. Wiek et al. (2011) define five key competences for SD: systems-thinking competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence. All five need to be interpreted and developed within a framework of 'sustainability research and problem-solving competence', thus ensuring a holistic approach (Wiek et al., 2011). Based on De Haans' (2006) 'Gestaltungskompetenz', Wals (2010) presents a model to foster Gestaltswitching between different mind-sets: the temporal Gestalt, the disciplinary Gestalt, the spatial Gestalt, the cultural Gestalt, and in addition, the trans-human Gestalt. Allowing and enabling students to switch between these different mind-sets is an enabling factor to realise transformative learning (Wals, 2010).

Other frameworks and models are oriented towards practical consequences of the competence concept to the curriculum. Sleurs (2008) presents a model for teacher training in which the competences for SD are connected to the different roles of teachers. The five competence domains defined by Sleurs (2008) are: (1) knowledge; (2) systems thinking; (3) emotions; (4) ethics and values; (5) action. The methodological re-orientation of the learning process is further envisioned in a model presented by Lambrechts et al. (2009, 2010, cited in 2013). This model provides insights to connect competences for SD with curriculum practices, methods and techniques to develop them. Three clusters of methods are included:

- Interactive and participative methods: e.g. Socratic method, Group discussion, Role play, Learning diary, Brainstorm, Peer assessment;
- Action oriented methods: e.g. Learning by doing, Internships, Field work, Solve real community problems;
- Research based methods: e.g. Bibliographic research, Problem analysis, Case studies, Concept mapping, Value clarification.

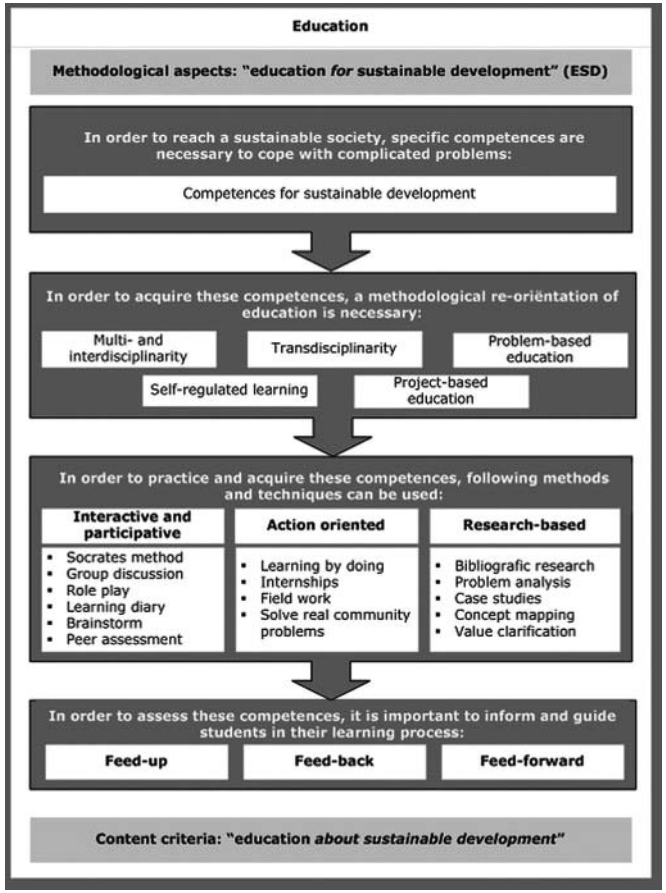

Figure 1. Sustainability integration strategy in higher education (Source: Lambrechts et al., 2009, 2010)

FURTHER POSSIBILITIES TO STRENGHTEN COMPETENCES FOR SD

Different studies have been looking at competences for SD from: (a) a general point of view, leading towards sets of general key competences for SD, to be applied in all higher education study programs; and (b) a narrow perspective, i.e. without connecting these competences for SD with other competence concepts already developed in higher education. This section specifically discusses the possibilities to connect competences for SD with other comptence concepts. While Wiek et al. (2011) state that general basic competences (like communication, research) could provide necessary prerequisites to acquire competences for SD, little research has been done to actually discuss the connection and contribution of these general competences.

Following the 'sustainability research and problem-solving competence' of Wiek et al. (2011), a connection between competences for SD and research competences seems a logical, yet often overlooked possibility. Research competences exist in many forms and definitions, however a general distinction is made between instrumental research competences (oriented toward learning how to do research) and 'attitudinal' research competences (oriented toward acquiring a critical attitude). Instrumental research competences are necessary in order to contribute to handling SD issues, while competences oriented towards attitudes are contributing to acquire values and attitudes inherent in SD (Lambrechts and Van Petegem, 2016, in press).

Competences for SD could be connected to other competence concepts as well. One of the possibilities focused upon recently, is entrepreneurship. While many European frameworks are encouraging the introduction of entrepreneurship into higher education curricula, critical questions remain about the type of entrepreneurship that is the focus. When interpreted from an economic profit-model oriented towards efficiency, it may become contradictory to sustainability competences. Connecting entrepreneurship competences to competences for SD seems to be a logical and even a necessity within the context of ESD, yet (again) the possibility to frame and connect these competences is often overlooked. The work of Lans et al. (2014) offers an inspiring case to do so.

The examples provided in this chapter point to the variety of approaches when it comes to competences for SD. A first approach is the definition and selection of general key competences, e.g. by Rieckmann (2012) and Roorda (2010). Another approach is the development of frameworks and models to enable the integration of these competences into higher education study programs, e.g. by Sleurs (2008), Wiek et al. (2011), Wals (2010) and Lambrechts et al. (2009, 2010). A third approach,

recently added to the domain, is the connection between competences for SD and other competence concepts, which have emerged in higher education such as research competences (Lambrechts and Van Petegem, 2016, in press), and entrepreneurship (Lans et al., 2014). The different approaches provide useful stepping stones and guiding principles, without pretending to be blue-prints or 'one-fit-for-all'-models. After all, as Mochizuki and Fadeeva (2010) point out, individual study programs should dive into the topic, define the competences for SD within their specific context, and decide which way to follow when integrating them.

CONCLUSION AND CRITICAL REFLECTIONS

Opinions are divided regarding competences for SD; whether to integrate 'new' competences, or to reorient existing competences within a framework of sustainability. Firstly, critical questions can be raised about the usefulness of implementing competences for SD, without reorienting the existing education system. Various authors believe that it is impossible to integrate SD within the current structure of our education system (Sterling, 2004). Others point towards the possibilities of the competence concept as a first step towards a more sustainable education (Sleurs, 2008). Integrating competences for SD seems, at least in the context of post constructivist educational policies and practices, a legitimate starting point.

A second critical question arises about the practical integration of competences for SD. Again, several options exist, ranging from interweaving elements of sustainability competences throughout the whole study program ('horizontal integration') to integrating one explicit sustainability competence comprising all elements and linked to one or a group of modules in the program. Of course, it is also possible to combine both strategies (Lambrechts et al., 2009, 2013). As with many concepts, there is no one fixed strategy, and every higher education institution or study program should determine the best strategy in their context. Rather than focusing on lists of general key competences, this strategy should be oriented towards specifiying the specific competences for SD relevant for the study program, and embedding them in the curriculum (Mochizuki and Fadeeva, 2010).

A third group of questions arises regarding the assessment of competences for SD: should we assess them? And, is it possible to assess them? These questions relate to the fact that competences for SD are often connected to attitudes, ethics and values. These so called 'soft-skills', are often interpreted as being difficult, or even impossible, to assess. This is a barrier to integrate them into higher education study programs, as the competence concept in general is often interpreted in an instrumental manner. Yet the integration of competences for SD can only be meaningfull if they are connected to a proper assessment process (Mochizuki and Fadeeva, 2010). The assessment of competences for SD remains a critical aspect in the further integration process (Cebrián and Junyent, 2015).

As a recommendation for further research, several other questions remain. Regarding the connection with research competences, it would be helpful to analyse whether study programs, characterised by a strong integration of research competences, indeed offer advantages when it comes to acquiring competences for SD. Regarding the entrepreneurship competences, clarification on the paradigm to integrate them is needed, especially when it comes to ethical perspectives on the economic system. Furthermore, the perspective of university educators should be analysed in depth, as well as their professional development when it comes to integrating competences for SD in a holistic manner.

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The Role of Higher Education Institutions in Preparing Youth to Manage a Sustainability-Oriented Future Workplace

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ABSTRACT
This paper reports on a critical interpretivist study that investigated the different forms, levels and pathways of engagement with climate change and sustainability of young people living in different contexts of vulnerability and adaptability. The study was conducted in the Netherlands and South Africa, and participants were undergraduate and postgraduate university students from diverse socio-demographic and academic backgrounds in the two countries. The study applied various methods of data collection including focus groups, interviews, policy document reviews as well as participant-observation at several youth and environmental events and forums. Key findings highlight the importance of building resilience and empowering academic and civic platforms that enhance young people's competences to manage sustainability-oriented lifestyles and workplaces.

KEYWORDS
Climate change, Empowerment, Engagement, Sustainability, Youth education

INTRODUCTION
Young people in higher education constitute the key leaders, decision-makers and stakeholders of future society. University and college students therefore need to develop the skills and competencies to live and work in an increasingly globalized world, climate-threatened future, and sustainability-oriented economy (Nyoni, 2009). Yet it can be argued that the prevailing educational system has partly contributed to widening the global climate crisis through unidirectional and individualistic worldviews which promote unsustainable values and practices (Sterling, 2008). Orr (2004) argues that *„the ecological crisis concerns how we think and the institutions that purport to shape and refine the capacity to think"* (p.2). UNESCO's Decade of Education for Sustainable Development (DESD) put forward a new purpose for education to replace the traditional informational approach. The core vision of the DESD was to engage all stakeholders in critical, holistic and fore-sighted education and learning, and to encourage multi-stakeholder and intercultural dialogue and collaboration, promoting a pathway towards positive and sustainable societal change (Tilbury, 2011).

With current transitions towards a green economy and important transformations in job requirements and tasks, the role of education and learning for sustainability in empowering young people is being increasingly emphasized (Stewart, 2010; Wiek et al., 2011). Today's higher education graduates will need to manage these transformations in their future lives and workplaces. According to Barnett (2000), climate change is characterized by super-complexity, necessitating new forms of education and learning that enable young people to influence positive changes. The International Labour Organization (ILO, 2012) and the United Nations Department for Economic and Social Affairs (UNDESA, 2010) have also emphasized the importance of addressing the current skills gap in the workforce and young graduates to enable them to adjust to major shifts in the global market towards sustainability. Young people therefore need to be empowered through knowledge, skills and competences that enable them to contribute to the consultations, decisions and actions shaping their future quality of life and career prospects.

AIMS OF THE STUDY
This study seeks to enhance understanding about the ways in which Higher Education Institutions (HEIs) are mobilizing and empowering young people to manage complex and global environmental and societal challenges. The research was undertaken in the Netherlands and South Africa throughout 2011, coinciding with the International Year of Youth and the 17th Conference of the Parties (COP17) of the United Nations Framework Convention on Climate Change (UNFCCC) held in South Africa. This chapter reports on one particular theme within the study findings pertaining to the educational opportunities and challenges for youth engagement with climate change and sustainability issues. The two main objectives of this chapter are to:

- Identify the educational challenges and opportunities for university students in the Netherlands and South Africa to manage and lead the transition to sustainability in future workplaces.
- Generate recommendations that can inform policy and practice in key priority areas to enhance the education and learning experiences of university students in contributing to sustainability.

SETTING
This research was conducted in the Netherlands and South Africa. The Netherlands is a developed country with a high vulnerability to climate change from sea level rise and associated risks, but has a wealth of human, financial and technical resources for adaptation and mitigation. The climate risks however

require continuous management, innovation and action. Dutch young people will be the frontrunners in dealing with these challenges in their daily lives as well as in working towards solutions in their communities and jobs (van Heeswijk, 2009). In South Africa, university students are facing long-term risks from climate change as well as overlapping social and developmental stresses including widespread poverty, social and economic inequities, complex governance and institutional problems and limited access to capital (Madzwamuse, 2010). Overall, such complexities overburden South Africa's higher education graduates in particular, who will need to drive sustainability whilst managing existing socio-economic and environmental difficulties. Such contextual country differences in terms of climate change vulnerability and adaptability present valuable settings for exploring the diverse forms, opportunities and challenges for youth engagement with climate change and sustainability.

METHODS

The study applies a critical interpretivist research approach. It seeks to understand young people's experiences through their own accounts and interactions in a reflective and dialogic setting. The focus is on the role of local country context (social, educational, political and institutional systems) in influencing youth opportunities and challenges for engagement with climate change and sustainability. The study methods included focus groups with youth, semi-structured interviews with young people and experts, participant-observation at various youth events, and a review of policy documents.

The study participants included Dutch and South African university students, undergraduates and post-graduates between 18 and 30 years old, both male and female. Participation in the focus groups and interviews was voluntary. In South Africa, a total of 10 focus groups were conducted with total of 117 students from more than 12 universities in different regions (including KwazuluNatal, Durban, Johannesburg, Pretoria, Grahamstown, Port Elizabeth, CapeTown). Semi-structured interviews were also held with university students from different academic fields and with key informants or experts including government officers, academic researchers and coordinators in youth or environmental organizations. The author also attended three youth events as a participant-observer: a southern African regional media conference, a national sustainability conference, and a youth leadership forum. These events included youth participants from different regions of South Africa and ranged from university students to young professionals. In the Netherlands, a total of 8 focus groups were conducted with a total of 66 participants from more than 10 universities (including Amsterdam, the Hague, Utrecht, Rotterdam, and Wageningen). Semi-structured interviews were also conducted with Dutch university students and with key informants. Three events were attended as a participant-observer: a two-day reunion by a youth nature group; an on-campus workshop by a student sustainability committee; and a youth-run energy efficiency campaign. The on-campus youth event mainly targeted university students, whereas the other two events included a broader cross-section of young people from different academic and professional backgrounds. The study applied thematic analysis using an inductive analytical approach. Research ethics were maintained through ensuring privacy, confidentiality and anonymity (Willis, 2007).

FINDINGS AND DISCUSSION

The study captured important findings regarding forms of engagement of young people with climate change and sustainability issues and the role of their education and learning experiences in hindering or enhancing this engagement. These findings are presented below and discussed in relation to the relevant literature.

A lack of Critical Reflection and Solution-Based Approaches in Current Education

A majority of the study participants highlighted weaknesses in the current way education prepares young people to manage real-world problems such as climate change. They particularly pointed out the prevalent disconnected thinking amongst the public, which they considered to have been shaped by educational approaches that do not promote critical and systemic thinking among young learners. A Dutch focus group (FG) participant discussed such shortcomings of current education:

> *When people buy a car they don't think of kids in Africa or how much energy and resources are needed. We need to see the bigger picture, realize we are all interconnected. We have to change education. Most educational programmes don't address these problems and this way of thinking. They teach small basics on environmental awareness but not the overall picture, or an understanding of a sustainability worldview. It wasn't really presented as an issue that we all have to work on.*

A South African student participating in a national youth forum also highlighted the lack of space for critical and reflective thinking in current modes of schooling and education:

> *Usually there is no reflection. For example in school, if environmental issues are raised, the teacher shows a picture, asks students what do they think about it;*

then switches off projector and that's it, back to normal class, no reflection, no discussion.

Many study participants also emphasized the need for educational reforms that incorporate more holistic thinking and integrate sustainability education and learning into various educational spaces and disciplines. For example, a Dutch FG participant discussed the need for teaching students through hands-on/practical and solution-based learning approaches:

Schools should do more. For me it was an important place where I got information. Not just by telling kids and giving info, but in giving them assignments, asking them to go and find out how the world works, doing research, letting them understand and look it up for themselves. Make them think about it. For example, I wrote an essay about different types of vegetarianism and looked at different arguments, it made me understand and I got convinced.

Similar insights into the need for critical thinking and problem solving skills were discussed by young participants in a study by Burandt and Barth (2010) who found that *„problem-orientation and the need to act and decide within complex real-life problems where multiple perspectives had to be integrated, was mentioned as the main precondition to acquiring new knowledge and skills"* (p. 12). Universities and colleges can optimize their role as key agents of social change by comprehensively integrating education and learning for sustainability into their framework of thinking through a comprehensive approach that engages students with research, education and learning, and outreach for sustainability (Wiek et al., 2011). Matthews and Waterman (2010) indicated that skills, values, and aptitudes are advanced through 'learning by doing' pedagogies for sustainability literacy. They emphasized that *„leaning by doing goes beyond the idea that core, disciplinary or technical knowledge is straightforwardly transmitted through uncomplicated processes of teaching and learning. Rather it involves hands-on activities which facilitate knowledge, skills application, and adaptation"* (p.83). ESD can thus empower youth to become core stakeholders and collaborators towards a sustainable future.

A Low Priority for ESD Education

A widely shared theme amongst participants in both countries was the low priority given to climate change and sustainability education in their academic curricula. This is reflected in the following quotes by two participants from the Netherlands and South Africa, respectively:

We have no university courses on the environment. In school we only get the basics, what pollution is...My main sources of knowledge or information on sustainability are climate scandals and social networks.

It's growing but we're still leaving it at an optional level. Right now in law, we have environment law as an option, then the lecturer became pregnant. They didn't try to replace the lecturer, they scrapped the course. It's that unimportant.

Another FG participant from South Africa argued that such shortcomings in their education impeded their ability to develop skills which they considered necessary for their future jobs.

We don't have a lot of environmental courses in our curriculum. So usually about climate change I see it accidentally on the internet; through campaigns or from television coverage of climate events or scandals...Existing school structures can't promote this knowledge. Students get no platform to expand their knowledge and skills and grow into a green economy.

The literature highlights the importance of embedding education for sustainable development (ESD) across the functions of higher education institutions. It also highlights the importance of experiential and interdisciplinary learning for enhancing the holistic and critical understanding of different academic and social disciplines for young people and preparing them for professional work (Stewart, 2010). ESD provides an opportunity for reflecting and re-orienting current ways of relating to and valuing ecosystems, utilizing resources, and understanding the inter-connections of the natural and social world.

A distinct theme expressed by some Dutch participants was the lack of depth and skills development in sustainability courses. Two FG participants shared their experiences:

I study entrepreneurship, and am now focusing a lot on people, planet and profit and how you have to consider all these. We have business presentations from companies who want to sell the fact that they are green. But we are not really educated on what the problem really is or how to manage it.

The sustainability course was very broad, too quantitative, not deep, - it was like children's physics. Too focused on teaching physics and technique behind it...

rather than impacts of climate change, or the diplomacy behind it and how we can change countries, or the policies that need to be adopted to get sustainability.

In an interview with a policy maker on the political dimensions of sustainability education in the Netherlands, he explained that „*the new government has announced 9 branches of industry for Netherlands to be leading in, such as chemistry; life sciences; bio-based economy; and the creative industry...the development agendas on economic reform have sustainability as an underlying principle. But at the same time they are cutting a lot of funds and investments from arts, culture, environmental studies...sure this will have an impact on how higher education manages. But anyway in Netherlands HE can decide their own programmes. So it also needs to come from there.*"

This reflects the institutional challenges of integrating ESD into higher education and the importance of attaining political and legislative support for sustainability education.

A distinct theme expressed by many South African participants was the lack of teacher training and awareness on environmental issues such as climate change. Two FG participants stated:

They introduced new subjects on sustainability and on corporate social responsibility but used the very same teachers that had been teaching other courses. They don't have the background and understanding or skills to teach this new material...Course didn't touch on anything new except what we all already knew. Save water, electricity...There was no real depth into what happens, the process, the outcomes, the long term issues we will have to deal with in our jobs.

Teachers are not properly educated about issues like climate change especially those in rural and under-privileged areas. We need proper teacher education...People in the community need to learn the skills to live sustainable and efficient lives.

These insights resonate with findings in other studies exploring ESD in South Africa. For example, Moodley (2010) found that the environmental education programmes in the Gauteng province „*had very little or no focus on the social and economic aspects of the environment...the practitioners sampled in the study were trained in environmental education and there appears to have been no formal training regarding education for sustainable development*" (p.64). Bopape (2009) similarly indicated the lack of teacher training within the South African academic context

and recommended the incorporation of environmental education into teacher professional development programmes in South Africa. McKeowen and Hopkins (2010) also emphasized that educating for change requires engaging teachers in this change process, and that climate change and ESD education need to be locally and culturally appropriate.

Another distinct theme emerging from the South African data was the low priority given by students to environmental courses. Some participants indicated that this was influenced by the socio-economic context:

The modern age is a service age, so fewer people are doing sciences. The focus is not on what's the way forward. The focus is on how we can improve budgets and what we have already ...Science majors are not getting as much money as business majors. Accounting is where most people are getting paid.

Students doing biology are pushed by their parents to do commerce - something with a real job. Most are first to get education in their households and are the main breadwinners. The family are dependent on them to get money...We need to link biology and science to business to show them possibilities.

Lotz-Sisitka (2002) indicated that environmental education in southern Africa is the key to investing in both human development as well as the protection of the environment to ensure sustainable livelihoods and safe environments. She emphasized that environmental education processes are essential, particularly in contexts where livelihoods are dependent on natural resources; hence the need for re-orienting and re-establishing the links between socio-cultural, economic, natural and political dimensions.

Contribution to Positive Societal Change

This study captured important findings about young people's perspectives regarding opportunities for personal and professional development through their responses to the global climate change crisis. Most participants discussed these opportunities in terms of the contributions they would like to make through their professional careers in enhancing awareness in society and action on climate change and sustainability issues. A law student from a South African focus group session expressed interest in working on sustainability policies that could better serve community livelihoods:

I hope to see more and stricter environmental laws. Perhaps as a lawyer I will play a role in bringing these laws to pass. I would like to see those communities who rely on unsustainable resources for their livelihoods successfully find alternative occupations.

Another FG participant from South Africa discussed the role of the media and art in raising public awareness on climate change:

I'm studying drama because I think theatre is a way to educate people and to bring about change, to influence people...So we can use theatre to raise awareness on climate change.

Similarly, a Dutch participant in a sustainability event hoped to work in sustainable agricultural production to meet the rising challenges from climate change:

I am studying agriculture and I now see the effect of weather changes on produce. As a future farmer, my ideal would be to produce enough food of good quality and every year to improve soil health. That would be my contribution; my own farm to increase soil health every year. It has to be worldwide, but I'll try to do my part.

Fritze et al. (2008) discusses the fact that climate change will generate the need for a range of different jobs and careers to support people and institutions and enhance people's resilience and "...galvanize creative ideas and actions in ways that transform and strengthen the resilience of and creativity of community and individuals" (p. 9). The ILO (2012) also indicated that climate change will have an impact on labour markets through the creation of new jobs and the substitution and transformation of existing jobs. Although some jobs might disappear, new jobs will be created, for example, in the construction sector building coastal defenses and green buildings. Certain job requirements will be redefined as society shifts from fossil fuels to renewables and with an increased focus of the industrial sector on clean technologies and of the service sector on energy savings. Such insights further highlight the importance of integrating ESD into academic curricula in order to build young people's knowledge and competences to manage a transforming workplace through skills for critical and futures thinking, flexibility and adaptability, social learning, sustainable technologies and inter-disciplinary collaboration.

Innovation in Future Career

Many of the study participants undertaking environment-related studies or courses

considered climate change as an opportunity for them to find jobs and to innovate within their career prospects. This viewpoint was especially prevalent amongst the South African participants, as demonstrated by the following quotes from various FG sessions:

Climate change can be a threat to a future career or can be opportunity to study changes occurring and adaptations in different organisms. As an etiologist, climate change will have impact on my career because the ocean as an ecosystem is very sensitive to changes we are facing now.

It opens up job opportunities. Every company and government sector needs environmental experts, also for enterprise development...It's a young field and it's growing. Also internationally, wherever you go they will always need environmentalists, especially someone from ‚Africa'.

A lack of food and resources creates jobs for us as environmental scientists to study and find alternative ways of food production. The government would not need to invest its money in expensive technologies.

Within the particular South African context, Lotz-Sisitka (2009) emphasized that the multiplicity of social and economic stressors present valuable opportunities for education for sustainability to be integrated into higher education, thus expanding the platform for South Africa's higher education youth to learn and develop into a sustainable society and economy.

Furthermore, some participants discussed the ways in which their future jobs and careers would require competencies and skills to perform well in an increasingly sustainability-oriented economy and market system. For example, a Dutch FG participant pointed out the importance of attaining the values and skills to adapt to the physical and structural changes happening in their everyday lives and for enhancing their performance in future careers.

There are a lot of opportunities in businesses and industries. You have to know how to do things differently. So I'm here (in the sustainability leadership class) because I will need to learn these skills for my job...and it's good on the CV.

Similarly, a South African FG participant pointed out to the skills and competences that future engineers will need to acquire:

Attitudes have to change in upcoming engineers and architectures. People in power are not really aware of these things (for example – climate change) and how to prevent them. So we as engineers, who are learning to make structures to build houses, need to learn to do it sustainability. We should focus on structures that incorporate the environment into it instead of destroying it.

Various scholars and institutions have emphasized that the future workplace will require skills in critical and fore-sighted thinking, collaboration amongst different disciplines and innovative solutions for efficient management of scarce resources (Fahey, 2012; Wiek et al, 2011). The European Commission (2009) considered that skills are "the best insurance against unemployment and an important factor for personal development and active citizenship" (p. 2). In addition the Netherlands Environmental Assessment Agency (PBL, 2011) warned that the Dutch and general European working population, is aging and expected to decline further, arguing towards more innovation, better education and a greener economy to maintain prosperity and deal with the long-term climate challenges. Yet a recent study on the integration of sustainable development concepts in HEIs in another European country, Belgium (Lambrechts et al., 2013) has similarly highlighted the lack of educational programs that promote competences for systems thinking, future orientation and personal action on sustainable development; hence further emphasizing the importance of revising HEI curricula to address sustainable development competences for empowering young people to manage a sustainability-oriented future workplace.

CONCLUSION

In this study, the participants' discussions revealed important insights regarding the extent to which their current education and learning is equipping them with the necessary worldviews, skills and competencies for a sustainability-oriented society and job market. Several participants criticized the low priority given to climate change and sustainability education in their current institutional programmes and courses, and that this impeded their ability to develop skills they consider necessary for future employment and social cohesion. The participants' perceptions of power and opportunity for personal and professional development through their jobs, and of their agency to influence the changes they envision might be diminished in the absence of adequate education and training to enhance their employability and performance. The study thus highlights the need for educational programmes that enhance young people's critical and reflective thinking, holistic worldviews, and collaborations with stakeholders across different disciplines.

Key recommendations for policy and practice that address the specific set of findings from this study include the following;

- Integrating educational programs in HEIs that focus on skills development for sustainable development, particularly through promoting young people's skills for social transformation including skills for critical reflection, futures thinking, creativity and innovation, and participatory and problem solving abilities so that they are better able to manage, personally and professionally, the complex real-world challenges such as climate change.

- Incorporating ESD concepts into teacher education programs and pre-service and in-service teacher training; establishing on-line platforms for teacher professional development, resources and teaching material on ESD; and developing ESD guidebooks for teachers and training teachers on their application in the classroom.

- Developing programs and mechanisms by the public and private sector for supporting and empowering young people with innovative ideas, solutions and community projects on sustainable development and climate change in order to encourage and enhance youth personal and collective contribution to positive societal change. At the public level, such mechanisms could entail establishing formal youth platforms and councils for meaningful youth consultation and participation in decision-making and action. At the private level, in addition to the role of HEIs, young people could also benefit from skill-enhancement programs by youth NGOs, sustainability-based internship programs by companies. Media exposure and awareness of youth initiatives on ESD and sustainability through journalist's reports, youth and sustainability event coverage, and interactive sustainability-themed television, radio and social media shows that such activities can be led and managed by youth. Such programs and mechanisms provide diverse opportunities for young people with innovative ideas and who are keen to engage with sustainability issues in their future careers to enhance their skills, networks, experiences, competences, as well as contributions for sustainability.

- Devising formal and informal skills development schemes, especially in developing countries, that can fill the current skills gaps across diverse youth and adult stakeholders and ensure social and gender equity in youth inclusion in the transition to a green economy.

Future research should explore the dynamics and possibilities for the political empowerment of young people and youth employment within the current complexities of post-2015 development debates, the global economic recession, rising challenges from climate change, and the pressing need for a transition to energy efficiency and a sustainable economy. Key research questions need to address the competences and leadership potential of young people to participate in decision-making on sustainability issues; the ways in which changing environmental circumstances affect the working conditions of young workers; whether job creation in emerging sectors can address the rising problem of youth unemployment; whether students across diverse sectors and disciplines have adequate skills to adapt and manage a transforming lifestyle and working environment, and whether gender balance is being considered and addressed in policy consultations and the transition to green jobs (ILO, 2012; Stevens, 2009). Answering these questions requires multiple systematic studies using quantitative and qualitative tools and across different countries and youth populations.

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Integrating local knowledge in ecological education in urban schools in Malaysia

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ABSTRACT
Ecosystems around the world are threatened by the colossal rate of human development. As a result, sound ecological literacy is necessary for people to make informed decisions that do not endanger the environment. Local ecological knowledge, innovations and practices of local communities are relevant for the conservation of ecosystems and their sustainability. This chapter focuses on ecological education as a form of education for sustainable development. The project was carried out with schoolchildren from two urban schools in Malaysia where the students undertook projects to reduce the generation of waste by converting it to organic fertiliser and other materials. The project also provided opportunities for students to explore and raise their awareness about the heritage related to the local flora and fauna. The effect of students' participation in ecological education activities on their ecological literacy, ecological thinking and local ecological knowledge were investigated.

KEYWORDS
ecological literacy, ecological thinking, local ecological knowledge

INTRODUCTION

The ecological balance of the global ecosystem is under immense threat as a result of ever-increasing development and consumption of the world's natural resources. Changes in the global ecosystem are largely influenced by human disturbances. Due to the effect of these disturbances on the diversity of species, renewal of systems and the structure and function of ecosystems, the role of humans must be included within any consideration of ecological, evolutionary and environmental processes (Wallington et al., 2005). Humans are thus an integral part of the global ecosystem (Smith, 2008/9). This relationship between humans and nature is a function of the experience and environments within which people live (Schroeder, 2007). Yet people continue to live unsustainably (Deluca, 2005) and rampant use of the earth's resources has seen the exacerbation of natural disasters.

Disturbances to the environment due to development have caused ecological imbalances in the global ecosystem. One of the major impacts has been on the

vertebrate species population across the world, as demonstrated by changes in the Living Planet Index (LPI). The LPI for vertebrates refers to the percentage of global vertebrate species population that have decreased since 1970 to the year of the report. The LPI for vertebrates risen from 28% in 1970 to 52% by 2010. This means a huge reduction of more than 50% in vertebrate species biodiversity in the past 42 years. Humans also place an excessively high demand on the Earth's resources, beyond the capacity of the Earth today. This is measured by the global Ecological Footprint, that continues to increase and is estimated to be 1.5 Earths in 2014. This is the size of the Earth that is required to provide the amount of natural resources necessary to satisfy current human consumption (WWF, 2012; WWF, 2014). With the current alarming rate of human consumption of natural resources, it is difficult to be certain that the generations of the future will have adequate access to these resources. Development is deemed to be sustainable by giving due attention to the economic, social and environmental dimensions. However, economic development seems to be the main focus, to the detriment of the environment (WWF, 2014), yet the economic and social domains depend on the ecological systems of the world.

Local ecological knowledge (LEK) has been described as the knowledge, practices and beliefs that a person has about local ecological relationships. LEK is a shared knowledge within a community and is acquired as a result of the experiences in, and observations made by, an individual about local ecosystems. When this knowledge is handed down through generations and then added to the new knowledge acquired by subsequent generations, it is known as Traditional ecological knowledge (TEK) (Chamley, Fischer and Jones, 2008; Gilchrist, Mallory and Merkel, 2005).

LEK held by young people is important as they will inherit the Earth of tomorrow. However, changing economies in developing countries have diverted young people away from their traditional homes to more urban areas for education and work. In developing countries, urbanisation has also caused changes in the livelihoods of residents as they move away from the natural resource based lifestyle they used to follow. In doing so, there is a decline in the LEK they hold, as their new lifestyle is no longer based on the natural resources around them (Punch and Sugden, 2012). People in rural areas are able to identify more ecosystem services as their livelihoods are closely interrelated with the environment (Martín-López et al., 2012). The rural people in this study were mostly from the older generation, while the younger generation tend to be located in the urban areas. These young people tend to have a perception of the natural environment based on what they learn in schools and institutions. A study of young people in Australia revealed that those who

reported strong, positive environmental intention and behaviour, had a higher level of environmental knowledge and concern. They also reported less environmentally harmful behaviour by this group (Fielding and Head, 2012). However, people who are knowledgeable about the environment do not necessarily display good environmental behaviour.

The LEK held by a community is often different to views about biodiversity held by other groups. However it is important that sharing of LEK with other concerned parties is encouraged to facilitate more effective biodiversity conservation (Chamley, Fischer and Jones, 2008). TEK is also deemed important in the utilisation and management of natural resources for sustainability (Phuthego and Chanda, 2004). LEK is gaining importance as it is seen to be an essential component in the documentation of environmental change (Beaudreau and Levin, 2014) and planning of urban land use (Yli-Pelkonen and Kohl, 2005).

As a result, every effort should be taken to reduce biodiversity loss and to conserve natural ecosystems. Improved ecological literacy and ecological thinking among the public may help reduce the problems of biodiversity loss and local ecological knowledge may be important to understand the ecology of different localities and in placing local problems in an appropriate context.

ECOLOGICAL EDUCATION

Ecological education is a pedagogical approach that is continuously evolving through the inclusion of ideas and values held by different communities (Duenkel and Pratt, 2013). The authors propose that this approach be governed by certain principles including the infusion of key ecological concepts across different educational settings and the ecological identities traditionally held by local communities. Some of the key ecological concepts are inter-relationships and interactions within ecosystems, diversity, communities and ecosystem change. Ecological identity refers to views held by people about their role on this planet. Another principle is that ecological education should be context based, be it cultural, locality based or through inter – and intrapersonal contexts. Thus ecological education is seen to place importance on the relationships that exist between specific biomes and cultures. Cultures that have developed practices that are compatible with the specifics of the ecosystem they are part of, tend to be more sustainable (Smith and Williams, 1998). Ecological education can be a plausible approach to educate people on ecosystems and the effect of human influence on them. Its design should include ways to improve ecological literacy and ecological thinking.

Ecological literacy

There are different but related approaches to ecological literacy. An extensive review by McBride et al. (2013) suggested that ecological literacy can be described in terms of a framework that encompasses three components: ecological knowledge, cognitive skills and systems thinking. Ecological knowledge refers to a knowledge of ecology, socio-politics and environmental issues. Cognitive skills are those skills necessary in ecological literacy and encompasses scientific enquiry. Systems thinking as a component of ecological literacy involves understanding the workings of the ecosystem, the dynamics within an ecosystem and the interrelations between the bio-physical and social components of particular environmental situations. In this case, ecological literacy refers only to ecological knowledge.

Ecological literacy is found to be low among many sections of society, from primary school children (Cutter-Mackenzie and Smith, 2003) to adult teachers. Hashimoto-Martell, McNeill and Hoffman (2011) also reported below average ecological literacy among urban youth. However a high level of ecological literacy is necessary for people to make informed decisions that do not endanger the environment. Ecological literacy is a key concept that necessitates a change of worldviews. In view of this, education at all levels should integrate ecological consciousness into the education agenda (Hampson, 2012). Powers (2010) recommends that young people should be taught ecological literacy so that they can be equipped with the necessary tools and knowledge when dealing with environmental issues. In Malaysia ecological consciousness and ecological literacy is incorporated into environmental education initiatives, the main pathway to raising environmental awareness (UNESCAP, 2000). Some initiatives are carried out in informal settings such as museums (Ng, 2008), nature parks (Sabah Wetlands Conservation Society, 2012; Yusof, 1999) and non-governmental organisations (Singh and Rahman, 2008, Sabah Wetlands Conservation Society, 2012). Environmental education has also been implemented in formal settings such as schools. Although labelled as environmental education, aspects of ecological education are embedded in the initiatives (Kamidin et al., 2011).

Ecological thinking

Ecology as a science is evolving and undergoing several changes in emphasis and perspective (Wallington et al., 2005). A study on the ecological thinking among ecologists by Moore et al. (2009) revealed a diversity of views and approaches. Generally, there was widespread agreement on ecosystems being in non-equilibrium. They also agreed that there are multiple organisational levels and the role of functional diversity in changes to the environment. However there were disagreements about

predictability of succession, the concept of patchiness, and the shift of focus from species to ecosystem processes. Central to the thinking about ecology is the place of humans. Changes in ecosystems are largely influenced by human disturbances. Due to the effect of disturbance on the diversity of species, renewal of systems and the structure and function of ecosystems, the role of humans must be included as a necessary part of ecological, evolutionary and environmental processes (Wallington et al, 2005). Thus there is a need to include values held by society, indigenous and local knowledge in ecology. This view is congruent with the frame of mind in sustainability that humans are connected with their origins and with what sustains them (Bonnett, 2002). It also reflects the ecological thinking that sees humans as being an integral part of the ecosystem (Smith, 2008/9). This relationship between humans and nature is a function of the experience and environments within which people live (Schroeder, 2007).

Ecological thinking has been described as a combination of ecological understanding, environmental awareness and the ability to discern the influence of human action on the environment (Balgopal and Wallace, 2009). It is also about the decision making that applies ecological understanding, and it consists of four factors (McBride, 2011). The first is critical thinking and its application, meaning that an individual is able to identify, evaluate and apply ecological evidence in decision making related to ecological issues. The second factor is understanding the uncertain nature of ecological science. This means that ecological patterns and processes occurring in nature vary according to space and time, are probabilistic, yet are inter-dependent and interrelated. The third factor is biogeography. This refers to appreciating ecology at different scales in time and space. The individual is able to think in terms of historical time and evolutionary time, and that the environment changes according to scale of space. The fourth factor refers to the ability to make connections that occur in ecological processes and systems.

Local Ecological Knowledge

As already stated above, traditional ecological knowledge (TEK) refers to knowledge embedded in the culture of local communities for centuries, having been passed down and applied by these communties through generations (Mamun, 2010). Local ecological knowledge (LEK) is often used interchangeably with TEK. However LEK has a shorter history in that it does not involve so many levels of intergenerational transfer, but will become TEK as communities continue to use it over many generations. Communities use LEK to source ecosystem services and natural resources, and to respond to fluctuations that occur in the ecosystem. Thus LEK is cumulative in

nature, but remains dynamic as local communities adapt to environmental changes. Extracting LEK from these communities is valuable in conservation.

Transferring LEK to the younger generation is an important conservation action. It can help improve knowledge of local ecosystems, their functions and local traditions that use these resources and at the same time help protect and preserve them. Many of today's young people have limited or no knowledge of LEK for various reasons. Development, urbanisation and modernisation has caused a diminishing of LEK. This is further exacerbated by the passing away of older generations that hold this LEK not being replaced by a younger generation that has this knowledge. A study by Pilgrim et al. (2008) across three countries indicated that LEK is higher in lower income communities compared to their wealthier counterparts. As the economic status of communities improve, they become less reliant on local resources. Thus LEK becomes concentrated among those with personal interest due to their resource dependent career, lifestyle or study field. The loss of LEK is also found to be faster in more economically endowed communities. With higher incomes, communities have greater access to, and dependency on, commodities available in the markets. They are less reliant on local resources, thus have less need to acquire LEK for their survival. This also leads to reduced sharing of LEK between the older and younger generation. Pilgrim et al. (2008) raised concerns about the threat to LEK due to improved economic growth across the globe, leading to the declining capacity of local communities in the management of the also diminishing environmental resources in their locality.

INTEGRATING LOCAL KNOWLEDGE IN ECOLOGICAL EDUCATION

An ecological education project was carried out in two schools located in two different urban areas in Malaysia. Participation in this project was initiated by the schools, as part of their Green School activities and their collaboration with Higher Education Institutions. The school administration approached the researcher, and after discussion, both parties agreed on the project. The research approach incorporated in this project utilised the quasi-experimental method applying the one sample non-equivalent group design technique. A pre-test and a post-test was conducted to collect data on students' ecological literacy and ecological thinking, using a questionnare adapted by the research team. The questionnaire consists of a section on demography, and sections on ecological literacy and ecological thinking consisting of five point Likert scale items. Interviews that focused on local knowledge were also held at the end of the project. After the administration of the pre-test, a workshop was carried out to train students to produce vermicompost – a worm produced organic compost. Students were also briefed on the tasks they were to complete in this project.

A total of 108 students aged between 14 and 16 years from the two secondary schools participated in this project. Two teachers from each school co-ordinated the project in their respective schools. From time to time, the research team visited the schools to follow up on their progress and to provide help, particularly in the vermicompost production. The project was conducted as a co-curricular activity run by the students outside school hours. This meant that the students stayed on after school for about two hours for this activity. This arrangement work in Malaysian schools as co-curricular activities are compulsory for all students. The ecological education project was linked to the school science curriculum as observations are made on plant growth, other living things associated with the plants student grow, the role of the associated plants and animals and the identification and uses of these plants. The project was also linked to Bahasa Melayu,the National Language.

In the project, students worked in groups of ten, and each group was allocated a plot of land in the school grounds to grow plants of their choice. Students were tasked to grow plants based on a chosen theme. The themes related to the local culture, such as local food, traditional remedies, and local sayings such as proverbs. Some of the themes were a Jam garden, an Indian Herb garden, Skin care garden, Laman Peibahasa (Proverb Lawn) and so on. The plants grown in these plots were local plants. For example, in the Jam garden, students planted sugar cane, the peanut plant, pandan (screwpine) and roselle. Thus students needed to research the local plants they should grow to fit with their chosen theme. They learned to identify the plants and find out the method for growing the plants. When their gardens were ready, members of each group took turns to care for the garden including daily watering and observation.

Image 1. Students showing the plants in their plot

Image 2. The jam garden

Image 3. The Chinese herb garden and skin care garden

Image 4. The Heritage garden (Laman Warisan) and the Proverb Lawn (laman Peribahasa)

Image 5. The passion fruit vine and fruit

Plants were fertilised using organic fertiliser that the students had made themselves. They used food scraps, lawn waste and cow dung to produce vermicompost. They also composted some of the organic waste generated within their schools. Composting and vermicomposting are natural processes that occur in undisturbed forests, contributing to the nutrient cycle that nourishes the flora. By replicating these processes, students were able to see the interrelationship between elements in the ecosystem and how the ecosystem provides services through the processes that occur within it. It is hoped that such an experience will have some influence on their ecological thinking.

As part of their project, students were also required to investigate local knowledge about the plants in their garden. Apart from sourcing information from books and

the internet, they also interviewed people in their community who had knowledge about these local plants, particularly the older generation. They also gathered information from their respondents about the benefits and use of these plants by the local people.

ECOLOGICAL EDUCATION, LOCAL KNOWLEDGE AND CHANGES IN STUDENTS' ECOLOGICAL LITERACY AND ECOLOGICAL THINKING.

As shown in Table 1, students' ecological literacy and ecological thinking was less than 80 percent of the total score for each category before the start of the ecological education activity. However, participation in the ecological education activity showed improved results. There was a 5.7% increase in the mean score for ecological literacy and a 5.6% increase in the mean score for ecological thinking after the project. The gains in ecological literacy and ecological thinking are statistically significant, at the $p < .05$ level with an effect size of 0.28 and 0.22 respectively. It can be inferred that the students' experience in the ecological education activity has contributed to their improved ecoliteracy by 28 percent, and their ecological thinking by 22 percent.

Item	*Test*	*N*	*Mean*	*Total score*	*Mean as % of total score*	*Std. Deviation*	*t*	*p*	η^2
Ecological Literacy	*pre-test*	*108*	*184.47*	*240*	*76.86*	*10.61*	*-9.15*	*.01*	*0.28*
	post-test	*107*	*198.07*		*82.53*	*11.17*			
Ecological thinking	*pre-test*	*108*	*90.81*	*120*	*75.68*	*6.56*	*-7.76*	*.01*	*0.22*
	post-test	*107*	*97.54*		*81.28*	*6.15*			

Table 1 Changes in students' ecological literacy and ecological thinking

A closer look at a few of the questionnaire items show the nature of these changes. Table 2 and Table 3 list selected items for ecoliteracy and ecological thinking, respectively.

Item	*Test*	*Frequency of responses (%)*					
		Strongly disagree	*Disagree*	*Agree*	*Strongly agree*	*X2*	*p*
Matter present in a tropical rainforest is recycled	*pre-test*	*3.8*	*34.6*	*49.0*	*12.5*	*14.01*	*.01*
	post-test	*1.9*	*16.0*	*54.7*	*27.4*		
The first plants to grow on bare land will change the soil properties	*pre-test*	*3.7*	*24.3*	*56.1*	*15.9*	*12.52*	*.01*
	post-test	*0.9*	*8.4*	*68.2*	*22.4*		
The leaves of rubber trees will fall during drought season	*pre-test*	*12.4*	*37.1*	*43.8*	*6.7*	*21.45*	*.01*
	post-test	*0.9*	*23.6*	*56.6*	*18.9*		

Table 2 Example of ecological literacy items and students' responses

In the examples given in Table 2, a greater proportion of the students agree to the statements given after the project. This is probably due to their experience of working in their own gardens and sourcing information about the plants they grew in their garden. In preparing their garden, students had to clear the plot of land allocated to them and most of them started planting on bare soil. They also became more alert to the plants and trees that they saw around them, as for instance, more students knew that rubber trees shed their leaves when there is prolonged absence of rain.

Item	*Test*	*Frequency of responses (%)*					
		Strongly disagree	*Disagree*	*Agree*	*Strongly agree*	*X2*	*p*
Vegetables that are grown alternately with legumes can protect soil fertility	*pre-test*	*2.8*	*21.3*	*55.6*	*20.4*	*10.75*	*.01*
	post-test	*0.9*	*12.1*	*47.7*	*39.3*		
Excessive fertilisers washed into rivers by the rain can cause more kiambang to grow	*pre-test*	*11.3*	*22.6*	*57.5*	*8.5*	*9.53*	*.02*
	post-test	*9.4*	*22.6*	*44.3*	*23.6*		
Leaves that fall in the yard and allowed to rot there will increase the soil nutrients	*pre-test*	*2.8*	*25.9*	*49.1*	*22.2*	*14.12*	*.01*
	post-test	*1.9*	*9.3*	*48.6*	*40.2*		

Table 3 Example of ecological thinking items and students' responses

As shown in Table 3, students demonstrated an improved understanding of certain phenomena and the reasons behind certain occurrences.

Interviews with students at the end of the project revealed that they have local knowledge about the plants they grew in their garden plots as well as about some of the animals that visited their gardens. The interviews were carried out in two phases. In the first phase, the research team visited the garden and interviewed

the students on site. Students explained the theme they had chosen and the plants they grew. In the second phase, the students talked about their project as a whole. This was conducted in the school building. Before the start of the programme, very few of the students could name the plants and animals that they saw around them. This was also true for other organisms that were present in their environment. Furthermore before the project they did not know much about the local plants around them or their ecology. For example, many of them did not notice that certain bird species frequented the school yard or their homes. In terms of ecological literacy, the project has encouraged students to be keener observers of what takes place in their garden and to identify visitors to their garden. As they progressed with the activities in this project, they began to make a greater note of the biodiversity. They could see that certain insects visited the plants they grew, and went on to investigate the role of these insects in their garden plots. They became more aware of the insects that frequent the plants they grow, and went on to discover whether these were beneficial or detrimental to their plants. They made similar investigations about other animals and new plants that appeared among their plants. They also identified other invertebrates and birds they saw in their garden and school grounds. To support their observations, they included photographs of the birds in their report. A few even reported that they had civets as visitors and showed the objects that they claimed to be the civet droppings. Students became more aware of the role of these organisms and the interrelationships between them.

Image 6. Visitors to the compost heap

Image 7. Roselle jam in the bottle and in jam sandwich

Image 8. A Roselle fruit and the sugarcane plant from the Jam garden

Through the project, students also discovered new knowledge, especially about the plants in their locality. One example of this is that they learned about the healing properties of certain herbs they planted. For instance, the students learned that turmeric can be used in treating pimples and to reduce the amount of body hair. To do this the rhizome of the turmeric plant is crushed to a pulp and applied on the face or other parts of the body. One of the students even tried it on herself to test the claim and gave a positive testimony to this healing property. The curry leaf, commonly used in the food of the Indian and Malay community, is also said to reduce hair fall and strengthen the hair. Curry leaves are documented as having antimicrobial and medicinal properties, apart from being an ingredient in food (Malwal and Sarin, 2011; Suman Singh et al., 2014; Vandana et al., 2012). According to Harish et al. (2012), poisonous animal bites can be treated with curry leaf paste.

Lemongrass is also a plant commonly used in the daily cooking by locals and the leaf broth produced from this plant is used to relieve stomach pains. Another local plant, Citronella, is used as an insect repellant.

CONCLUSION

Local ecological knowledge will soon disappear if there is no concerted effort to preserve and ensure its continued existence. Modernisation and development, although beneficial for human progress, can erode LEK. As more of the older generation pass on there is a reduced inter-generational transfer of LEK and therefore ecological education becomes an important tool for the conservation and preservation of LEK. Opportunities provided through ecological education can provide real life experience of growing plants and caring for them. Observing what happens in the garden including the unintended growth of other plants, visitations by animals and studying these organisms can help in improving ecological literacy and ecological thinking.

Once the students in the project looked at gardens and plants, and saw them as part of the landscape, they then began to see that a plant is a thriving organism and has interactions with other organisms. As a result they then began to know more about these organisms through the study required of them in the project.

Knowledge of the living components in the garden include the interrelationships that occur between them. Students will see that any human action can cause changes in these relationships and as a result begin to develop their ecological thinking. Choosing particular themes for their gardens encouraged students to give more attention to the plants that they use in their own lives. Tasking them to select local themes and local plants helped students to become more aware of the local biodiversity, and to learn more about the local ecological knowledge in their community. In carrying out this task their interactions with other members of their family and community brought them closer to local biodiversity, gaining LEK in the process. They began to appreciate local flora and fauna, and understand the importance of conserving local biodiversity. Although most students live in urban areas, local natural resources are still valued by these communities, for example as the components of their food system. Integrating LEK into ecological education can help to educate young people about local biodiversity. The aim is that the real life experience they gained from the project will influence their future action towards sustainability.

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PART III.

Connecting Education and Research for Sustainable Development

Reflections on 'committed' research into education for sustainable development: challenges and responses

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ABSTRACT
This chapter presents critical reflections on 'committed' research into education for sustainable development. The concept of education for sustainable development has implications for the delivery and content of education and for the process and practice of research into sustainable development. This in turn has consequences for theory and methodology and for the complex relationship between pedagogy and practice. Drawing upon insights from a workshop involving teaching, research and community development practitioners the chapter argues that, while education for sustainable development as a concept crosses all these boundaries, there is often a practical disconnection that can only be addressed through problem focused, action-oriented and collaborative approaches. It concludes that these approaches are underpinned by the identification, development and assimilation of the transdisciplinary attributes that facilitate moving across, as well as between, disciplines, roles and contexts.

KEYWORDS
education for sustainable development, higher education, research, transdisciplinarity

INTRODUCTION
Society today is facing major sustainability challenges, characterised by their complexity and reluctance to succumb to clearly bounded definitions and solutions based upon 'hard' evidence (Funtowicz and Ravetz, 2003; Lemon et al., 2014; Rieckmann, 2012; Rittel and Weber, 1973). As key actors in the narratives and the production of the 'evidence' that contribute to societal perceptions and behaviours, researchers and academics have to assume some responsibility for how those behaviours influence transitions towards more sustainable development (SD) or more specifically to the ability to navigate away from unsustainable futures (Sterling, 2004). However, worryingly in light of their role as educators, or at least as conduits for stakeholder reflection, educators are often unable to make sense of or to communicate coherently about, the complex and uncertain contexts and issues they teach about, research into and consult on. There is a disconnect between the explicable discipline and perspective based constructions, narratives and explanations of specific problem contexts and their often inexplicable, and complex, realities. While this is a problem for researchers to address it extends to the increasing demand from educationalists to have research that supports their teaching; particularly when they are addressing complex real world topics such as those linked to sustainability.

Research into Education for Sustainable Development (ESD) is aimed at improving research literacy in the educational and stakeholder communities. Jucker (2014) argues that central to this endeavour is clarity of aim, i.e. what is SD; clarity about what is effective in collaborative (social) learning and an appreciation of what pedagogic, institutional and collaborative structures need to be in place to support this.

Researching what SD might look like in a complex world is potentially a floored endeavour (Lemon et al., 2014). Once the future has been sign-posted with any confidence there is a strong possibility that individual and collective behaviour will be modified on the basis of that confidence, sometimes with counter productive outcomes. For example, if we are able to produce cheaper cars that are also more efficient and less polluting the market will grow as will the overall vehicular footprint even though the individual unit produces less carbon. This Rebound Effect (Sorrel, 2009) provides one example of a disconnect between expectation and experience and the continually changing landscape within which they occur (Allen, 2010). It also introduces the importance of understanding how complex systems emerge and the uncertainty and unpredictability associated with that emergence. This means that we have to be careful what we are exploring, explaining and anticipating when we engage in ESD and by extension when signposting sustainable futures. A more appropriate, and useful, way forward may well be to identify unsustainable futures, even if they never occur, and to generate the adaptive capacity – social, economic and ecological capital – required to avoid them. In other words to pursue social learning about, and through, systems behaviour (Wals, 2015).

These underlying challenges facing researchers, teachers and practitioners engaged in ESD related issues are invariably the unpredictable product of continually changing social, technical, economic and ecological interactions. One response to such an interpretation would be to adopt a fatalistic stance whereby we are reluctant to intervene, because nothing can be predicted with any degree of certainty. Alternatively we can assume the reductionist paradigm whereby we focus upon a specific part of a problem and assume that 'everything else is equal'. While neither fatalism or reductionism are particularly helpful with how we research 'real world' issues, it is possible to identify a number of features of complex systems that might support a 'replicable' framework or approach to understanding them; in other words, is it possible to understand complex systems systematically? To do this there is a need to acknowledge complexity and map the system out as a whole rather than trying to solve the whole problem (Sterling, 2004).

An additional key challenge facing committed or applied research for ESD is a disconnect between the range of key actors and agencies and the discrete and often poorly integrated roles that they perform. Even when academics, teachers, students, community representatives, companies and other stakeholders conform to a common vision about the future, the specific responsibilities and restrictions of their roles can mitigate against an adaptive transition that draws upon and generates, social learning (Sajeva et al., 2015). Academic researchers have to publish and generate funding, teachers have to meet curricula criteria and ensure that results are acceptable and development practitioners have to ensure that outcomes are specified and met even if the context has changed to make those targets no longer relevant. Indeed the latter challenge is generic. Where targets are put in place, whether they be for publication, exam results or community engagement the targets themselves become the focus of attention and not the reason for their installation. Publication quantity can overtake quality; passing exams supercede the quality of learning and numbers at a community event be more important than any sustainable engagement. Where targets are introduced and are linked to some form of penalty they can undermine the flexibility that is necessary to respond to the very reasons they were introduced (Lemon et al., 2010). Within the context of multiple actors and their respective roles and targets it is possible to identify a number of other factors that make an integrative research approach to ESD more problematic. These issues are introduced in the following sections.

This chapter emerged from a workshop run by the authors for the final CoDeS conference [4]. The purpose of the workshop was to explore the challenges facing researchers, teachers and practitioners engaged in ESD and particularly in the undertaking and or use of research into ESD. The participants were school and university teachers, researchers and users of research, primarily from public bodies. They also represented a wide range of national and cultural backgrounds from across Europe and the far East. The workshop was divided into two two-hour sessions each of which was initiated by short presentations from best practices. The purpose of the first session was to explore the challenges facing those undertaking, commissioning and using research into ESD and the second was oriented towards the identification of potential responses to those challenges. The chapter will broadly follow that format.

The following sections will consider some of the challenges that emerged from the CoDeS workshop and were highlighted by participants who were engaged in research into ESD related topics. Where relevant each section starts with a summary of points raised in the workshop; then expanding upon these to introduce more generic insights into how Research into ESD might develop.

ISSUES OF PLACE AND TIME

Workshop discussion:

- *There is a researcher in all of us, we are all critical thinkers in childhood, but we seem to lose this ability along the way.*
- *We need long-term research. Nowadays everything has to be done fast and in the short term.*
- *After project funding stops, there is often no follow-up.*
- *Access to the teachers: how can we generate time for them and interest from them?*
- *Introduce place-conscious pedagogy that is multidisciplinary, experimental, and intergenerational, this implies a change in perspective and in the curriculum.*

The central theme of this chapter is that ESD is dealing with complex systems and multiple actors that function at different temporal and spatial scales and, importantly, not all of which are human. The Rebound example introduced above

4 This chapter is based on the outcomes of the thematic workshop entitled "Committed research on education for sustainability", held at the final CoDeS conference 'Desiging a sustainable future through school community collaboration', May 21-23, 2014, Barcelona, Spain.

links household decisions about transport to more energy efficient vehicles, the strategies of multinational automotive organisations and climate change. While this obviously influences how we understand and communicate the issues of sustainability (e.g. see Rivoli's example of a T-Shirt, 2009) practical issues of time and place are also important in the 'act' of ESD research. The time required to explore a sustainability related issue can be in excess of that which is available for any specific, and timetabled, subject or research project. The development of cross-curricular, issue focussed, material is not only time consuming in itself but may require significant investment in developing new relationships and forms of delivery among the teaching staff. As discussed in the introduction, this investment may run contrary to the measures by which teachers are judged. For researchers and practitioners similar temporal constraints can emerge. With the former these may manifest themselves through the time required to generate cross-disciplinary working relationships and to negotiate access to stakeholders, with the latter the pragmatic focus on specific outcomes may restrict the time available to explore new approaches with researchers or other areas of practice and to undertake the reflective practice that is fundamental to this exploration.

Other more structured aspects of time are also significant constraints that have to be managed; political and financial cycles, the school timetable and working day all constrain engagement with a topic that is ongoing and emergent. The response to such time constraints may well require flexibility on the part of the individual – i.e. to be involved outside of their accepted time commitment; and on the part of organisations - to support their personnel in this more flexible approach and potentially to make resources available for this, e.g. premises for meetings.

One final aspect of time for consideration, particularly within ESD, relates to the temporal perspective that is adopted; focus on the natural environment will invariably require a longer term perspective than one on the economic and political environment which may be determined by their respective short(er) term cycles (Lemon and Green, 1996). The abillity to engage with stakeholders at specified times only (e.g. when the council offices are open, when the school governors are meeting or not at work) provides one example of how access can be socially and or physically constrained by time.

SOCIAL AND PHYSICAL ACCESS

Workshop discussion:

- *How can researchers access 'local' knowledge?*
- *Researchers need to be able to collaborate and gain access to a range of stakeholders.*
- *Researchers need to be aware of language issues: cultural, disciplinary, conceptual and contextual.*
- *They need to mediate and facilitate and to be able to communicate with a 'sense of audience'.*
- *What might a school-community collaboration pedagogy look like? How can we create local reflexive communities of learners across and between stakeholder groups – participatory design?*
- *Can educational institutions provide a venue for this collaboration?*
- *Can we re-contextualise (e.g. Ubuntu) and value traditional, indigenous knowledge; two way transfer of knowledge and the generation of connections with physically and socially isolated communities.*

Physical access is not just a question of reaching the target group or location at the appropriate time but can also involve negotiating entry to it. It may be self-evident to state that the ability to reach a study area is of particular importance when that location is geographically isolated (Liarakou et al., 2014). However access to a specific respondent or group of respondents may not be determined by geographical isolation but by their availability; this may be due to time pressure (e.g. for senior personnel in an organization) or to issues of social acceptability. For example work carried out into Indian forest management discovered on the one hand family gender issues could prevent female participation in resource management and on the other hand institutional barriers prevented the access of NGO's to government agencies (Martin and Lemon, 2001). The identification of gatekeepers who can facilitate access, or champions who are willing to negotiate it, is of particular importance here; for example access to senior management or to an isolated village may depend upon negotiations through a trusted intermediary.

Physical access is also relevant where issues of 'territory' and cultural acceptability are evident; for example, some sections of the population may be uncomfortable being interviewed in their home and may prefer a communal location while others may prefer the reverse. Cultural factors may determine which of these is acceptable and at what time, as in the Indian example above. A further consideration is that if physical access is negotiated through a gatekeeper with direct or indirect influence and power then the potential for bias has to be recognised and managed. Negotiating access for research into ESD relies upon the generation and maintenance of trust with participants and stakeholders and this in turn necessitates a cultural

awareness both as the basis for engagement (appropriate dress, language etc.) and to support analysis and explain variation between groups. Cultural criteria will manifest themselves through different perspectives on an issue and these perspectives may change as new contexts are forged and experienced.

MULTIPLE PERSPECTIVES AND THE PURSUIT OF CONSENSUS

Workshop discussion:

- *We tend to operate in disciplinary silos, but sustainable development is an interdisciplinary issue.*
- *The researcher is a member of the learning community, (s)he needs to understand the context, respect expectations and needs of stakeholders.*
- *Researchers must become familiar with teaching and learning methods that engage the whole community and appreciates the different perspectives.*

ESD calls for action-oriented and collaborative approaches in which all stakeholders can be involved in the research process (Espinet and Zachariou, 2014). This means that the involvement of stakeholders can take different forms and functions within a research process: e.g. (1) informing stakeholders about research (e.g. in a newsletter); (2) consult stakeholders (e.g. in a survey); (3) dialogue with stakeholders (e.g. in focus groups); (4) stakeholder participation (e.g. in action research) (Lambrechts et al., 2009). It is clear that the different forms of stakeholder involvement demand different levels of committment and forms of collaboration and can be linked when defining and applying quality criteria (Lambrechts, 2012).

The cultural climate in which behaviours take place invariably means that the world as it is perceived by different stakeholders does not coincide with the way that policy makers, politicians or scientists feel it should be perceived. Of course these agencies will often have an influential part to play in the creation of those perceptions. Problems, and by extension options, are defined by the perceptual space within which individuals and groups operate and while there are likely to be varied perceptions over an issue those perceptions are also likely to change through time. Society therefore reflects, and presents, a variety of different perspectives: world views, priorities, perceptions of education and interpretations of the role and value of research. Differences also occur in the experiences of, and relationships between, actors relating to a specific phenomon or issue (e.g. of researchers with students and staff, of staff with contractors, of community with school) and in the use of language, depending on the context and credibility, (technical, pedagogic, cultural, organisational, etc). The language of the classroom differs greatly from the language of the business case and the language of community development; of course each of these generic languages will also have significant variation within them and that language will change over time – increasingly mediated by the presence of technology and social media. The cultural contexts and multiple perspectives that exist among community, pedagogic and research based stakeholders can mean that we are prematurely susceptible to the lure of consensus. Dealing with the mess of everyday complexity is uncomfortable and, as suggested above, not always in line with the aims and objectives of institutions and their desire for clarity and solutions. Ongoing debates over the relative merits of positivist and reductionist models as compared with constructivist and holistic ones can drive us towards the pursuit of consensus rather than the acceptance and appreciation of difference (Lemon et al., 2014). Consensus is invariably interpreted as the place where different perspectives converge, the common ground. A more useful approach is to elicit and collate the multiple perspectives on a particular issue (e.g. transport to school – safety, carbon, convenience, parking, availability of options, pedestrian access, health) and to map these out as a whole. To define the problem, let alone a potential solution or response prior to this would be premature, particularly if we recognise that many of the perspectives and factors are interconnected – poor access and large numbers of working parents may compromise safety and the willingness of other parents to allow their children to walk to school thereby increasing the number of cars. This approach not only generates a more complex context upon which decisions have to be made, it also highlights the importance of whole system thinking and within that conceptual tools that need to be taught and assimilated such as the importance of positive feedback.

Multiple perspectives are an inevitable source of disconnection in research for, and into, ESD but they are also the source of understanding about the range of potential futures and responses to those futures. Understanding those perspectives requires an empathic capability; bringing them together to generate a qualitative narrative requires expertise in elicitation and representation, and underlying all of this resides the issue of trust.

RESEARCHER IDENTITY, CLARITY OF ROLES AND TRUST – THE GLUE TO RESEARCH INTO ESD?

Workshop discussion:

- *What is the role of the researcher: mediator, facilitator, outsider?*
- *Researchers can feel isolated because they are not a "real" teacher nor an "exclusive" researcher.*

- *There is a need to involve students and community members in evidence based research (e.g. data gathering).*
- *Avoid research that 'just takes' and does not 'replenish', add value.*
- *Guidance is necessary for dealing with the tension between doing 'my research' and the needs of stakeholders.*
- *Generate confidence within the researcher, training and stakeholder communities that 'to not have all the answers' is acceptable.*
- *Give consideration to potential bias and ethics in research.*

There was a recognition in the workshop that the role and identity of the researcher might not only be confusing for other stakeholders but for the researchers themselves; are they acting as a mediator, a mentor, a supervisor, an observer, a facilitator, an outsider, an activist or combinations of these roles? Guidance was felt to be necessary in how to deal with this tension between doing 'my research' and the needs and participation of practitioners and community stakeholders. The management of expectations is problematic when the researcher has personal and institutional targets and a 'relationship' with stakeholders. Issues of ethics are often addressed systematically but these do not necessarily deal with how expectation is addressed. Trust, clarity of purpose and relationship building are key to avoiding the perception that researchers "collect data and go". It is also important that teachers and students are supported in the acquisition of research skills so that they have the option to explore themselves when appropriate, they are not reliant on external researchers and they are able to evaluate the quality of the research they encounter. We have highlighted the need to address issues of social access and to recognise and draw upon the multiple perspectives that exist within research into ESD. Both of these require different stakeholders in the ESD process to trust other participants, on the one hand in terms of providing and not abusing access and on the other recognising that constructive dialogue is essential, particularly where there are conflicting views. John Locke stated that trust is the bond of society (Hollis, 1998) and it could be suggested that it is the key to addressing the disconnections in research into ESD.

Trust is multi-faceted in the way it influences our ability and willingness to act. Newell and Swan (2000) suggest three types of trust that emerge within a research project and are relevant to ESD. Companion trust is based upon close interpersonal bonds and relates to high level principles, or 'moral foundations'. The establishment of companion trust is likely to be slow, and when threatened or destroyed, causes the "greatest rift between the parties involved" (Newell and Swan, 2000, p. 1295).

This type of trust is of particular importance in cultures that are based upon the establishment and maintenance of close personal relations. For example economic development among small businesses in Northern Italy is grounded in tight family ties and social networks, the breakdown of which would often be irrecoverable. Elsewhere, for example within Northern Europe and North America, there is more of an emphasis upon professional ‚competence' as the basis for economic relations. Competence trust, therefore, is the perception of expertise and the associated confidence in the ability of an individual, group or organisation to undertake specific tasks. Trust in competence does not only relate to human skills per se but can refer to the structures and procedures that are formulated by people. For example, where performance measures are felt to be inappropriate or unachievable then trust in them can evaporate and strategies formulated to by-pass or falsify them. Within multi-agency research for ESD the need to establish relationship trust is extremely important because it can facilitate a feeling of allegiance to the project in which individual opinions are of more significance than disciplinary background. Obviously this has to be mediated by the ability to act with professional competence, albeit in a questioning manner, in terms of specific disciplines.

Finally, commitment trust indicates a contractual relationship (e.g. work and remuneration) and a willingness to put in the required effort to ensure reward, material and otherwise. There is flexibility on both sides with regard to the contractual agreement and it is only in extreme cases where trust has irreconcilably broken down that the contract is used to settle conflicts. It is important to recognise the reciprocal nature of trust and the possibility that the nature of that reciprocity might refer to different types of trust; this is relevant both to the focus of the research and to the management of the research process. For example the competence shown in the pursuit of a particular task e.g. running a training workshop, may well be in part dependent upon the personal relationship between the person or organisation responsible for running the workshop and the person or organisation employing them to undertake the task. This relationship will obviously be damaged if the workshop is not delivered with the expected level of competence. Consideration of competence also relates to the knowledge and skills that researchers, and potentially teachers and practitioners, need to acquire for 'managing', learning about, and adapting to, continually changing contexts. The next section will consider these skills and set them within a research and learning context that accepts uncertainty and messiness and is cautious about the pursuit of solutions and predictions.

DISCIPLINARITY: KNOWLEDGE AND SKILLS FOR RESEARCH INTO ESD

Workshop discussion:

- *How can an ESD researcher be more flexible and adaptive?*
- *Need to consider how to combine collaborative (participatory) action research and traditional research.*
- *Qualitative and quantitative research may also need to be integrated in this process.*
- *Introduce researchers and students to action research and facilitator skills.*
- *There is a need to recognise that sustainable development is a process of social learning.*

One cause of the disconnect between research, teaching and practice of ESD is the bounding of problems by, and often the linking of job descriptions and opportunities for career progression, to specific disciplines. The disciplinary approach and the organisational structure of higher education institutions (HEIs) are often seen as a major barrier to the integrative pursuit of more SD (Verhulst and Lambrechts, 2015). Dealing with the complexity of SD issues poses additional theoretical and methodological challenges. Disciplinary expertise is undoubtedly essential for addressing specific and clearly bounded problems but, as discussed above, the clarity of these boundaries can often only be realised following a holistic exploration of the 'mess' of the problem or issue being considered. All the different approaches to understanding a problem carry baggage – good deductive science often tells us little about context but a qualitative narrative does not, and cannot, provide theoretical clarity and statistical validity. For example, research into the community response to water quality needs to understand the chemical impact of pollutants in a watercourse and the reasons for them arriving there. The chemistry and industrial processes of the former are inextricably linked to the organisational, economic and cultural influences on the latter. The narrative is the whole story; to understand one without the other is often not helpful but while good physical science and good social science are both important it is the integrative capability that should underpin the narrative, complement the disciplinary expertise and collectively contribute to a holistic understanding.

However, it should be recognised that the 'whole' problem refers to viewing the system as a whole, not attempting to solve the whole problem. Furthermore, we do not and cannot know what the future holds. SD issues are always uncertain. Teaching, research and practice operate in an increasingly interconnected, complex and messy world. This summarises a number of epistemelogical and pedagogic questions arising from the previous discussion:

- Should we focus on what is sustainable, but will almost inevitably change as a result of that knowledge, or should we learn to anticipate more effectively what might be unsustainable and identify the skills and resources necessary to deal with this?
- How do we adopt, assimilate and communicate a whole systems approach to complex phenomena (e.g. Sterling, 2009)?
- How do we think about such systems systematically?
- What competences can help us address the systems approach and uncertainty issues?

RESEARCH IMPACT, TRANSDISCIPLINARITY AND HEI RESTRUCTURING

Workshop discussion:

- *How can we deal with the tension between theoretical frameworks ("ivory tower") and reality/practice and develop a more blended integration of research and practice?*
- *How can we develop a pedagogy for school community collaboration and in so doing create spaces for new forms of knowledge creation within a post-normal science?*
- *Evaluation of ESD research should not only be based on impact factors but on the feedback from those affected by the research (i.e. the community).*
- *We need to adapt how we report and share research, e.g. co-creation, Regional Centres of Excellence (RCE's); involvement of teachers and students as research evaluators.*
- *Academic journals could include the impact of the reported project in their evaluation of articles.*
- *New ways could be introduced to organise conferences and teaching; these would involve stakeholders.*
- *By extension universities and research institutions should benefit, and be operated in collaboration with, the local community (e.g. see the Square Mile in Leicester, DMU, 2015).*

In the light of the disconnects and pedagogic barriers some key, interlinking, challenges can be identified facing researchers in Higher Education Institutions (HEI's). Firstly, the tension between traditional science and more interpretivist approaches has been highlighted but also seen as the basis for a fundamental synergy that is necessary for exploring, and addressing, complex sustainability issues. Flyvbjerg (Flyvbjerg, 2001; Flyvbjerg et al., 2012) provides an insightful perspective into how social science needs to avoid replicating the experimental and deductive approach

of natural and physical sciences. Within the context of ESD the insight from inductive, interpretive and participative social science is complementary to, not in conflict with, the physical and natural sciences. This leads into an additional challenge highlighted in the workshop; how to ensure that the research has impact? This is becoming an increasingly important component of Higher Education metrics (e.g. within the Research Excellence Framework (REF) in the UK) and encourages revisiting some earlier work in management science. Gibbons et al. (1994) differentiate between Mode 1 problems which are clearly defined and addressed through traditional, disciplinary approaches while Mode 2 are contextual, applied and accountable, in other words they have the potential for impact. Engaging with multiple stakeholders in complex ESD contexts, even if that engagement is primarily pedagogic rather than action based i.e. through the transfer of practical skills and or communicating new ways of exploring an issue, does mean that researchers can impact by being a part of the process they are investigating (Reason and Bradbury, 2001).

These initial challenges lead us directly into questioning how multi- and transdisciplinary studies can be fitted into a disciplinary based higher education system. Before considering this it is worth differentiating multidisciplinary approaches, as those which operate between, and draw upon, different disciplines; and transdisciplinary approaches which essentially works across the disciplines (Waas et al., 2012). Transdisciplinarity, as interpreted in this chapter, is complementary to multidisciplinarity and is characterised by a set of skills and attributes that should be made available to all stakeholders, i.e. teachers, students, researchers, practitioners and community participants. As impact becomes more important to HEI's it is possible that new 'issue' oriented research structures and centres will be introduced; such centres are becoming more common e.g. for natural resource management, for health and wellbeing, and this is reinforced by the opportunities that are generated by virtual centres which have access to a range of researchers, albeit from disciplinary based groups and departments. What has not been addressed adequately, and it could be argued that it is still not being so, is the cross agency and cross disciplinary training in transdisciplinary expertise. This calls for an exploration of the links between competences for SD and research competences (Lambrechts and Van Petegem, 2016, in press). Research and sustainability skills (e.g. systems thinking) and some of the conceptual (e.g. postitive feedback) and practical (e.g. diagramming) tools that support them should become part of the curriculum and training for all disciplines; possibly as part of a broad sustainability module or course.

CONCLUSIONS

This chapter has argued that research into ESD takes place in complex, 'real world,' problem contexts that seldom have clear cut 'sustainable' solutions. By extension, if sustainability is seen as an increase in adaptive capability, resilience, we need to be able to anticipate potential futures (i.e. that to which we have not yet been exposed) and to learn from them (Lemon et al., 2014). Issues of place and time need to be acknowledged, as many sustainability challenges are characterised by uncertainty when it comes to timescales and geographical scales. What we think is important for sustainability here and now might not be the case in the in another place in the world nor in the future (Wals, 2015). Committed research into ESD also requires social and physical access, even when this access is not evident (e.g. in isolated communities, Liarakou et al., 2014). Local, cultural, traditional, indigenous knowledge needs to be valued as sources for research. However, even when stakeholders involved in ESD are aware of the multiple perspectives, there's a danger to strive towards consensus, instead of acknowledging and respecting the differences.

The chapter has further argued that disciplinary knowledge and skills are important when it comes to handling sustainability issues, but it is not enough. In order to understand the complexity and uncertainty, holistic mapping of the problem is essential, leading towards a whole systems approach (Sterling, 2009). Because of the complexity of sustainability related issues, research into ESD has to adopt interdisciplinary and transdisciplinary methods that can triangulate and reflect that complexity. Interdisciplinarity means that an intensive collaboration between different disciplines leads to connecting the results in order to analyse a problem or topic together. Transdisciplinarity goes a step further, as it also involves other actors in society (e.g. NGO's, enterprise, etc.) in analysing the problem or topic; and more importantly, requires the acquisition of cross-cutting skills among all stakeholders (e.g. systems thinking, empathic awareness, communication skills). Transdisciplinarity offers opportunities to bridge the gap between research and society and as such must be seen as fundamental to all levels of education (Waas et al., 2012).

A final conclusion is oriented towards the role of the researcher, as he or she has to find a balance between mediation, facilitation and being an 'objective' outsider. This requires new mental models which are issue driven, rather than discipline or function driven, and a shift in the way new researchers are prepared to do research (see on this issue: Lambrechts and Van Petegem, 2016, in press). It requires action oriented and transdisciplinary skills and the recognition that sustainability research will not remain the responsibility of the Higher Education sector but is central to

action and as such should be undertaken by practitioners, and ideally community stakeholders, in the same way that professional researchers may become increasingly engaged in practice. There is therefore likely to be a significant re-defining of the roles played by, and expectations of, different stakeholders in the co-creation of more sustainable, less unsustainable, futures.

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Cultivating Action and Collaborative Research on ESD: Case study on the 'new researchers generation' in ENSI's network.

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ABSTRACT

Engaging in research has always been one of the main pillars in the vision of the Environment and School Initiatives network (ENSI). Schools struggling to realise aspects of sustainability in collaboration with their local communities cannot contribute to the development of theoretical and practical frameworks for education for sustainable development, if not deeply involved in a reflection on their own action. Action research and collaborative research have grown in ENSI since 1986 and to foster this approach a special group was started in 2008 with the aim of sharing ENSI ideas and practices with a 'new generation' of researchers, not previously involved in ENSI. The following chapter examines the history of this group, the initial philosophy of aiming to share very different research experiences and the findings of a small survey among the group members involved. The experience was not easy but positive. During the last 8 years new people were invited to join the ENSI initiatives and projects, and ENSI was able to incorporate new ideas and practices.

KEYWORDS

ENSI, involving new generation of researchers, research and innovation network

A BIT OF ENSI HISTORY

In the ENSI vision, from the very beginning research was not meant as an academic feature but as an inclusive tool, oriented towards professional development. Action research was the main research approach ENSI proposed to teachers and researchers: "Action research is not a form of technical or instrumental means/ends reasoning because means and ends are investigated jointly. It is a process which aims both to improve practice and to develop better theories to guide it. Hence, action research not only increases our understanding of how to achieve an innovatory curriculum concept in local and national contexts, but also further develops that concept." (Elliot 1991a, p.19)

The action research feature was taken further when ENSI was launched as a fully-fledged OECD CERI Project in 1991, and 'a pedagogical support person' (in many cases a researcher based in an university), was appointed in every country participating to the project, with the role of a teacher facilitator: "Problematising practice, destabilising the 'self ' and becoming reflexive are all necessary conditions for adopting an action research approach" (Elliot 1995,p.69).

This research vision is strictly connected with a vision of Environmental Education (EE) and of Education for Sustainable Development (ESD) as engagement for a future we cannot predict. If EE and ESD are conceived as 'education for change', then research (and action research) is not a luxury reserved for the few but it is an obligation for every professional engaged in innovation, including teachers: "As innovators, teachers are asked to take on, initially at least, the burden of incompetence" (Stenhouse 1975, p.169).

EE and ESD had to accept being embedded in a culture of complexity and to be focused on the 'structure which connects' all the elements of reality (Bateson, 1972). In this situation it is no more possible to clearly separate the observer from the observed (Maturana and Varela, 1992) and it is essential to pay attention to the 'relevance' of questions and to the 'values' that guide theories and practice, rather than to the correctness of results.

ENSI proposed a systemic view of Education where governance, teaching-learning processes and educational research were strictly connected together. As a result, research became one of the main components of any ENSI project, and of the ENSI network as a whole. Other components of ENSI projects were the presence of Educational authorities and of active schools/teachers/students. Educational Research guarantees the characteristic of continuous exploration and innovation that EE and ESD should have. As it was written after the Rio+10 Johannesburg meeting; "What makes ENSI so particularly effective is that it has formed partnerships across different levels of education in a way that has not been done before. By linking up education practitioners, education authorities, higher education institutions and government agencies, ENSI's partnerships are helping to address conflicting interests, and embed change towards Environmental Education and Sustainability in all levels of the education system" (Mayer 2004, p. 70).

In practice, what has characterized ENSI research was the interlinking of three main research lines:

- A collaborative research line mainly involving students, but also other local stakeholders, concerning SD problems and concrete actions to be carried out in order to improve the quality and the sustainability of the school or local community. In this line, ENSI focused on solving real problems, tackling controversial situations, and confronting the question of the values and interests of students, teachers and the local community. Students' ownership of projects was seen as a 'quality criterion' of the 'ownership of knowledge' and of their capacity to take initiatives in their own situation (situated knowledge).
- An action research line carried out mainly by groups of teachers inside a school who agreed to document the 'collaborative research' and at the same time to reflect on their own educational methodologies and aims was. The purpose of this was to better develop students 'dynamic qualities' (Posch, 1993) and their 'action competences' for sustainability (Jensen and Schnack, 1997). In this line ENSI focused on the epistemological level, trying to tackle questions of interdisciplinarity and complexity, understanding that real problems can rarely be simplified and fit neatly into one discipline (Losito and Mayer, 1995).
- A second order action research line (Elliott, 1991b), involving external researchers and teachers in order to jointly reflect on the feasibility and effectiveness of a whole project. The teachers' professional identity is often destabilised and their practices need to become reflexive rather than simply reflective. The researchers supported a whole project mainly as facilitator of the teachers' reflexivity. They were involved in the construction, together with teachers, of 'theoretical knowledge' on the perspectives and obstacles of EE and ESD. Supporting research and action research processes is not a simple task. There are no recipes: "it requires people to know how to improvise, not to lose sight on research objectives, to make the most of unexpected situations, and to build a concrete example of ecosustainable relations and behaviours" (Mayer, 2006, p.150).

BUILDING THE ENSI 'JUNIOR RESEARCHERS IN ESD' NETWORK IN 2008

In 2008 the ENSI network began to reflect on the need to involve a new generation of researchers committed to ESD. Without such a change there was a risk that ENSI would remain a closed community and to lose contact with the research that other groups in Europe and in the world, were undertaking.

ENSI called the group it was seeking to establish 'junior researchers' (JR) because independently of their ages they were all at the 'first step' of their research career,

rich in energy and enthusiasm, open to different ideas, interested in listening and exploring new research lines. The ENSI aim was to constitute a 'small community of practice', sharing ideas and questions about EE and ESD under the umbrella of the ENSI international network. One of the foci of the ENSI JR idea was to involve the group in ENSI network activities and projects, and to offer members of the JR group opportunities for regular exchange in order to compare and debate research questions and research methodologies.

ENSI started JR activity 2008 with a seminar in Switzerland, organised with the support of the Council of Europe. The seminar sought 'to harness the energy and enthusiasm of a new generation of researchers, committed to Education for Sustainable Development (ESD) and to pool the expertise of those research newcomers in the field of ESD by developing a small researcher's network' (ENSI Invitation letter).

The participants were invited to pool their research with others in their PhD or master's thesis or in other relational research projects. The idea was to share different approaches, methodologies, research topics and priorities, and culture and values based research styles. ENSI offered the JR's an experience in research collaboration and networking in the fields of EE and ESD. A deepening understanding of Action Research as a crucial methodology was also an outcome.

The seminar consisted to three days of sharing and debating with 19 researchers from 11 countries: Australia, Austria, Czech Republic, Germany, Hungary, Italy, The Netherlands, Spain, Sweden, Switzerland and the UK. Issues fundamental for any research practice were raised including:

- the 'values issue' and how ESD values influence the research paradigm,
- the impact of the "World Views" or "World Visions" ('mundovision' in Spanish), of epistemology and ontology, on research methodologies;
- the influence on research design of a consciousness of human and world complexity;
- the role of the research and 'the researched' in Educational Research;
- the influence on research of the kind of institution in which a research takes place, and vice versa.

The following is the synthesis given by one of the JR, Monika Reti (2012) a few years after the meeting: "People in the first part of their professional careers found it overwhelmingly exciting to discuss their general dilemmas about sustainability, to discover how others struggle with some similar research problems, to share

their views about teaching and learning from the ESD perspective, to learn about innovations and genuine actions carried out by others or to find out how solutions emerging from other disciplines may improve the quality of their own research and development activities. It was especially fruitful because group members (besides coming from different countries, having diverse cultural background) represented miscellaneous disciplinary areas (from sociology to engineering or science) and were engaged in the teaching and learning processes at various levels of education (from kindergarten to university)".

Continuing the ENSI's 'Junior researchers in ESD' initiative

The ENSI effort of involving JRs has continued from that initial seminar time until now. Different initiatives have been launched where the initial group met and where new people were invited to join the group. Some of the researchers became strong and effective agents of ENSI, others followed different life lines but many of them are in contact with ENSI, sharing their ideas and research results.

After the first seminar, ENSI tried to find situations and events where the JR group could meet. The digital platform was not easy to maintain as an active forum whilst personal contacts were strongly appreciated and gave opportunities to other 'Junior Researchers' to join the group.

In the Leuven Conference of 2009, ENSI gave the JR an important role. They were invited to be rapporteurs of workshops, to present posters and to conduct their own workshops bringing new ideas and fresh approaches to ESD. With the JR contribution, the conference served as an 'intergenerational learning platform' giving an opportunity to junior and senior researchers to share enthusiasm, doubts and questions. As Monika Reti wrote, the members of the Junior Research Group contributed to "making this conference a reciprocal learning exploit, which not only remains a pleasant memory but which empowers such future ambitions of professional exchange" (Reti, 2012).

The PRISM Research Conference held at the University of Gloucestershire in Cheltenham in 2011, gave the ENSI network the possibility to share ideas with another research network "of postgraduate and early career researchers, based in universities across the UK and overseas, who are engaged with the conceptualisation as well as the applied practice of sustainability-related research" (PRISM Conference Program). The focus of the Conference was the Interdisciplinary researcher, and research works were reported during three parallel sessions focusing on paradigms,

on practices and on possibilities. The PRISM Conference gave the ENSI JR network the opportunity to take part in a joint workshop on "Researching Education for Sustainable Development (ESD) for a Better World'. The workshop gave about 30 participants the opportunity to become acquainted with the research issues and methods of the ENSI network, to share experiences and concerns with ENSI junior and senior researchers, and to discuss research issues and methodologies.

In the PRISM ENSI workshop different questions about the utility of a research network were addressed. These questions included: what difficulties and/or open questions do researchers face and how can a research network help and support; what are the advantages for researchers in being active members of an international network; what are the research questions to suggest as a future challenge for an international network such as ENSI?

In the following period another important initiative was taken by ENSI in order to involve the JR network in concrete research practices. ENSI involved junior researchers in the CoDeS Life Long Learning project on Schools and Community for Sustainable Development. This project ran from 2011 to 2014 and the Quality Assurance of the CoDeS project was the responsibility of ENSI, and within the different features that characterised the ENSI approach to evaluation (discussed by Mayer and Dillon in a different chapter in this book), another innovative evaluation method was added. The internal evaluation of the three main conferences within the project was delegated each year to a different pair of junior researchers in ESD. These junior researchers were not involved in other partner institutions and they were new to the project. In this way, the evaluation process integrated fresh research perspectives and at the same time allowed people coming from different traditions to comment on the project.

The junior researchers worked under the guidance of Michela Mayer who served as Internal Evaluator of the CoDeS project and as such was responsible for their work. The JRs brought with them new ideas, new evaluation tools, fresh enthusiasm and produced good quality reports. They were also important for the dissemination of the CoDeS project work in institutions that were not CoDeS partners. The six junior researchers involved were all women, coming from different backgrounds and countries. Some of their comments after the completion of their work give an interesting reflection on the importance of this kind of exchange for researchers at the beginning of their career:

"Though my field is ESD in higher education, it made me realise that the challenges faced by schools and CoDeS project are similar to those in higher education for sustainability, and that we can learn from each other" (G. C. 2013).

"Being a bachelor student for business administration with a particular interest in sustainable development and education for sustainable development, I consider the participation in the CoDeS 2013 Conference as a great opportunity to get acquainted first-hand with the practices and possibilities of school-community collaboration. It was particularly interesting to experience the interaction between and active participation of a diverse variety of stakeholders" (L.R. 2013).

"Due to the role, I had the privilege to conduct interviews with many participants, which was a valuable chance to have deeper insights into the engagement and passion of the people. It was indeed inspiring experience to witness the willingness and the enthusiasm that people put into their work of ESD as a student interested in the field of SD" (J.A. 2014).

Perspective of Junior Researchers in a small empirical survey

To enrich the perspective of ENSI's involvement of JRs since 2008 a small qualitative survey of 12 JR members was undertaken. They were asked three open-ended questions with the aim of capturing their subjective perspectives and understanding the reciprocal influences (Heinrich 2005, p. 92) that ENSI structures and JR members had in this mutual activity. "Meaningful text units" were structured in an open coding process (Saldaña 2012, p. 114), in order to analyse the results against the background of subjective plausibility and inter-subjective conceivability (Bosch 2010, p. 387). The aim was to try and identify components that showed a certain consistency that could be easily distinguished and that at the same time were connected inextricably (Deleuze and Guattari 1991, p. 19) to serve as axial coded references (Saldaña 2012, p. 222).

To begin with, the components in each of the three guiding questions below were identified. The findings are derived from the answers of the 12 JRs, which were paraphrased from their quotations. Paraphrasing instead of original quotations became necessary, because most of the JRs answers overlapped in some way. Some of the original quotes have been kept (shown between quotation marks), because they highlight some specific characteristic. The identities of the 12 JRs have been kept anonymous.

Q1. How did you perceive ENSI's research and innovation activities when you approached ENSI?

- JRs perceived ENSI as a dynamic and independent network of research and innovation opening new ways of understanding environmental education and research paradigms. In particular the action-oriented approaches such as the action research undertaken by the network were seen as critical to link "theory to practice and action" connecting stakeholders at "all levels of the educational sector with expertise in curriculum, school policy..."
- ENSI connected researchers, fueling the competences of "my work and the work of others" and opening up a broader and different view of what ESD research could imply.
- ENSI involved the JR members in several European projects such as SEED, CSCT, SUPPORT and CoDeS, emphasising sustainable development and schools.
- The international cooperation has been mentioned as an encouraging but at the same time difficult endeavor due to language barriers and cultural diversity. This complicated the process to the extent that it hindered the emergence of real innovation.
- In general the participation in ENSI had been perceived as empowering for the JR members. The network welcomed them as young people with "open arms" and placed the responsibility of particular tasks on them. That was been perceived as a rare opportunity, because representatives of the "youth are seldom meaningfully engaged or consulted ... for existing projects, programs and events". This kind of support is important, because researchers at the beginning of their career often "face critique and unacceptance", when undertaking innovative approaches.

Q2. To what extent your involvement with ENSI contributed to your vision of ESD and to your research activities?

- JR members valued following other researchers in the ENSI and JR community, experimenting on their "winding road, and in a continuum of reformulation and new ways to understand things", which sometimes end up in PhD theses. The ENSI JR meetings served to structure work, and enrich it with contributions from other people and other research, and through being "taught to ask the right questions". The members could actively and professionally explore the vision and principles of ESD.
- ENSI activities triggered JRs to approach ESD based on research paradigms "to achieve more human goals" as encounters to explore differences and to embrace complexity, the action competence approach, the socio-critical paradigm, the interdisciplinary approaches (e.g. "dialogue with art"), "dealing with uncertainty" and the "focus on competences for SD". In a more critical perspective these components of ENSI as well as being helpful as tended to be "a bit too theoretical (model-oriented)" and showed sometimes "too little cohesiveness and resources" to be meaningful in the work of the JR members.
- The working with and in respect of, the local community and the collaboration with educators, researchers and policy makers and in particular "isolated communities" helped to understand different stakeholders' worldviews, priorities and experiences with ESD and to value networking.
- Offering opportunities to experiment and to design workshops together with other JR members in workshops, conferences and as an online community. Those experiences of collaboration "showed that 1 + 1 = 3!".

Q3. Which advice can you give to the ENSI network to strengthen its "engaging research" platform and initiatives?

- The activity of the JR network depends heavily on joint activities such as CoDeS to provide purpose for collaboration and involvement on a regular basis. A common goal or outcome, such as "collaborating on a project or publication together", is essential to encourage people to be active in a network. It might be important to clarify the role of JR in ENSI activities. The JRs could be more active if ENSI offered opportunities and funding to the JRs to organise and conduct small research projects to be undertaken by members.
- The phase in the career of the individual JR member should be considered, as some need support in PhD writing through PhD and master's classes, whilst others who have started employment need support in researching their practice. This is particularly true for those who seek to research and innovate teaching and curricular practice, developing high quality international education projects that are "truly innovative". It is a matter of fact that in this community JRs will only participate if they see an added value to enrich their daily work.
- JRs recommendations for joint activities included joint literature seminars, conferences, publishing and disseminating EE and ESD research papers and books, newsletter and ICT based conversations and web-seminars. Collaboration might include mutual data collection, exchange of theoretical ideas, research methods and lead to co-write articles and organisation of international workshops.
- Last but not least, ENSI is strongly requested to recruit and engage new JR's and other ESD researchers through stronger networking.

CONCLUSION

The findings of the survey highlight some of the crucial components of a Junior Researcher's involvement in an international network for research and innovation of EE and ESD. The JRs expressed their commitment to a network that offers a unique approach of diverse stakeholders in the educational field of EE and ESD. They appreciated the chances to participate in active roles as evaluators and co-researchers to gain in-depth views into the work of national and international collaboration of researchers, policy makers, community member and educational practitioners. The participation supported their student's and research careers and enabled new perspectives on the epistemological paradigms of EE and ESD.

In summary it seems that the ENSI network offered something special. It was this first-hand experience in the practical actions conducted around the world in the field of ESD that make the ENSI JR 'unique'. In the UNESCO Midterm review of contexts and structures for ESD, Arjen Wals in 2008, noticed:
"Little evidence was provided in the mid-term review that there are policies in place in formal education, professional development and teacher training that encourage educators to become reflective practitioners themselves and to conduct their own research. There are, however, some networks of practitioners and academics that seek to bridge the theory practice divide using forms of action research to improve practices" (UNESCO 2009 p. 62; the ENSI description follows in Box 27).

The JRs also gave critical feedback and expressed aspirations in their feedback. International collaboration is expensive and as all cultural exchanges sometimes need significant effort in terms of language and intercultural abilities. In addition the personal life and careers of JR members naturally leads to a fluctuating membership and therefore a challenge to long-term collaborations. The willingness of the JRs to participate in ENSI in peripheral and sometimes central position is encouraging and it is up to ENSI to open their frequent activities to JR. For example, opportunities for JR to take part in both conferences and funded projects would be hugely welcomed by both existing JR members as well as new candidates.

Other possibilities to enhance this kind of exchange and collaboration might be to improve universities openness to action oriented international networks. What made a difference in the ENSI network wasn't just the deepness of the theoretical approach – that could be offered by many universities – but the mixture of and balance between, academic rigour and practical involvement. The collaboration between universities is very important (at the moment there is in Europe an interesting attempt to improve this collaboration through the Erasmus + project University Educators for SD - UE4SD) but the connexion with national educational authorities and the concrete world of formal and informal educators is an added value that the research world should take into account.

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The role of transdisciplinarity in research and education for sustainable development

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ABSTRACT
Sustainability problems are widely recognised as wicked problems. The scientific expertise needed to deal with multifaceted and complex sustainability problems requires innovation, creative thinking, action-orientated and transdisciplinary approaches. This chapter explores the transdisciplinary approach with sustainability lenses and highlights the need of transdisciplinary practice as one of the guiding principles of education for sustainability by bringing about mutual learning, collaborative research, and problem solving processes among academia, business, government and civil society. The concept of linking knowledge to action for sustainability requires a very different type of education to generate the knowledge that matters to people's decisions and education. From analysing the principles and different implications of the transdisciplinary approaches on both sustainability research and education and revising some implementation experiences on transdisciplinary education approaches for sustainability it is concluded, that transdisciplinarity has the potential to break the dominant fragmentary disciplinary thinking. Some of the assessments of transdisciplinary experiences suggest that there is a need to focus on education professionals training and on the revision of the best practices.

KEYWORDS
Higher education, knowledge co-creation, Transdisciplinarity, sustainability science

INTRODUCTION
In our world characterised as it is by rapid change, uncertainty and increasing interconnectedness, science is increasingly called on to contribute to the solution of persistent, complex, global problems. There is political agreement on the need to build awareness and develop strategies to deal with current societal global challenges, such as economic crises, climate change, desertification, deforestation,

environmental degradation, inequalities, wars and poverty eradication (United Nations, 2012) and in this global context, the idea of sustainability as the way forward to ensure quality of life, equity within and between current and future generations, and environmental health, has gained widespread international recognition.

Although the conceptualisation of sustainability remains controversial, and there are different perspectives and definitions of the term (Dresner, 2002), the academic approach to sustainability is to generate scientific knowledge, as well as other forms of knowledge, from different subject areas, such as social and environmental sciences, economics, ethics and politics.

Transdisciplinarity (Td) breaks away from this fragmentary disciplinary thinking (Ramadier, 2004) preserving the different realities to confront them in a controlled way, no longer searching for consensus but for articulations. The intellectual fluidity is also what possibly most clearly distinguishes Td from both multi and interdisciplinary inquiry. As multi refers to cooperation among epistemic stakeholders without intellectual cooperation and inter refers to cooperation through an integrative concept, Td refers to intellectual cooperation by ad hoc rules adopted for each individual case (Huutoniemi et al., 2010).

SUSTAINABILITY AND TRANSDISCIPLINARITY

Sustainability problems are widely recognised as wicked problems (Hadorn et al., 2006; Lawrence and Després, 2004; Klein, 2014; Seager et al., 2012; Rieckmann, 2012; Wiek et al., 2011; Brundiers and Wiek, 2010). As Norton (2005) conceptualises, sustainability problems typically exhibit five characteristics that are shared by wicked problems: difficulties in problem formulation, multiple but incompatible solutions, open-ended timeframes, novelty (or uniqueness) and competing value systems or objectives (Seager et al., 2012). In this sense, beyond the scope of the current industrial-age science, sustainability problems involve dealing with ambiguity, complexity, different stakeholders, views and values and are difficult to solve because of their evolving and moving nature. The scientific expertise needed to deal with these multifaceted and complex sustainability problems nature is in need of reform, so that it requires innovation, creative thinking and problem-driven, action-orientated and transdisciplinary approaches.

The concept of Td has also become aligned with sustainability in the most recent discourse on problem solving (Klein, 2014). Knowledge demands from society are about issues that call for change in societal practices. These can be complex matters,

"*where facts are uncertain, values in dispute, stakes high and decisions urgent. In such a case, the term 'problem', with its connotations of an exercise where a methodology is likely to lead to a clear resolution, is less appropriate" (*Funtowicz and Ravetz, 1993, p. 744). The situation is not so much solved, as frequently attempted, by creating supposed teams of specialists in different areas, around a given problem. With such a mechanism one can only hope to achieve an accumulation of visions emerging from each of the participating disciplines. As Max-Neef stated *"an integrating synthesis is not achieved through the accumulation of different brains. It must occur inside each of the brains and, thus, it's needed to orient higher education in a way that makes the achievement of such a purpose possible"* (Max-Neef, 2005, p. 5). The 'problem' situation demands a problem-solving strategy that is achieved through a transdisciplinary orientation in research, education and institutional aims (Jagër, 2008). With sustainability as its normative model, scientific activity is demanded to be an "agent of change", adopting problem-solving approaches and innovation for society (Leuphana, 2012). It raises the need to efficiently consider Td as one of the guiding principles of education for sustainability.

Agreement exists on the need to develop new ways of knowledge production and decision-making in order to deal with sustainability challenges (Lang et al., 2012). A critical element of sustainability science is the engagement of different actors from outside academia into research processes. This allows the integration of the best knowledge available, the reconciliation of different values and political interests, and taking ownership of problems and solutions. In this sense the multidisciplinarity, interdisciplinary and transdisciplinary aspects of sustainability have been widely acknowledged as the best means to deal with sustainability.

Participatory, interactive, transdisciplinary, transacademic, collaborative and community-based research approaches are referred as appropriate means to meet both the requirements posed by real-world problems as well as the goals of sustainability science as a transformational academic discipline (Lang et al., 2012). The commonality of these approaches can be found in the establishment of widened participation and research collaborations amongst scientist and non-academic stakeholders from business, government, and the civil society to address sustainability challenges. The next sections focus on the need for, and the principles of, transdisciplinary approaches.

DEFINING TRANSDISCIPLINARITY

After 40 years of intensive scholarly discourse a universally accepted definition is

not available and consequently, approved guiding standards for transdisciplinary research and education are also lacking. One reason could be that, at first sight, Td appears to be a rather elusive concept.

Beyond cross-disciplinary methodologies (Scholz and Marks, 2001) Td is transcending, transgressing, and transforming. It is theoretical, critical, integrative, and restructuring but, as a consequence of that, it is also broader and more exogenous (Hadorn, 2008). Thus by bringing about mutual learning, collaborative research, and problem solving among business, government and civil society, Td can serve as an important guiding concept for sustainability science and practice. Td emerged to counteract the tendency of disciplines to separate knowledge into artificial compartments (Russell et al., 2008). The central challenges of transdisciplinarity are:

- **Crossing boundaries:** between disciplines, between academia-society, individuals-companies, between forms of generating knowledge and communication and between educational systems;
- 'Not for society, but **with society**' (INIT, 2012): Moving from a conception of research on or for society, to research with society;
- **Co-production and integration of „knowledge"**: related to the resolution of a complex and evolving problem, it is considered the main cognitive challenge of transdisciplinary process. A problem solving process moves to a process-driven approach of problem definition and problem managing.

FROM DISCIPLINE TO TRANSDISCIPLINE

Different approaches exist between disciplinarity and transdisciplinarity (see Table 1, Figure 1).

Disciplinarity is about a mono-discipline, which represents specialisation in isolation. In both multidisciplinarity and pluridisciplinarity, disciplines are considered as being complementary and juxtaposed in the process of understanding phenomena, taking into account only part of each model, in order to maintain coherence. This approach highlights the different dimensions of the object studied and respects the plurality of points of view, searching for consensus.

Interdisciplinarity differs from multidisciplinarity in that either it constructs a common model for the disciplines involved, or transfers models or tools from one discipline to another based on a process of dialogue between disciplines, with the purpose being to create a new approach, as new needs and professions have emerged (e.g. biotechnology, cheminformatics, nuclear medicine). Interdisciplinarity,

like multidisciplinarity, avoids paradoxes and having to solve them, both approaches are fragmented in dealing with disciplinary thinking.

Cross-disciplinarity	***Multi-***	***Pluri-***	***Inter-***	***Trans-***
Thinking system	*Disciplinary*			*Real-life*
Boundaries and Integration	*Non crossing —> Non integration*		*Crossing —> Integration*	
Objectives and models	*Juxtaposition*	*Compatibility*	*Common*	*Coordination (academia+ society)*
Tools	*Comfort*	*Combination*	*Consensus*	*Articulation*
Results achievement	*Comparison*	*Coordination*	*Synthesis*	*Confrontation of paradoxes*
Particularities	*Difference of dimensions and approaches*	*Strengthening understandings*	*Transfer of tools and models*	*Preservation of realities*

Table 1. Characteristics of multi-, pluri- inter- and transdisciplinarity

Transdisciplinarity goes a step further and breaks away from this type of thinking, since the objective is to preserve the different realities and to confront them in a controlled way, no longer searching for consensus but for articulations. The aim is thus to avoid reproducing fragmentary models typical of disciplinary thinking (Ramadier, 2004) and also to take into account the real-life thinking.

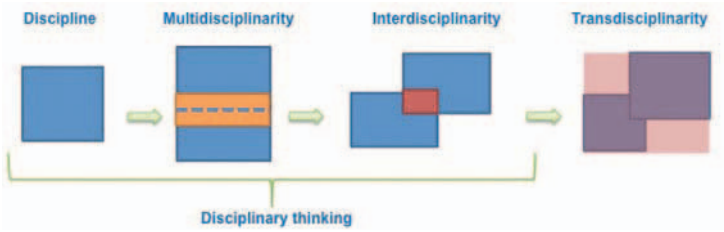

Figure 1. From discipline to transdiscipline (adapted from Ramadier, 2004).

THE PRINCIPLES OF TRANSDISCIPLINARITY FOR RESEARCH AND EDUCATION

Sustainability research and transdisciplinary research strongly overlap and they are often used interchangeably (Kates et al., 2001). In this sense transdisciplinary aspects of research for sustainability also encompass the different academic disci-

plines, and it is based on participation and collaboration between different actors and stakeholders.
Td is also seen as an ambiguous and contested concept with a variety of terminologies and definitions and diverse research approaches used. Yet where concepts or ideas are not properly defined, the risk is, that a rather shallow interpretation prevails, a fate that paradigmatically befalls the notion of sustainability. The likely damage that can occur with such a mainstreaming is, that the true challenges of transdisciplinary collaboration are underestimated (Jahn et al., 2012).

In the earlier conceptualisations Td was understood as a superior form of interdisciplinarity with its aim being to develop an overarching framework for complex problems that needed to work across disciplines.

By the end of the last century new definitions of Td as a methodology emerged. This was mainly because of the need to facilitate a broader scientific and cultural dialogue within the new complexity view and the need to deal with real-life problems such as sustainability (Klein, 2004). Thus Td is a reflexive, integrative, cooperative, method-driven process that aims to (Lang et al., 2012):

a) Identify the solutions to or transitions of relevant societal problems and concurrently of related scientific problems by integrating knowledge from various scientific and societal bodies of knowledge;
b) Enable mutual learning processes amongst researchers from different disciplines (from within academia and from other research institutions) as well as actors from outside academia, on an equal basis; and
c) Create and integrate knowledge that is solution-orientated, socially robust, and transferable to both the scientific and societal practice, also considering that Td can serve different functions, including capacity building and legitimisation.

Td research is also considered a form of action research. Participation and learning circles have to start from the beginning where the scientist acts as an "observer of the common learning process" (Häberli et al., 2001). The concept of linking knowledge to action for sustainability (Kates et al., 2001) obviously requires a very different type of research and education to generate the knowledge that matters to people's decisions, create an education that enables students to be visionary, creative, and rigorous in developing solutions, and leave the protected space of the classroom to confront the dynamics and contradictions of the real world (Wiek et al., 2011). Also, Td raises the question not only of solving problems, but also of problem choice and definition (Klein, 2004), where different approaches are needed depending on the kind of problems.

FROM TRADITIONAL KNOWLEDGE BOUNDARIES TO KNOWLEDGE CO-CREATION

Over the last decades many scientists have argued that our relationship with a complex world requires complex thought. Max-Neef (2005) suggested that knowledge should be organised around hierarchical systems at four levels: purposive (values), normative (social systems design), pragmatic (physical technology, natural ecology, social ecology) and empirical (the physical inanimate and animate worlds, and the human psychological world). As Figure 2 shows, this hierarchy corresponds with the pyramid of Td, where the four levels (purposive, normative, pragmatic and empirical) are interconnected, including horizontal principles within levels (interdisciplinarity) and also vertical principles between levels (transdisciplinarity).

Figure 2. Pyramid of transdisciplinarity (adapted from Max-Neef, 2005)

Furthermore, in the context of research, three types of knowledge are needed to accomplish a Td research process:

1. Systems knowledge: related to the origin and development of problems. It seeks to identify causal relations, the interconnections and complexity existent within systems;
2. Target knowledge: this makes reference to the knowledge and development of the required or desired system status to be reached, e.g. in the identification of the need for change, desired goals and better action;
3. Transformation knowledge: is about the means to achieve a transformation,

in relation to the technical, social, historical, legal and cultural dimensions amongst others. It is related to the means needed to transform existing action into new directions.

The domain of Td research is situated at the interface between these three types of knowledge, which are seen as to be complementary. As Figure 3 shows, Gaziulusoy and Boyle (2013), linked the pyramid of Td with the three types of knowledge as part of the transdisciplinary research processes.

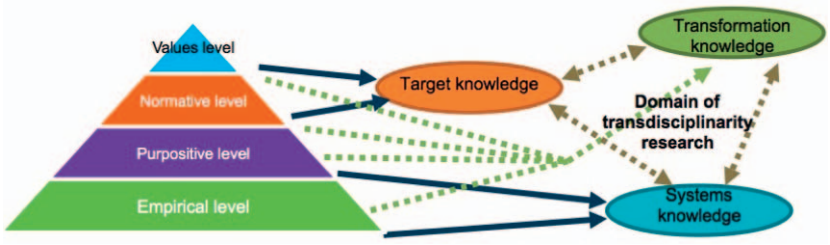

Figure 3. Relationships between the pyramid of transdisciplinarity and the three types of knowledge of the transdisciplinary research (Gaziulusoy and Boyle, 2013)

Systems knowledge is mainly acquired from the two bottom levels, which provide the empirical information necessary to understand phenomena and situations. Target knowledge involves visioning for a new system status, and is mainly obtained from the normative and the values levels of the pyramid. Transformation knowledge does not directly link to any of the levels of the pyramid since the means to achieve this transformation are amorphous and vary according to the problem or situation being addressed. It is therefore generated through the reflection and synthesis of knowledge from all four levels of the pyramid.

TRANSDISCIPLINARITY IN HIGHER EDUCATION FOR SUSTAINABILITY

Spangenberg (2011, p. 275) suggested there is a distinction between the "traditional disciplinary-based science for sustainability (descriptive-analytical) and the transdisciplinary science of sustainability' (transformational)". In other words, sustainability science in its transformational mode seeks broad transdisciplinary participation throughout research and practice, focused on solving sustainability problems. Regarding complex, actual "wicked problems", Kates and colleagues maintain that sustainability research and transdisciplinary research strongly overlap and are hence considered interchangeable (Kates et al., 2001).

Without having reached the 1997 Locarno Declaration aim to devote 10 percent of teaching time in each discipline to Td (Locarno International Congress, 1997), the inter- and transdisciplinary approach still experiences promising advances in education and research. It does at the same time face institutional, epistemological and methodological barriers (Darbellay, 2014). Therefore, beyond the university, transdisciplinary education can occur in situ, in the workplace and in projects with community stakeholders (Klein, 2008). In this sense the most complex challenge according to Nicolescu (2000) is the teaching of education professionals and developing appropriate pedagogy.

In spite of this the business of education has traditionally been just the transmission of knowledge. However the future has to be more dynamic. Inter- and transdisciplinary researchers offer new academic profiles for the multiple and hybrid identities that take the risk of working on the boundaries of disciplines. To encourage this, the skills associated with them should be supported, enhanced and valued (Darbellay, 2014). In different sets of transdisciplinary skills (Derry and Fischer, 2006; Pohl et al., 2008), the underlying theme is cognitive flexibility, manifested in a willingness to see beyond one's own discipline and to the integration of knowledge. Of course, the authors warn that nobody will be expert in all areas and other members and teams are needed to fill skill gaps. Additionally, the concept of linking knowledge to action for sustainability (Kates et al., 2001) has been reiterated during the last decade in the discourse of Td (Komiyama and Takeuchi, 2006; van Kerkhoff and Lebel, 2006; cited in Wiek et al., 2012), in alignment with research methodologies as action research, participatory future studies, etc.

Td education and research methods developed in different universities (Scholz and Tietje, 2002), have required innovative methods that can allow knowledge integration in four differentiated dimensions:

1. Different disciplines in order to establish interdisciplinarity (humanities, social and natural sciences)
2. Different systems and compartments to create holistic approaches (such as water, soil, air)
3. Different qualities of thought (such as intuition and analysis)
4. Different interests of stakeholders involved

Td or forms of Td have been introduced in many different formats in curricula. As there is no systematic compilation of models and practices (Klein, 2008), some

initiatives and practices have been collected from network websites, publications from conferences, and books:

Compulsory courses in undergraduate programs
Minor Sustainability in Humanities, Leuphana University, Germany;
First-year course: Society, Science and Culture, Faculty of Education-GRET, UaB, Spain;
Ecosystem Health Program, University of Western Ontario, Canada.

Master programs
Graduate Studies and Continuing Education in Transdisciplinarity, ETH-UNS, Zurich;
Master in Sustainable Development, University of Basel, Switzerland;
Master's program Sustainability Science, Leuphana University, Germany;
Master in Science and Technology for Sustainability, UPC-BarcelonaTech, Spain.

Doctoral programs
Transdisciplinary Ph.D. Program, Stellenbosch University, South Africa;
Transdisciplinarity course at Doctoral school "European Paradigm", Babes-Bolyai University, Romania.

Winter or summer courses
"Science Meets Practice" Winter School, Competence Center Environment and Sustainability- CCES, Wislikofen, Switzerland;
Td Summer School, Leuphana University.

Workshops
Training courses or activities for professionals and other academic modalities, Wageningen Initiative for Strategic Innovation, Wageningen UR, Netherlands;
Intensive participatory design process led by the Interdisciplinary Research Group on Suburbs- GIRBa, Faculté Aménagement, d'Architecture, d'Art et de Design, Université Laval of Québec City, Canada.

A few universities have implemented an experiential learning environment that affects the whole learning and campus living of students including the Institute for Sustainability and Technology Policy, Murdoch University, Australia; Leuphana University of Luneburg, Germany; and the School of Sustainability, Arizona State University- ASU, USA.

Generally speaking, academic programmes tend to be located within discipline-

dominated institutions rather than autonomous institutions. Often when entering Td, researchers enter unfamiliar grounds for the production of scientific knowledge (Hadorn et al., 2006).
At the graduate level, Fry (2003) urges an increase in the availability of supervisors in pertinent methods, more teamwork, a wider range of courses and seminars, and greater opportunities to mix with students of different knowledge cultures.

Other areas for improvement include collaboration between academics and practitioners, joint problem definition, and the guidance of students to participate successfully in collaborative, real-world projects. In the AGB project, students strongly felt the need for additional research to connect research on how people learn with research on pedagogy, or how to teach people how to learn (Holden et al., 2008).

Nevertheless, operationalising the goals of the field, developing the necessary competencies, and seeking novel partnerships between society and the academy will position academic institutions to impact on the transition towards sustainability (Leeuw et al., 2012).

CONCLUSIONS
In a context of complex real-life scenarios Td emerges as a critical method-driven approach to the progress and development of the new academic field of sustainability science. Td as a research approach spans across disciplinary boundaries to develop a holistic approach with society. The aim is to search for articulations and thus to avoid reproducing fragmentary models typical of disciplinary thinking and also take into account real-life societal problems. It allows a dialogue and collaboration to be established between disciplines and society, where mutual and transformative learning can be fostered, which can in turn provide the management of solutions to current sustainability challenges that society is facing.

The largely declared need for universities to prioritise their pragmatic social mission of addressing problems coming from society (CERI, 1982) towards a common social purpose should be the key to address the transgression path through a "socially robust knowledge". In this sense, the search for articulations of different realities has to be present in the higher education for sustainability framework (curriculum structure, faculty competences, pedagogical approaches, etc.). This opening movement can also be seen in the researchers' transformed and hybrid identities that lie between and beyond disciplinary boundaries and participate in the development of a new thought style.

This chapter focuses on the potential of transdisciplinarity to break the dominant research and education approach of fragmentation and to avoid reproducing fragmentary models typical of disciplinary thinking. An unanticipated analogy emerged between the kind of additional responsibility central to the Td experiences and the additional responsibility that is central to moving toward sustainability. Issues that point the way to transdisciplinarity for sustainability are the revision of the best practice and best thinking on teaching and learning possibilities. The further aim is to integrate and to co-create between disciplines, between researchers and practitioners, and between research-based knowledge and action.

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The role of the critical friend in supporting action for sustainability: exploring the challenges and opportunities

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ABSTRACT
Many universities have signed international and national declarations that have publicly committed them to embed sustainability within education, research, outreach and management operations. To date, research has focused on examples of good practice and case studies. Little research exists that has looked at the change process itself. This chapter is based on a doctoral study conducted at the University of Southampton in which a doctoral student was engaged as a critical friend for a period of more than one and a half years working with a group of staff and students trying to implement a programme to embed sustainability within the institution. In this paper evidence is provided on the impact and contributions made by the critical friend, and reflections presented on the challenges and opportunities the critical friend encountered during the research.

KEYWORDS
action research, critical friends, higher education, institutional change, sustainability

INTRODUCTION
Many universities have signed international and national declarations and have publicly committed themselves to work towards achieving sustainability in their education, research, outreach and management operations (Wright, 2004; Higher Education Funding Council for England, 2010). However sustainability in Higher Education (HE) is a rather recent and emerging research area (Wright 2010). Most of the research in the field has focused on: environmental management and greening of university estates and operations; descriptive case studies and examples of good practice; embedding sustainability in specific courses such as environmental sciences, business and engineering; theoretical developments in teaching and learning approaches towards sustainability; university and policy analysis (Cotton et al., 2009; Barth and Rieckmann, 2013). The lack of a theoretical basis for research conducted in the field has been criticised for leading to descriptive and non-theoretical accounts

(Fien, 2002; Corcoran et al., 2004). It could be argued that the focus of research to date has been on explaining part of the transformation stories, as papers have concentrated on the achievements and positive experiences without paying sufficient attention to the barriers to progress and the process of change per se (Velazquez et al., 2005). The environmental management and greening of campus operations and estates has seen much more progress than curriculum development (Jones et al., 2010). Despite the emerging literature, the signing of international declarations and the creation and development of university strategies and policies, little implementation and holistic transformation has been achieved in the curriculum arena so far (Thomas, 2004; Cebrián, 2014). Curriculum, pedagogy, structure, organisation and ethos are the shaping dimensions of education, therefore embedding sustainability implies a cultural change rather than an add-on to existing curricula and structures (Sterling, 2004).

The existing body of literature reports on different university experiences in implementing sustainability, but HE institutions have so far failed to bring about the necessary structural changes required for the paradigm shift and transformation advocated by Education for Sustainability (EfS) experts (Sterling, 2004; Tilbury, 2012). Most of the research has focused on small-scale projects and examples of good practice that show the potential for creating organisational learning and in HE becoming a leader and innovator to advance sustainability (Albrecht et al., 2007; Beringer and Adomßent, 2008). These projects have generally proved successful but they are sometimes fragmented and often happen on the margins of the institution (Sharp, 2002).

Institutional commitment, allocation of resources for innovative projects, leadership and the professional development of staff, amongst other factors, are needed for holistic curriculum change towards embedding sustainability (Ryan, 2011). Emergent areas of research on sustainability in HE, which so far have been overlooked include the professional development of staff, organisational learning and change processes and leadership (Thomas, 2004; Tilbury, 2012; Cebrián et al., 2013). Few contributions in the literature report on lessons learned derived from successful organisational change projects and the wider application of these in HE (Velazquez et al., 2005; Verhulst and Lambrechts, 2015, in press). Universities face two major challenges in becoming learning organisations towards sustainability: the fact that sustainability is an evolving and moving target and the need to "become skilful at the process of change itself" (Sharp, 2002, p. 129). Further research is needed to understand the processes of organisational change and learning towards embedding sustainability

in HE curriculum (Cebrián et al., 2013). Little empirical research on EfS has documented the key issues, processes and learning generated through organisational change processes (Velazquez et al., 2005; Verhulst and Lambrechts, 2015, in press). There is a need to promote research on curriculum and staff development within an institutional environment to truly aim for the implementation of the principles of EfS within university curriculum and for the generation of holistic organisational change (Holdsworth et al., 2007; Barth and Rieckmann, 2012). Within a university, success in embedding sustainability depends on learning at an individual and institutional level. This involves the empowerment of members of the organisation and the creation of spaces for collective and interdisciplinary reflection and collaboration, that encourage learning, critical reflection on existing practices and worldviews, and creative and innovative action (Sterling, 2004).

One of the aims of the doctoral research described in this chapter was to explore the organisational learning processes linked to curriculum development in the area of sustainability in HE, taking the University of Southampton as the focus (Cebrián, 2014). The overall aim of the research was to inform future developments and actions of the University in terms of curriculum development and organisational learning towards sustainability. This chapter is based on part of the work emerging from the doctoral studies. In this work a doctoral student was engaged as a critical friend for a period of more than one and a half years with a group of staff and students at the University seeking to implement a programme to embed sustainability within the organisation. In this chapter the methodological contribution of this work is presented. Evidence is provided on the impact and contributions made by the critical friend and reflections presented on the challenges and opportunities encountered during the research.

ACTION RESEARCH

Framing the different dimensions of action research

Participatory and action-orientated approaches have been said to be critical in fostering organisational learning and change towards sustainability in both private and public organisations (Doppelt, 2010). Action research methodology is in line with EfS processes such as learning-by-doing, empowerment, dialogue and collaboration, innovation, and active and participatory learning (Tilbury et al., 2004). In this study, action research allowed the critical friend to adopt an active role as a researcher to examine a real change programme towards sustainability at the University and permitted her to work with practitioners in order to reflect and promote changes

in the curriculum and institution. The methodological principles of action research are: the integration of research and action; it is conducted through collaborative partnerships; there is a high level of reflection; it stimulates transformative learning amongst participants; it embraces broader political and historical contexts and it starts from aspiration and a vision of social transformation and social justice (Somekh, 2006).

For Noffke (2009), there are three dimensions of an action research approach: the personal, the professional and the political. These dimensions can be differentiated according to the purpose of the action research work in educational settings, where different assumptions and practices can be recognised. The personal dimension makes reference to the practitioner as researcher and the processes of self-reflection, planning and introducing changes to improve self-practice (McNiff and Whitehead, 2002). The professional dimension corresponds to professional development goals which usually in education have the aim of enhancing the skills of the teaching profession (Noffke, 2009). The political dimension is usually embedded in the other two dimensions, but the purpose is mainly to generate democratic processes to empower those groups that are often without a voice, such as lower socio-economic groups and underprivileged communities (Carr and Kemmis, 2009). It is linked to power and political issues, structures, participation and the decision-making process within a community, and ideally leads to educational and social change (Kemmis, 2010). For Noffke (2009) these three dimensions are interconnected, however researchers tend to focus on a single aspect.

The integration of these dimensions is what makes action research particularly relevant and transformational in the exploration of sustainability because of the different interpretations and complexity of the term (Marshall et al., 2011). The emancipatory or critical approach consciously explores the relationship between these three dimensions (Carr and Kemmis, 1986). Acquiring a dialogue and a self-critical position in relation to real problems of practice can lead to new insights and ways of embedding sustainability holistically in the curriculum. It can also potentially lead to educational and social change. For this reason, Emancipatory Action Research (EAR), placed in the critical paradigm, brings about personal, professional and organisational learning towards curriculum development in EfS (Cebrián et al., 2012; Cebrián et al., 2015).

Moreover, a useful differentiation is made between first, second and third person (or order) action research (Reason and Bradbury, 2008; Marshall et al., 2011). Action

research projects that engage all three modes of practice, such as this one, are more compelling and sustainable in the long-term. This study contemplated the influence and impact of the critical friend role, the assumptions, motivations and values and the learning gained through the research process at a personal and professional level (first person action research). According to Reason and Bradbury (2008, p. 6), "second person inquiry starts with interpersonal dialogue and includes the development of communities of inquiry and learning organizations". This study was carried out with an existing community of practice. The researcher engaged them in collaborative, supportive and reflective discussions that aimed to develop new understandings and practice in EfS, fostering organisational learning towards sustainability (second person action research). The third-person action research makes reference to extending the project to the wider community consequently having a wider impact that can contribute to wider human and social development. This is the contribution made through the development of an evidence-based model on how to embed EfS within the undergraduate curriculum at the University of Southampton (Cebrián, 2014). In this chapter the focus is on the processes and outcomes from the critical friend role.

The critical friend role

A critical friend, as the name indicates, is a person who assists reflective processes in a supportive and helpful way. Costa and Kallick (1993, p. 50) define a critical friend as:

> *"A trusted person who asks provocative questions, provides data to be examined through another lens, and offers critique of a person's work as a friend. A critical friend takes the time to fully understand the context or the work presented and the outcomes that the person or group is working towards".*

Critical friends are facilitators of learning. They are able to listen, step back from the process, and assist through providing another perspective (Kember et al., 1997). Critical friends allow for time to reflect on processes and actions. Action research is about the process of learning in both the insider-teacher and the outsider-supportive role. The critical friend is an outsider-supportive role and can adopt different approaches, being more proactive or passive, depending on the project and the needs of the group (Kember et al., 1997). Critical friends have been widely used in a school context to promote individual and professional learning and reflection on practice (Bambino, 2002; Butler et al., 2011). They can be outsiders to the organisation such as HE academics or external advisers acting as educational experts (Nind, 2003), or they can be peers from the same organisation or peers from other schools

(Bambino, 2002). Critical friends, being external advisers (Kember et al., 1997) or peers (Fulcher and Paull, 2010), have been used in HE to facilitate action research projects to improve professional practice of academic staff members. Critical friends are key agents for organisations that see themselves as learning organisations (Senge, 2006) because of their ability to foster reflection and improvement.

Critical friends face a number of challenges including effective communication, ownership of the project, power relations; time constraints; type of support required and interpersonal relationships (Pettigrew, 2003; Tilbury et al., 2004). Becoming a political entrepreneur (Buchanan and Badham, 2008) is important and involves adopting different strategies and diplomacies to work with participants and to acquiring a critical reflective position in relation to the position of different people. Buchanan and Badham (2008) suggest that managing this political role involves performing and back staging. Performing and pursuing the change process and agenda involves being pro-active and facilitating participation for change, whereas back staging requires skills that enable negotiation, justification and influence to mediate and interact within the existing culture and politics of the organisation.

THE RESEARCH CONTEXT

The University of Southampton is located in the South East region of the United Kingdom (UK). It is one of the top-research universities in the UK and is a member of the Russell Group. It has over 22,000 students and around 5,000 staff members. The profile of sustainability at the University of Southampton has increased over recent years. Some indications of this are the creation of a university sponsored PhD focusing on EfS, whilst the institution also supports a group of practitioners engaged in the Higher Education Academy (HEA) Green Academy programme 'Curricula for Tomorrow'. The HEA Green Academy programme is an innovative initiative launched by the HEA Education for Sustainable Development (ESD) Project, in association with the Environmental Association for Universities and Colleges (EAUC) and the National Union of Students (NUS). The main aim of this programme is to help institutions achieve sustainability in their curriculum goals (Kemp et al., 2012; McCoshan and Martin, 2012).

The HEA Green Academy institutional change programme has provided evidence of significant institutional change across the HEIs that participated in its 2011 programme (McCoshan and Martin, 2012). These institutions were: Canterbury Christ Church University, Keele University, the University of Nottingham, Swansea University, the University of Wales Trinity Saint David, the University of Worcester,

University of Bristol and the University of Southampton. The programme adopted a bottom-up approach by engaging university groups of senior managers, academic staff and student representatives in training activities to support their action and to foster change agents towards sustainability in their institutions (McCoshan and Martin, 2012). The main aim of the programme was to embed sustainability within the student experience. The Green Academy acted as a catalyst for achieving institutional change, developing strategic vision, institutional developments, senior management commitment and raising the sustainability profile and practice of the participating HE institutions (Kemp et al., 2012). At the University of Southampton, institutional developments and a strategic vision to become a global leader in sustainability were developed, along with embedding sustainability in the CORE (curriculum, operations, research and experience). This goal is reflected in the university strapline 'The University of Southampton: A Globally Responsible University'. These institutions identified the role of critical friends, senior management commitment and engagement, the fostering of partnerships and a focus on opportunities rather than on barriers, as critical to progressing the implementation of the programme in the university (Kemp et al., 2012).

The HEA Green Academy Programme at the University of Southampton provided a suitable context in which to conduct an action research project. A doctoral student was allowed to engage as a critical friend with the Green Academy group and research, with others the processes and outcomes in learning from their experiences of implementing a change programme. The Green Academy Programme represented an opportunity to learn from an innovative curriculum change programme during, and as part of, the research process.

THE RESEARCH PROCESS

The aims of a critical friend were: to contribute to the self-reflection and collective reflection of the group; promote a critical group reflection that could facilitate the acquisition of new perspectives and discourses; and explore the impact of the role of critical friend and the method used in generating new action and practices. An outsider role was adopted, stepping back and listening. The aim was to understand the group dynamics and action, through engaging as an observer in the group meetings, and by conducting three individual interviews and two reflective sessions. These activities took place over a period of a year and a half, from January 2012 to May 2013.

The sampling was purposive. The participants were selected because of their involvement in, and membership of, the Green Academy Programme. The main

features and conditions of the critical friend role and the process of engagement were agreed with the Programme leader during informal interactions and meetings before the start of the research. These were then shared with the group in order to gain informed consent from the different members willing to participate. The group was made up of six people representing different areas of University operation and with different responsibilities. The majority shared an environment-related background, coming from environmental sciences, geography or biology. Participants' roles within the university included a staff member, lecturer, teaching fellow, undergraduate student and senior manager. Participants held specific roles and responsibilities within the group such as programme assistant, programme leader, environmental manager and student representative. This group was particularly valuable to the research because of the involvement of academics, students, a senior manager and the environmental manager of the University on a real time change programme.

A total of three one-hour individual interviews and two two-hour reflective sessions were conducted, and observations that could inform reflective sessions conduced with the group. Table 1 maps the focus of each individual interview conducted.

Interview 1	*Gain a deep understanding of the context and conditions under which the Green Academy Programme was operating. Find out initial successes, challenges and opportunities faced, and the desired outcomes, aims, and expectations.*
Interview 2	*The members of the Green Academy Programme had the opportunity to reflect upon the process so far. What has happened since the last meeting and what are the current challenges, successes and opportunities.*
Interview 3	*Focused on the process and evaluation of the programme so far, the key achievements and remaining challenges, and the identification of opportunities and future insights.*

Table 1. The focus of individual interviews

The two reflective sessions conducted focused on sharing the insights of the critical friend and giving feedback, mirroring data and helping the group reflect and discuss on issues related to EfS, the curriculum and organisational development. Feedback documents were shared with the group during the research process. These were brief summary documents on emerging themes and key findings from previous interviews and from the research, research papers and other relevant documentation related to EfS and organisational change. So for example, three days before

Interviews 2 and 3 a working document on the key themes that emerged in previous interviews was shared with participants. At the beginning of these individual interactions, participants were asked for their views and feedback on key themes. This allowed time to reflect on the progress made, the remaining challenges and emerging opportunities.

OUTCOMES OF THE CRITICAL FRIEND ROLE

Some of the outcomes that emerged from the reflective sessions and interactions with the critical friend included: the organisation of an away-day devoted to reflection and strategic thinking; the streamlining of meetings; and the establishment of more formal roles and responsibilities for members. The feedback documents, individual interviews and reflective sessions became useful tools for fostering critical reflection and helping the group find focus. One of the participants considered the process of individual interviews as a valuable way to enable them to reflect on the programme.

> *"This is extremely useful for us and helps us to think a bit more strategically both about our individual roles and the role of the Green Academy Programme within the university" (*Andrew – Interview 1)

The members saw the value of the critical friend in terms of mirroring the existence of a shared vision amongst the group and contributing to reflection. The actions of the critical friend were seen as useful to help the members reflect on the programme development. As one participant emphasised, these sessions contributed to team learning and the creation of communicative action.

> *"The reflective session was very helpful. I thought it was probably one of the better Green Academy Programme meetings in terms of the group working more as a group, having something to discuss and work around, compared to other meetings we have had" (*Richard – Interview 3)

Feedback was provided through sharing theoretical ideas on effective leadership for sustainability, EfS and organisational learning. The concept of an ideal learning organisation (Senge, 2006) was used as a tool for reflection in the first reflective session. Members were asked to consider on how the Green Academy Programme might contribute to making the University become a learning organisation towards sustainability. Achieving a shared vision was seen as difficult and depended on the whole-institution vision and strategy. A perceived lack of power within the institu-

tion was made evident when sharing the learning organisational ideal. Although there were senior staff members in the group, they felt disempowered to make change happen in the organisation. One participant stressed that:

> *"I think that's too big for anything that we're trying to do and anything we could do as a group, I think that's something which is more systemic across the whole organisation, only then I think it's possible"* (Bob - RS1)

DISCUSSION: THE MAIN CHALLENGES AND OPPORTUNITIES FACED

Reflection is necessary in becoming a reflective practitioner and to enhance the validity and quality of the research (Somekh, 2006). In this study, emancipation was understood as liberating participants from previous knowledge and power issues within the organisation that might constrict EfS practice. Reflective sessions were used as they allowed participants to explore and reframe current assumptions and practices in EfS. However these sessions contributed to critical reflection amongst participants, existing organisational conditions and dynamics could hinder participants' emancipation or empowerment.

Expectations of the critical friend role differed amongst participants. So for example one participant stated that 'I expected you to be more critical'. However being more critical was difficult as the critical friend felt powerless in the face of the personalities of the academics, their strongly held-views and their expertise and experience in academia. The following research memo shows that a sense of protectiveness was felt which disempowered her from being more critical:

> *"It's been very challenging... because there's a power relationship issue between myself, being a PhD student, and my participants, being professors and experienced in lecturing at universities"* [Researcher memo 15-04-2013]

Being a PhD student with less power in the organisation and less academic experience hindered her role as a critical friend. As pointed out by other authors (Pettigrew, 2003; Gaventa and Cornwall, 2008), balancing power relationships is a critical skill for action researchers to enable them to create democratic participation. According to other action research facilitators (Buchanan and Badham, 2008; Pettigrew, 2003) flexibility and the development of strategies and diplomacies to work with people holding different values and worldviews are needed. Several authors have made reference to the different roles facilitators need to play to fulfil participants' expectations and achieve the research goals (Kember et al., 1997; Tilbury et al., 2004). A number of roles were adopted by the researcher including being a mirror, teaching consultant and resource provider as well as being flexible to meet in any environment and situation. This allowed the building of a personal and professional relationship with participants. As the next quote shows, participants also saw the value of the critical friend role in this sense:

> *"What I'd be very interested to see is when you report back about not only how we all felt, but how you feel. You're in the privileged position of having taken each of us independently and then you can more flag together in a picture of how you think it's working or not working" (*Andrew – Interview 1)

Moreover, the researcher' supervisors and two other academics at the University, both experts in action research, acted as critical friends to the researcher during the project, helping to critically reflect on the roles, challenges faced and decisions and actions taken.

Second order action research makes reference to the facilitator and critical friend roles when working with others to facilitate action research (Reason and Bradbury, 2008). Similar to other critical friends or facilitators a number of challenges were faced, such as ensuring effective communication, ownership of the project, organisational politics, power relations, and time constraints (Kember et al., 1997; Pettigrew, 2003; Baskerville and Goldblatt, 2009). Finding effective communication strategies to ensure continued engagement of participants in the action research is critical (Kember and Associates, 2000). However, ensuring on-going communication was particularly challenging when working with academics because of existing workloads and seasonal changes in academic work practices.

Gaining access to research participants is another of the challenges that qualitative and action researchers face (Coghlan and Brannick, 2005). It took from February to November 2011 to gain access to the Green Academy Programme Group. This might have been for a number of reasons such as lack of time, lack of interest in, or value placed on the critical friend role, academic culture, and existing politics within the organisation (Pettigrew, 2003). Gaining access is political, and particularly so when doing action research in your own organisation (Coghlan and Brannick, 2005). Access might be even more of a challenge in academic contexts because of protectiveness, competition, recognition and existence of academic tribes and territories (Becher and Trowler, 2001; Hegarty, 2008). Becoming what Buchanan and Badham (2008) called the 'political entrepreneur' is critical when doing action research with

others. Political strategies, performing and back staging, being active, and building collaboration, but also being able to interact with the existing cultural and political system, are critical (Buchanan and Badham, 2008). It is about being politically smart, whilst still ensuring an ethical practice (Coghlan and Brannick, 2005). Building trust and rapport was key to establishing this relationship and to performing the task of critical friend. Others (Kember & Associates, 2000) have highlighted mutual trust and rapport as preparatory steps to facilitating action research. Critical friends need to develop interpersonal capabilities such as influencing and emphasising (Fullan and Scott, 2009), building trust and rapport and collaboration through interacting with the existing cultural and political system (Buchanan and Badham, 2008). Thus flexibility in the approach and in the different roles adopted is intrinsic quality of critical friends (Kember et al., 1997).

CONCLUSION

This chapter shows the contribution of critical friends and second-order action research in acting as a catalyst for critical reflection, creating a shared vision, and supporting learning and action within communities of practice or teams working towards embedding sustainability within HE. The study suggests that more empirical research using second-order action research approaches is needed to discover and foster new understandings of, and organisational change towards, EfS, and that participatory and emancipatory approaches, such as action research, can foster this transformation and learning.

The critical friend role has enabled reflection and action, together with the identification of specific needs of the members of the programme and the factors influencing their engagement and action. This research has demonstrated the potential of using these approaches to rethink current practice in embedding sustainability and to lead to new practices and actions of the studied community of practice. The critical friend role and second-order action research can contribute to better decision-making in terms of sustainability because it questions practice, current assumptions and worldviews. The findings of this study have shown the role of action research in opening up communicative space and action (Carr and Kemmis, 1986; 2009) allowing the team to see the challenges and opportunities they faced while contributing to reflection-in-practice. Through these processes and practices, university teams and members can develop new ways of understanding, and new practices for embedding EfS within their professional practice and within the organisation. This type of research and process can lead the learning of individuals to wider organisational learning and change towards embedding sustainability, with critical friends being key in the process to ensure critical reflection, collaboration and improved action within communities of practice focusing on embedding sustainability within HE.

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Sustainability Concepts in Environmental Educations' Master and PhD Theses - Explorative Study in a Korean Graduate School.

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ABSTRACT
Recent research works on Environmental Education in master and PhD theses contain more or less explicit or implicit concepts of sustainability. This chapter explores the notions of sustainability in a selection of recently accepted theses of a Korean graduate school for Environmental Education. Although those theses differ in topics and even in faculty disciplines, their common ground should be that they were written in the light of the ESD decade. But the students' conceptualisations mirror more a fuzzy divergence than a well-reflected variety of sustainability concepts. Hence the chapter examines the need and potentials for future graduate students to identify and to offer rather explicit concepts of sustainability in their research papers on Environmental Education.

KEYWORDS
divergent concepts, environmental education, higher education, master and PhD theses, sustainability

INTRODUCTION
There is a growing number of graduate students whose graduate theses deal explicitly or implicitly with sustainability. Among those is Janet Moore (2005), who admitted that she had only little background in the area of sustainability. Originally she majored well trained in a traditional discipline but admitted in her self-reflection, that at the beginning she failed to deal with the complex requirements of sustainability. Higher Education for Sustainable Development (HESD) seems to require interdisciplinary approaches (Pearce & Russill, 2005). This interdisciplinary characteristic leads to a variety of research approaches and a diversity of facets on environmental education (Wals & Jickling, 2002).

In this small case study we want to show that this diversity bears also some danger. The object of our case study is a graduate school for environmental education in Korea, where students work under the supervision of faculties from various disciplines. On the one hand, this multiplicity of epistemological foundations and variety of concepts of sustainability can be seen also a free choice of understanding of the respective researchers (McKeown & Hopkins, 2003). On the other hand, sustainability is a confusing and contested notion already, which has been defined in many different ways reflecting theoretical foundations (Boogaard et al., 2008). These differences challenge higher education institutes in their rally to integrate sustainability under their banner (Cotton et al., 2009).

HIGHER ENVIRONMENTAL EDUCATION AND SUSTAINABILITY

Universities worldwide promoted steps for creating more sustainable campuses (Wals, 2014). Based on a number of international declarations – among those the Thessaloniki Declaration (IAU, 2006) – universities committed to address environmental issues and Sustainable Development (SD) in their disciplines' curricula and research (Wright, 2002).

Lozano et al. (2013) analysed the 24 declarations, charters, and partnerships developed to foster SD from 1972 to 2009 and identified three levels: society, education, and higher education, showing the evolution of these initiatives. They point out that despite a number of initiatives and efforts to engage with SD, universities have adhered to traditional "Newtonian and Cartesian mental models (p.17)" so they suggest that multi-disciplinary education and research is needed to accelerate societal transformations to SD in universities.

Similarly, a great focus in literature on HESD emphasize to teach and to learn, but these endeavours are limited to scientific or economic activities like the composting system, finding alternatives to toxic chemicals, assessing ecological footprint, or sifting towards fair-trade coffee (Cortese, 2003). With this activities universities want to engage students in understanding sustainability (Everett, 2008). However, few examples only show how on-going research – in particular for master and PhD theses - articulate new and highly diverse concepts and theories by observing fundamental transformations which are taking place in society (Poeck & Vandenabeele, 2012). Based on a small Croatian case study, Anđić and Tatalović (2014) recommend that Bachelor's and Master theses in their faculty are among others an important measure to reorient teacher education towards sustainability.

In particular, graduate students foster their competencies and values in higher education through conducting research for their master's and PhD theses. Due to this core activity, graduate students of environmental education could integrate the notion of SD or Education for Sustainable Development (ESD) into their theses and relate it to their respective research topic (Gough & Scott, 2007). Nevertheless, while teaching and greening were mentioned to implement SD into universities, none of the deans or faculties talked about theses writing as an instrument of implementation (Wright, 2007). Looking into the international journals we found only a few attempts to review theses and dissertation research related to environmental education since the 1980's (Marcinkowski et al., 2013).

FUZZY MULTIPLICITY OR CONSTRUCTIVE DIVERSITY

In the UNESCO report on Contexts and Structures for Education for Sustainable Development (Wals, 2009), the author argues that various correct interpretations and usages of SD exist, despite that most of them are consensual with the general goal. Wals wrote, "There is no 'one size fits all' when it comes to SD, and the road that will take us there, does not necessarily make SD and ESD weak concepts" (Ibid., p.7). Furthermore, he argues that this variety opens multiple ways towards a SD.

However, maybe this openness to a variety of conceptual meanings of SD derived from the need of international documents, which have to embrace different worldviews and perspectives, as well as varieties of "locally relevant and culturally appropriate terms used to describe sustainability and ESD" (McKeown & Hokins 2003, p.125). Of course, in diplomatic perspectives, we should acknowledge usage of politically and culturally astute names. There were terms like "Green Growth" in Korea from 2008 to 2010 (Cho et al., 2014) or "Smart Growth" in Tennessee, because the governor did not use the term SD. Although we can follow the practical argument for coining SD to get along with various synonyms (McKeown & Hopkins, 2003), we might question if the basic concept of SD will finally follow a joint intention as Wals argued at the beginning of this chapter.

There seems a kind of common understanding and vision of SD on the surface, which might cover possibly different conceptions of sustainability (Sylvestre et al., 2013). Therefore, the authors warn us to mute debate about the differences, because they might lead to incompatibility in graduate programs. The authors see a need to argue and debate SD, because to them, the tensions and differences seem necessary for an evolution of the concept. Hence the question arises if difference in the conceptual understanding of SD means just a form of fuzzy and ambiguous multiplicity or a

constructive diversity of concepts. The fuzzy multiplicity might cause an inherent ambiguity of the concept of SD which results in an ill-defined consensus but leads to conflicts instead of common visions and joint actions (Sherren et al., 2010).

WRITING THESES AND SUSTAINABILITY CONCEPTS

Notably, many universities require students to complete a dissertation in order to graduate and apply for a scholarship (Patton, 2001). It is a rite of passage into each student's chosen field (Marcinkowski et al., 2013). However, since the early 1980's, environmental education research has limited attention to dissertation research, nonetheless, a review of dissertations can help identify academic communities where students have been socialized and inducted. Probably, as Stevenson (2007) argued, the discourse-practice gap is attributed to absence of the discourse of practice for environmental education research within scholarly groups, particularly educational practitioners, and "fuzzy contours (González-Gaudiano, 2006)" often failed to identify "either the principal tasks or the key concepts and messages." Particularly, the environmental education policy-makers and academic communities have not enough to consider pedagogy (Hart, 1993), because of this, principles that frame the sustainability discourse cannot be connected to pedagogical practices (Stevenson, 2007).

ESD in the Korean case

The decision to conduct this case study about Korean teacher education graduates seems worthwhile, because environmental education is a school subject in Korea with a comprehensive curriculum for all school types and ages. Under the government's plan, ESD was chosen as one of the cross-curricular themes in the general guidelines of the national curriculum revised in 2007 and 2009 and was recently emphasized in the curriculum of local educational offices and schools from time to time (Lee et al., 2013).

Korean ESD definitions had been based on Presidential Commission on Sustainable Development (PCSD)'s Implementation Committee. PCSD developed the UN DESD implementation strategy in 2005; announced the related plans in 2006; enacted and promulgated the Basic Act for SD in 2007; and finally established the Environmental Education Promotion Act in 2008. These endeavours set up the basic framework for ESD as a high quality education about values, behaviours and lifestyles for sustainable future and social transformation (PCSD, 2006).

Korea's ESD can be generally categorized into the following three phases in terms of the aspect of changes during the DESD (Lee et al., 2014). In the first phase (2005-2008), ESD was emphasized as part of the plan to implement SD under the leadership of PCSD. In the second phase (the end of 2008-2010), as the government announced the "Low-carbon Green Growth" initiative as its national strategy, Green Growth Education (GGE) was implemented to facilitate the scheme. In the third phase (2011-2013), with the change of government, many activities were enforced under the name of ESD again. Additionally Korean National Commission for UNESCO contributed to ESD with their own definition of ESD (Jeong et al., 2010). Hence this decade had been ruptured by three fundamental different concepts in that three phases, which might have limited the chances to achieving fundamental parts of ESD (Cho et al., 2014).

Although the national curriculum has a substantial impact on school education in Korea (Kim et al., 2011), it seems difficult to identify how Korea defines the concept of ESD exactly. ESD is included in a number of themes of the cross-curricular sections such as Human Rights Education, Unification Education and Environmental Education, but is recognized marginally and unsystematically (Lee et al., 2005). Furthermore, ESD-related communication and education have expanded in quantity but substantial progress in quality has yet to be fully achieved (Lee et al., 2013).

The case of the Environmental Education Graduate School in Seoul National University (SNU)

The case explores the usage of ESD concepts in theses of the Interdisciplinary Program of Environmental Education in the College of Education in SNU. This program was designed to promote professionals in environmental education at the master's and doctoral level, "who can play a bridge role in interlinking the academic research with environmental education practices in formal and informal settings (SNU http://enviroed.snu.ac.kr)." The specific characteristic of that graduate school is, that the affiliate professors of the school come from a variety of disciplines and departments. Each student chooses an academic advisor among those affiliate professors. Therefore the students of this graduate school write their theses in natural sciences, social sciences or humanity studies. Although it seems that they are cognate with ESD, it was difficult to find the immediate relevance to their theses.

In this small survey we sought for explicit explanations on ESD concepts in those theses, which were published over the DESD (2005-2014) in the graduate school of environmental education. We searched the electronic databases of the university's digital library by using these descriptors: "Sustainability", "Sustainable Develop-

ment", "Education for Sustainable Development", and found the total number of 62 theses submitted and approved in the respective period of DESD. But only 7 entries identified the notions corresponding the descriptors appearing in the titles or dissertation abstracts (See the Table).

Degree	*Author (Date)*	*Keywords*	*Title*
Master	*Park, Deok-Soon (2007)*	*Love Earth Il-Chon Program, middle-school students, pro-environmental behavior, teachers mini-homepage*	*(The)Effect on students' pro-environmental behavior change through the environmental education by using a teacher's mini-homepage*
Ph.D	*Cho, Eun-jeong (2008)*	*community building, residents-participatory community revitalization, social network, sense of place, place identity, adult environmental education, practical knowledge, learning community, environmental justice*	*A study on the Implication of Community Building in Environmental Education*
Ph.D	*Eom, Eun-Hui (2008)*	*neoliberalization of the environment, globalization from below, the Philippines, RapuRapu Project, mining industry, political ecology, environmental justice, ESD*	*Neoliberalization of the environment and the changes of the third world environment : political ecology of the RapuRapu mining project in the Philippines*
Master	*Kim, Tae-Yeon (2013)*	*identity, adult learning, sustainable human development, docent, narrative research*	*Exploring transformation of adults' identity in view of learning as sustainable development : a narrative research on becoming a docent in a natural history museum*
Ph.D	*Seo, Eun-Jung (2014)*	*environmental curriculum in secondary school, environmental curriculum perspective, environmental education, key competencies, competence-based curriculum, delphi method, quantitative research*	*The Study of Key Competencies and the Epistemological Perspective in Secondary School Environmental Studies Curriculums*
Master	*Nam, Mi-Ri (2014)*	*proverbs, Traditional Ecological Knowledge(TEK), environmental lesson, analogical thinking, schema theory, experimental study*	*The effect of the proverb in traditional ecological knowledge lesson on elementary school students analogical thinking*
Master	*Cho, Yoo-Ri (2014)*	*biophilia, biophobia, connectedness to nature, environmental disgust sensitivity, private-public partnership for experiential environmental education, honey bee*	*An investigation into elementary school students' environmental disgust sensitivity and connectedness to nature using the case of a honey bee experiential education program*

Table. The 7 theses for analysis

MAJOR FINDINGS OF THE CASE

We found little discussion of the concepts of sustainability in the sense, that not all studies included comprehensive information on the theoretical approach to the concepts of ESD similarly to findings of research trends in journal of Korean association for environmental education (Hwang et al., 2012). In the following we just give a short insight into the perspective of ESD in the analysed theses.

Although the environmental education research discourse related to sustainability has gradually drawn the attention of environmental education researchers (Berryman & Sauvé, 2013), there were only 7 documents involving the concept of ESD explicitly. This result reflects on the facts that HESD in Korea have been amplified in connection with sustainable university management including greenhouse gas reduction and the installation of environmental facilities, whereas there is a little autonomous and independent research related to ESD (Lee et al., 2013). Once again, HESD has been gradually developed in the quantitative aspect, but the qualitative aspect has been relatively neglected.

In a similar vein, most theses sought for evidence how environmental education or ESD programs effects on students' behavioural changes. The concentration on how the programs work seemed to be attributed to the conventional positivism – one of the research paradigm among the Fien (2002)'s research paradigm taxonomy. For example, Park (2007) introduced the environmental education program focused on using Social Network Services (SNS) for reinforcing the learner's competencies. Nam (2014) pointed out that within the perspectives on Analogical Thinking and Traditional Ecological Knowledge (TEK), the TEK lessons through the proverb have an effect on environmental education to make an effort to get a sustainable living. And Cho (2014) developed the honeybee environmental education program to increase emotional affinity and connection with nature. The researchers commonly agreed with the idea that goal of environmental education is to achieve sustainability, analogous to Seo (2014)'s contention theorized the key competencies of environmental education as the integral abilities required to learners to solve environmental problems and act toward sustainability. However, as Berryman and Sauvé (2013) pointed out, there was a lack of definition or related theory to support their repeated claims about SD and ESD. These claims could be understood the notion of "slogan systems (Popkewitz, 1982, p. 20)" originally proposed to illustrated changeless reform (Robottom, 2013).

On the contrary, as Cho (2008) started her thesis with the definition of "environment" and "education", some researchers shared her perspectives based on the

interpretative research paradigm. She mentioned "environment is not a separate on with us but the medium that we acquire identity from and participate in" (p. 180). And for education, she insisted "we need the constructive approach" to involve student-centered learning. Hence, she contemplated the meaning of the resident participatory community building in environmental education. This intention was similar to Kim (2013)'s research because she revealed the docents in a museum with the view of learning as sustainable development as called "ESD 2" (Vare & Scott, 2008). The alternative concept of learning as sustainable development was proposed as a different view of what SD could be. As Foster (2002) argued SD can be itself a social learning process to improve the life conditions of people.

Moreover, Eom (2008) claimed that current Korea's high-dependent industrial development strategies should be reconsidered to achieve sustainability considering the limit of environment. Hence, she thought ESD is possible through "reflective learning (p. 224)" characterized formative and transformative processes to empower people to transform environmental and social conditions based on the critical paradigm. Huckle (1997) mentioned that contested meanings of sustainability let people act and reflect on these meanings, so it might be possible to make alternative futures in more democratic way.

CONCLUSIONS

The case of an environmental education graduate school showed that only 7 out of 62 academic graduates embraced the notion sustainability in their thesis research, although they show their expertise in specialized fields of environmental issues. A particular reason for most higher education students in Korea might be that they never received any ESD, even though they learned SD in middle school or high school (Lee et al. 2006). DESD in Korea has been supported by a variety of sectors. These endeavours to spread ESD-related performances to the schools or universities as a whole have expanded in quantity but substantial progress in quality has yet not been fully achieved (Lee et al. 2013).

It seems crucial in time of the international orientation on sustainable development, that all the environmental education theses require an appropriate foundation in the light of sustainability. But still misunderstandings of sustainability extend from the society to higher education (Shriberg, 2002). Because environmental sciences are still the major place for studies about sustainable development (Reid and Petocz, 2005) the focus of sustainability lays still on understanding the environment, rather than the way humans interact with it.

Regarding sustainability as a political idea (Bengtsson, 2014), which is not necessarily consensual but might be antagonistic (Mouffe, 2005), we argue that an active debate among scholars and students seem to be a crucial activity in theses seminars and theses advisory. Faculties can encourage theses excellence in their respective fields but additionally should influence graduates to orient their theses in line with sustainability (Everett, 2008). Faculties affiliated to interdisciplinary graduate schools and programs in environmental education have a particular mission to offer floors for constructive exchange and debate about the divers concepts of sustainability.

As Robottom & Hart (1993) answered the critical question, – "What is a more appropriate form of environmental education research?" – the one possible consideration as to whether the research deliberate moral and social matters about educational teaching and learning, which the predominant view (of research paradigm) cannot. Furthermore, as a "subset (Fien, 2002)" of educational research, research on sustainability in higher education based on discussions about paradigmatic questions will lead to an advancement in the appropriateness and scientific proficiency of research.

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PART IV.

Evaluation and Assessment of Education for Sustainable Development activities

Evaluating Education for Sustainable Development Programmes consistently with Education for Sustainable Development values: a challenge for evaluators

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ABSTRACT
Evaluation has been a major challenge for environmental education and for education for sustainable development (ESD). While national and international funding favours a kind of evaluation that could be defined as 'positivistic' concerned more with quantity than quality, ESD research asks for a paradigm and methodologies that are more consistent with its values. Complexity, systemic thinking, participation and collaboration are some of the many key constructs that accompany educational research on ESD and which need to be taken into consideration in strategies for evaluation.

From the beginning of its life, the ENSI network explored different research lines for an evaluation consistent with the research and innovation asked for by ESD: Drawing on European projects SEED, SUPPORT and CoDeS, this chapter discusses a research arena for experimenting with evaluation that takes into account not just products but also processes, not only facts and concrete outcomes but also the process of community building, together with the quality of the 'internal learning' of the networks themselves considered as 'learning organisations'.

KEYWORDS
Frontstage and Backstage, Learning Organisation, Project Evaluation, Quality Enhancement

> *'It has often been said that scientific explanation lies in explaining what is complex and visible by referring to what is simple and invisible. But in this way, it would completely dissolve all that is complex and visible, while it is also the complex and visible with which we must deal' (Morin, 1985).*

THE CHALLENGE OF EVALUATION

Evaluation has been a major challenge for environmental education (EE) and for education for sustainable development (ESD) from the beginning: both EE and ESD deal explicitly with values and cannot be approached with 'positivistic' approaches dealing only with outputs and outcomes and asking for 'value-free' and objective reports. The application of a positivistic paradigm to EE and to its evaluation has been strongly criticised in the past (e.g. Robottom and Hart, 1993; Flogaitis and Liriakou, 2000; Sterling, 2001; Mogensen and Mayer, 2005). Complexity, systemic thinking, participation and collaboration, situated knowledge, attention to 'emergence' and to 'wicked problems', future visioning, openness to change, these are some of the many key constructs that accompany educational research on ESD and ask for a different evaluation paradigm, less concerned with quantity, more interested in quality enhancement and innovative development, open to uncertainty and unexpected events.

Environment and School Initiatives (ENSI) was established in 1986 by the Organisation for Economic Co-operation and Development (OECD) as a Centre for Educational Research and Innovation project that places emphasis on school development in the field of ESD (OECD, 1991). The ENSI project became an international network influencing policy makers and researchers, proposing an action research approach to school-based national networks (OECD, 1995), combining international processes of quality development and improvement in order to propose guidelines and quality criteria (Breiting et al. 1995).

From the beginning, ENSI project explored different lines of research for forms of evaluation that were consistent with research and innovation in EE (OECD, 1994). In its second phase (1991-1995), ENSI incorporated evaluation within its action research methodology, complementing the self-evaluation country report with a series of national policy reviews and with an analysis of the national reports carried on by the ENSI Scientific Committee (OECD, 1995). The model of analysis and evaluation was strongly influenced by the methodology of the Centre for Applied Research in Education, University of East Anglia, UK (CARE) and aimed to respond to political demands for accountability and at the same time to be consistent with the values and the reflective stance of the ENSI project.

However, national and international funding agencies still ask for the kind of evaluation that could be defined as 'positivistic', concerned more with quantity than quality, which tries to reduce to 'objective' and 'measurable' items the data collected

and the results obtained. In this situation, the evaluation of a programme may conflict with the needs for formative development and quality enhancement that are consistent with the main aims of ESD.

ENSI´s vision and methodologies inspired the paradigm used for evaluating three projects in the European Union Comenius/Life-long Learning programmes: SEED (Tilbury et al. 2005), SUPPORT (Mayer, 2010) and CoDeS (Dillon, 2014). The paradigm that was explicitly accepted for the evaluation framework was 'socio-critical' (Robottom and Hart, 1993) in contrast not only with the positivistic paradigm but also with the relativistic/interpretative one inspired by post-modern criticism (Flogaitis and Liarakou, 2000). In ENSI's vision, evaluation is a 'transformative' process, accompanying the ESD idea of 'transformative learning' and in order to bring about change it deals with processes and not only with results. In the socio-critical paradigm, evaluation is no longer reduced to an assessment process with 'definite' outcomes, but proposes instead a reflexive process which proceeds through negotiating values, searching for quality, taking care of unexpected issues and constructing new meaning. Such an evaluation tries to take account not only of facts but also of the values of the participants, their visions of ESD and the qualities they want to achieve within the project. The role of the evaluators has changed as well: they are no longer 'objective' observers, but social agents of change. They bring their own interests and values, which cannot be eliminated but rather must be made explicit. This strategy gives attention to emergence and to unexpected and unplanned events; the aim is to understand the actions and processes going on in order to participate in their development and to propose reflections and scenarios in line with the values involved. Such an evaluation is concerned with the processes of building communities within the partners' networks and with the quality of the 'internal learning' of the network itself, considered as 'a learning organisation'.

QUALITY AND EVALUATION: THE QUALITY CRITERIA PROPOSAL

These understandings of quality and evaluation run counter to the language and culture of the educational evaluations used by politicians and administrators in Europe. ‚Evaluation' has been used as a tool mainly for educational control and not for school development towards ESD. For this reason it was, and still is, important to rethink the concept of educational quality in order to build a new meaning, useful for all members of a school community, and consistent with the importance of accepting uncertainty and complexity as a part of ESD.

In a culture of complexity, evaluation cannot reduce the quality of educational processes to ‚sets of standardised procedures', ‚outcomes' or ‚performances' so much favoured by management and control public bodies. Rather, it should take into account the educational values, the cultural characteristics of the local community, as well as the emotions and perceptions of members of that community. Quality and quantity are not contrasting concepts, but should be defined and harmonised within an evaluation design. Robert Pirsig, author of the famous novel *Zen and The Art of Motorcycle Maintenance*, makes a distinction between 'static quality', the one which pushes a system to achieve defined benchmarks and standards, and 'dynamic quality', the quality that a system needs when something new happens, when it is necessary to proceed in uncertainty where standards do not exist. Both are relevant and necessary: *„without dynamic quality an organism cannot develop, without static quality it cannot last"* (Pirsig 1992; 375).

One of the tools developed by ENSI was an ESD friendly version of a classical positivistic tool: quality indicators. The term itself 'quality indicators' is an ambiguous one, trying to reconcile the two paradigms, and to reduce once more qualitative information and people's feelings to numbers and quantities. The process may, however, be reversed and indicators – data both qualitative and quantitative – could be used as clues, as traces, embedded in a consistent value system, able to construct shared meanings through mediation and participation. In a socio-critical paradigm quality criteria should take the place of ‚performance indicators'. The notion of quality should build on values and principles that inspire engagement with sustainability issues and provide indications or general descriptions that help to turn values into educational actions, behaviours and choices. Moreover, quality criteria should be seen as an instrument for change and not as an instrument for assessment, focusing the attention not only on foreseen results but also on emergent and unexpected outcomes. The criteria thus bring theory and visions closer to practice and can be used as links for moving from ideal values to the realities one wishes to change. Taking account of these considerations, a booklet, Quality Criteria for ESD Schools (Breiting, et al. 2005), was produced during the SEED European project as one of the ENSI contributions to the construction of instruments consistent with ESD needs for evaluation. The booklet tried to summarise an ESD educational philosophy and offer to teachers and practitioners a tool for internal/external evaluation.

ESD PROGRAMME EVALUATION AS AN INSTRUMENT FOR SOCIAL LEARNING

In the last ten years, ENSI has been strongly involved in the planning and implementation of European Union Comenius and Life-long Learning Projects related to ESD development and innovation (SEED, 2002-2005; SUPPORT, 2008-2010; CoDeS,

2011-2014). When confronted with the request for evaluation by the European Union, the ENSI vision has been further enriched as is illustrated in the most recent project, CoDeS.

CoDeS (Community-based School Development for Sustainability) is a multilateral network, a network of networks comprising twenty-eight partner organisations whose work focuses on collaboration between schools and communities to address education and issues of SD. Based on the partners' wide range of experience, CoDeS aimed to identify exemplar cases of school-community collaborative partnerships, investigate the factors that made them successful, and develop models, indicators and tools to improve the quality of such collaborative efforts. The CoDeS network includes experts who have direct experience in the development of school-community collaboration in ESD and SD. They bring to the network a strong background based on their experiences in different sectors: teacher education, NGOs, research, policy making, educational administration, school teaching. This context is diverse in terms of stakeholders, cultural backgrounds, and countries and therefore demands methodologies that respect the diversity, acknowledge it, develops its theoretical base, and produce tools to facilitate practical applications.

Figure 1. ENSI Quality Assurance System for European Projects

In CoDeS, the widely shared idea of an external evaluator was transformed to a 'system for quality assurance and for quality enhancement', where different figures play different roles as shown in Figure 1. The monitoring function was performed by the project coordinator who was responsible for the appropriate use of time and resources; the internal evaluation function was performed by the internal evaluator coordinating the collection of data through questionnaires, interviews, observations, and self-reflection activities; and the external evaluation function was performed by the external evaluator in the role of a 'critical friend', facilitating the constructive development of the partner network. This approach is consistent with the ENSI action research tradition.

The quality assurance framework constituted the three components working together, identifying the main quality areas to be monitored and evaluated as the project progressed. The methodology was participatory evaluation, promoting reflections among partners and proposing tools and workshops during the meetings in order to foster reflective thinking and improve the quality of partners' work. The validity of data collected was assured by the systematic use of triangulation: every summary statement referring to the project was based on data collected from different partners or stakeholders, using a plurality of methods and tools (such as questionnaires, interviews, field notes, focus groups, observations), with a systematic comparison of different visions and opinions in order to overcome bias.

A new, important feature introduced in the CoDeS project was the involvement of 'junior researchers in ESD' in the evaluation of the three CoDeS conferences. The six junior researchers involved were all women (this may be an indication of how important the field and its issues are for women!), coming from different backgrounds and countries, contracted through the 'junior researcher on ESD network', led by ENSI. The junior researchers worked under the guidance of the internal evaluator. They brought new ideas, new evaluation tools, fresh enthusiasm and good quality reports to the evaluation.

The project coordinator and evaluators attended all partner meetings and project conferences. They participated as active members of the group, organising workshops and making presentations to gather information on how the aims of the project were being met, and to help focus the project and contribute cumulatively to its development. This style of evaluation - engaging with the whole process, attending meetings, mapping emergent ideas, following through actions, giving regular feedback, as well as using the standard methods of evaluation - also fits well with the ENSI tradition.

The 'evaluation team', internal and external evaluators and project coordinator, made extensive use of quality improvement tools in workshops with participants. The tools contributed to cumulative development through the project, helping

to clarify aims, develop a collective identity, refine processes and products, and agree strategies for implementation and dissemination (Figure 2). This approach, combining professional development and critical appraisal, has been refined by the external evaluator in his work with academics in Finland (Dillon et al. 2014).

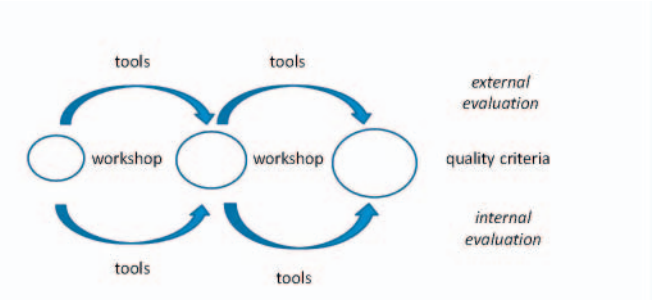

Figure 2. Cumulative evaluation through the project with quality improvement tools

Cumulative evaluation with quality improvement tools is also developmental in the sense that as the project progresses it 'changes its shape' through clarifying objectives and re-focussing. Its information base also gets 'bigger' because the progressive accumulation of new data. This leads to greater understanding of what the project can achieve and greater refinement of its working methods (Figure 3).

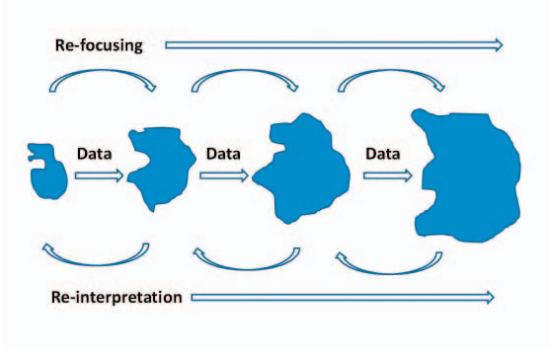

Figure 3. Cumulative development through the adding data, refining methods and re-focussing

CODES. A DEVELOPMENTAL JOURNEY THROUGH EVALUATION

The connections between project coordination, participatory evaluation and cumulative development with quality improvement tools can be illustrated through the CoDeS project history. In the three years of the project there were three partner meetings to support coordination and continuity, and three conferences to provide participants with genuine experiences of multidisciplinary and multinational approaches to ESD. Partner meetings offered the possibility to foster the critical, reflexive approach to evaluation while the conferences gave the evaluators the possibility to observe the 'network in action' and to collect data concerning both external communication and internal development. Through the partner meetings CoDeS members explored in depth the type of community they wished to become, how they intended to collaborate and how they intended to disseminate their achievements. Similarly, through the conferences, CoDeS members explored the relationship between theory and practice, the roles of stakeholder and instigators, and processes of consolidation around CoDeS products.

CoDeS started its work with a first partner meeting in Friedrichsdorf, Germany. At this meeting the evaluators led workshops and discussions around the subject of community. 'Community' is central to the collaborative actions needed to address ESD and issues of sustainability and to run a project within the evaluative approach described above. Workshops were held around a set of lead questions: What makes a community? How do we characterise our community? What is the intellectual capital of the community? What community do we want to become?

In response to the last question, what community we want to become, the partners expressed a desire for clear goals, responsible roles and a 'future orientation' guided by motivation and team spirit. The community should be open minded to different worldviews, equitable, effective and friendly and supporting, sharing new knowledge with a critically reflective approach. CoDeS saw itself as a flexible, responsive, sustainable learning community: a leading community on collaboration for SD in Europe and beyond.

The characteristics of community listed above represent a collectively agreed statement of intent about how CoDeS expected to work both within the project and with its associated partners. Those qualities internal to the project, for example team spirit, responsible roles and friendly and supporting stances, guided the project at every stage of its operation. In terms of being 'a leading community on collaboration for SD in Europe' it should be noted that the members of the consortium are already leaders in the field in their home countries and thus have considerable influence on policy and practice. The coming together of these key figures in the project has created a momentum and produced outcomes that go beyond the sum of the contributing parts.

The first conference in Vienna brought together a wide diversity of stakeholders involved in school-community collaboration for sustainable development. The conference took stock of 'where we are now' with SD and ESD and explored some latest ideas about theory and how these might translate into practice.

The second partner meeting was held in Györ, Hungary and the evaluators' work focused especially on workshops and discussions around the process of collaboration. 'Collaboration' is central to actions required to address ESD and issues of sustainability and the approach to evaluation outlined above.

Collaboration was seen as:

- Not so much doing the same work, but rather understanding the work of one another so that ideas and practices can be adapted and applied elsewhere.
- More than the sum of the individual participants' contributions, there is an emergent, shared knowledge (joint work). It cannot be reduced to the separate knowledge of the individual participants.
- Not just planning, deciding and acting jointly but also thinking together.
- Its products reflect a blending of all participants' contributions.
- Participants' listen and discuss/read and analyse each other's contributions, identify recurrent themes, make cross-site comparisons.
- Selection, highlighting and negotiation of meaning of what is being reported are through processes of mutual validation.

The most important conditions necessary for collaboration identified in the workshop were: complementarities of expertise, skills, effort and roles in trusting relationships. Following from this, there was a commitment to shared resources and power: no individual's views should dominate; authority for decisions and actions resides with the group.

Amongst the potential barriers to collaboration were the following: language; cultural differences; conflicting objectives; between-group differences; tensions between participants; reluctant participants; competing obligations, loyalties and expectations; time demands and allocations; differences in worldviews; differences in working methods; difficulties in writing together.
There is no definitive definition of collaboration. Each group finds its own way of working in which the factors identified in our workshop have different levels of importance (see also John-Steiner and Weber, 1998). Collaboration takes different forms according to the objectives: e.g. in product-orientated collaborations roles tend to be clearly delineated and producing the 'outcome' is the primary objective; in other types of collaboration, the emphasis might be on process and dialogue with more flexible roles. In terms of barriers to collaboration, the CoDeS partners recognised that there were no 'set piece' ways of dealing with them. Each group is unique; part of the process of collaboration is in identifying the barriers and finding ways of dealing with them. A characteristic of CoDeS was the proactive way in which it dealt with barriers to communication, especially of finding ways of engaging different constituencies of stakeholder, of getting groups talking and working together who would otherwise have no incentive to contact each other. The workshops proposed by the evaluators and discussions around collaboration held in Györ demonstrably influenced both the subsequent working of the CoDeS group and its products.

Following from observations above about 'collaboration', the theme of the second conference in Kerkrade was 'Learning for the Future' and the conference brought together about 105 participants including local administrators, staff from municipalities, politicians and political networkers, members of NGOs, local entrepreneurs, members of Regional Centres of Expertise (RCE), and students and teachers working in school-community projects.

The Kerkrade Conference was somehow a critical turning point for CoDeS and the evaluators highlighted some of the difficulties in communication between different interest groups: CoDeS members, as part of their professional responsibilities, have spent much time analysing the issues and developing a deep understanding of SD and ESD – they know the 'field'. Politicians, policy makers and people from the commercial sector typically do not have a deep understanding of SD. Nevertheless their policies and commercial processes shape the environment in which SD actions take place. This paradox means there is an inverse relationship between 'understanding' and 'power'. This inverse relationship can cause frustration. It seldom happens that the different stakeholders work together in ways that lead to joint thinking and the production of shared knowledge. Conferences involving different stakeholders illustrate the point: politicians and delegates from the private sector typically give short 'set-piece' presentations and then leave. They talk at the audience rather than engaging in critical discussion with them.
CoDeS has been much preoccupied with finding ways of 'bridging the gap'; of overcoming the separation between on the one hand ESD and on the other hand the policy framework of SD and the practices of private companies. A question about the impact of CoDeS in the longer term is the extent to which initiatives

instigated in schools can be shown to have had an impact on shaping policy and, more profoundly, on influencing the production processes of private companies. There is a need to develop strategies for engaging politicians, policy makers and representatives of private companies more actively in discussions with educational stakeholders.

The focus of the Third Partner Meeting in Larnaca, Cyprus was dissemination: the task was to collect the feedback on the finished products, plan the last steps of the project, and agree a framework for dissemination. But in order to disseminate the achievements, every member of the network had to understand and appreciate the products prepared, and be able to present them critically. What should be disseminated, only the products or also the processes? And what are the processes worth disseminating? What was the 'collective cultural heritage' of the CoDeS project and how should the partners transmit this to their own networks?

Various metaphors can be applied to the product-process issue. One such is Goffman's (1956) notion of frontstage and backstage. In the theatre, the frontstage is what the audience is familiar with, whereas the backstage, accessed through the 'stagedoor', is restricted to those involved in the production. If one wanted to develop an understanding of the theatre the audience's view of the frontstage is a good place to start, but it offers a far from complete picture. A backstage view is also required. The front of CoDeS is its website, products and formal documentation. The back, as in the theatre, is fragmental, intuitive and tentative, comprising conversations, strongly held opinions, points of view, things argued, ideas and practices taken away and developed or applied elsewhere. The formal business of the project focused on its frontstage, that is, the means through which the project met its objectives and was held accountable within the Comenius programme. But there was also considerable discussion about the interrelationships between the developed of products and the means by which their active use may be facilitated in new sites. These are very much backstage matters. They influence dissemination and evaluation strategies, but are seldom connected with them explicitly. Providing an insight into the backstage of CoDeS revealed some of the wider perspectives of the project team and the creative tensions that existed between them. Such matters typically do not find their way into evaluation reports, but are nevertheless important intellectual and professional outcomes with transformative potential.
The goal of the final conference, hosted by the Autonomous University of Barcelona (UAB) in Barcelona was to provide an interactive space for partners and delegates to learn from each other and to foster collaboratively local SD facilitated by the CoDeS products which were presented and shared. The conference show-cased CoDeS products and provided a forum for critical review of CoDeS school-community initiatives and ESD generally. The conference had over 100 delegates from across the world. Additionally, there was a post-conference seminar at which researchers and practitioners reported their research work.

The internal evaluation confirmed that the conference marked an appropriate end to a successful project, reflected in the number of delegates and the wide range of expertise they brought with them. There was a tangible sense that the project had reached a higher level of operation and influence. Three years of steady, cumulative development, growing international recognition, raised academic and practitioner profiles of CoDeS partners, well received products – these and other factors have contributed to the impact of the project across the sustainable development and educational communities. A seamless transition between practitioner matters in the main part of the conference and academic themes in the post-conference seminar was indicative of how CoDeS had achieved one of its major aims of bridging between different ESD communities and bringing a unified energy to the field.

CONCLUSIONS

Quality and evaluation are still central needs within ESD: in the recent Decade of Education for Sustainable Development, monitoring the quality of processes has been considered as important as the quality of products (or even more, form a learning community point of view), and a reflective approach to evaluation and monitoring is the only one consistent with the ‚learning changes' the decade aimed at:

Efforts (...) only have value when used to improve the quality of processes and products. On the other hand, an imbedded reflexive approach helps to build in ways of continuously reviewing past actions and learning in order to enable better, more meaningful and transformative processes to achieve the same goal. (UNESCO 2012: 81–82)

During the three years of the project, CoDeS, through its extended network, involved many people in the forefront of developments in SD and ESD. Not surprisingly, the project revealed to the evaluators and to partners many issues and questions concerning current theory and practice. Some of the issues and questions have long histories, others are new. Some of them might be reformulated as 'next generation' questions for future projects. These are:
'Legitimating differences' while improving reciprocal understanding. We know in ESD that differences are crucial to building something new, but collaboration not-

withstanding, differences are always a great challenge. The purpose in ESD is not to overcome differences - in language, culture, visions – rather to manage them in the construction of trust and reciprocal understanding.
Internal and external to the partner networks has been the tension between 'action' and 'thought'. While actions without responsible thought have driven our society to unsustainablity, there are still pressures toward 'fast' and 'effective' actions; the practice of critical thinking helps the 'activist' accept also the moment of reflection. When different groups involved in ESD are asked to collaborate there is the problem of reconciling different priorities and different quality criteria. Often they remain implicit, in the backstage, and it is only during the actions that partners discover how different are their expectations and their judgments when confronted with practice.

Related to the points above, a strength of CoDeS underlined by the evaluation reports was in bringing together academics and practitioners in pursuit of common aims. But this is not without tensions. Higher education worldwide is predicated on a 'growth' model. Academics are under great pressure to publish. This may lead them to take on more of the collective workload, and push it towards academically recognised outcomes. This puts onus on very careful negotiation in the initial stages of a project when individual and institutional agendas should be put up front and their longer term implications discussed.

ESD is a topic which attracts people wanting to work for a better future. Such people are usually not strong in solving conflicts because of their ethical values. Solving conflicts is important in making SD a reality. Negotiation and conflict resolution are important matters emerging from our evaluation.

Power relations. Schools do not have the financial means to instigate projects and so typically have to 'follow' the economic/financial agendas, and ultimately the interests of those providing the funding (very often commercial organisations). CoDeS has shown that students of all ages are not only willing to engage in collaborative projects, they also have innovative and often unusual ideas about the content and direction of projects.

Related to the last point is intergenerational change. Ten years ago, few people would have predicted the impact that social media has had on modes of communication. We cannot assume that the future offers a linear transition from the present. Every fixed assumption about society alters, at least if one takes a long enough

perspective. Whatever forces prompt cultural change, not all the values of society respond simultaneously. This is immensely important to how issues of SD and ESD are perceived and acted upon in each generation.
Finally, the problem of terminology. It has been said that this is a 'tired' question. However, CoDeS has shown that it is a question that needs to be revisited. The notions of 'sustainable' and 'development' are at least in part contradictory. SD has been hijacked as a marketing slogan where it can be applied to anything, which reduces its meaning to nothing. The re-emergence of 'environment' (as in environmental and sustainability education) in the terminology is welcome, especially in its more mature meaning where it is taken to be the unity of the 'human' and 'natural' dimensions rather than seeing them in conflict. What CoDeS and the CoDeS evaluation highlighted is that terminology is in part dependent on national habits and contexts. For example, in Switzerland, ESD is closely tied with 'Global Learning 21', while in Finland there are strong links with 'wellbeing'. The book Schooling for Sustainable Development (Jucker and Mathar, 2015), an additional CoDeS output, gives detailed accounts of some of the contexts that determine localised interpretations of SD and ESD across Europe.

There are logistical difficulties in a project of this kind: the EU-schedule is difficult to integrate with effective conduct of the research; the limited financial support for project partners means that publications, work in communities, translations, opportunities of exchange etc are always tightly restricted; there is a shortage of time for in-depth development; and the positivistic attitude toward evaluation which is prevalent in general is not compatible with the principles of SD and ESD.
What we have experienced in CoDeS is that to focus on the evaluation of processes is not in conflict with the evaluation of products. The quality of CoDeS products in fact was largely due to the quality of the process of collaboration: some of the products involved the majority of partners and none of the 32 partners was a 'silent one'. The 'intrinsic quality' was surely enhanced by the internal debates and reflections, but also by the evaluators who were very much involved in the 'quality enhancement' of the project and not only in its quality control.

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Challenges in evaluating sustainability aspects in complex science education programs in Hungarian primary schools

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ABSTRACT
This chapter describes a meta-research project using soft systems methodology (SSM) linked to a participatory development process of complex educational programs for all-day schools in Hungary. The project involved close collaboration between program developers, partner schools and a diverse group of external experts. Part of the project involved developing inquiry-based science education programs where partner schools used reflective tools to prepare modular learning cycles by using online and on-the-spot consultation. This process was supported, guided and evaluated through participatory action research (PAR) using convergent interviews. The SSM research (reflecting on PAR) highlighted challenges linked to incorporating, integrating and implementing elements of sustainability in a science education program. Dealing with complexity, choice of topics, a diverse understanding of sustainability and different emphases on aspects of sustainability were the most persistent challenges.

KEYWORDS
science education, soft systems methodology, sustainability

BACKGROUND

PARTICIPATORY DEVELOPMENT OF SCIENCE EDUCATION PROGRAMS

The Hungarian Institute for Educational Research and Development (OFI), with the support of Social Renewal Operational Programme: TÁMOP 3.1.1., developed a complex educational program for extracurricular activities in all-day schools through close collaboration with partner schools. In this three-year project, science education programs have been prepared based on a number of overarching priorities. The first was to use inquiry-based science learning based on the 5E-model. This model defines the inquiry cycle as a number of steps moving along a sequence: engagement, exploration, explanation, elaboration and evaluation (Trowbridge and Bybee, 1996; Bybee et al, 2006). Other priorities included supporting scientific thinking, educating for sustainability, the use of ICT, fostering parity and inclusion, and promoting international perspectives.

Defined by Section 6 of Government Decree 110/2012 (VI. 4.), a complex education program consists of seven elements: a pedagogical concept, a teaching-learning program, modular teaching-learning sequences, tools (student information sheets, webquests, etc.), assessment and evaluation tools (grids, checklists, reflective tools), a professional development program and a mentoring system. From these elements, the expert team developed the pedagogical framework (via a dialogue with experts and teachers), including success criteria (as a result of a Delphi research), a first version of the pedagogical concept, a proposal for the framework of assessment and evaluation tools, a professional development program and mentoring guidelines. These tools were refined through iterative cycles of trials, piloting and reflection. Then the partner schools prepared teaching-learning sequences (modular learning cycles) reinforced by online and on-the-spot consultation using reflective tools. This process was supported, guided and evaluated through participative action research using convergent interviews. Figure 1 highlights the main elements of the complex pedagogical program as a system (Falus et al, 2012).

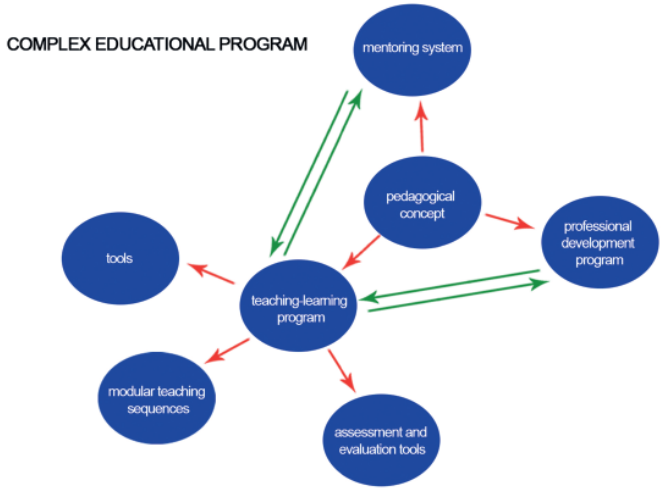

Figure 1. The elements of the complex educational program

The science education team collaborated with 8 partner schools (involving 44 teachers and some 1100 students) throughout Hungary. These were all "all-day" schools. These schools, as opposed to regular schools in Hungary, are open from at least 7am to 4pm, and organise activities for pupils throughout the day. All-day schools are a sort of mix of an extended school and other types of open schools. This

way of operation was introduced by the new act on public education in Hungary in 2012: and all day schools offer a different model, new to Hungary. Lessons and extracurricular activities (as well as individual work, sports or relaxation) are part of the schools' program, in a balanced schedule. In other schools, usually curricular lessons are in the morning hours (usually from 8am to 2pm) and after that the school may or may not offer extracurricular activities in the afternoon.

There were frequent visits to schools as well as collaboration through a digital platform. The modules were prepared by the teachers through intense dialogue and including differing levels of guidance from experts. The lessons were observed either by an expert team member or by another teacher from the same school. The process was guided by pre- and post self-reflection and self-evaluation, as well as peer evaluation. Negotiation and dialogues served as a basis for dynamic evaluation (Guba, Lincoln, 1989). There were at least two waves of action research in each school, one focusing on teachers preparing their own modules, another focusing on adapting a module prepared by another teacher from another school. Figure 2 summarises the main steps in the Research, Development and Innovation (RDI) process framework. Research was based a paradigm of initiating development by recognising and embedding innovative practice in the program (Checkland, 1992, Patton, 2011). Compared with the diagram the actual RDI process included more iterations between cycles of research and development itself.

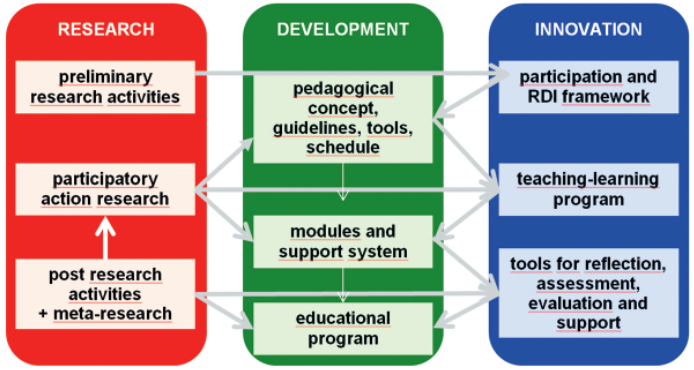

Figure 2. The research, development and innovation (RDI) framework of the project

Soft systems methodology (SSM) was used in two ways. First of all, it provided an overarching framework for the RDI process, namely in designing the RDI framework and refining the "problematical situation" (Checkland, 1991) of creating an extracur-

ricular educational program. Secondly, it served as a meta-research tool allowing reflection on results from 22 different participatory action researches, conducted by 4 researchers. As became apparent, SSM as an action-oriented way of tackling dynamic situations (Checkland, 1972) proved to be extremely useful in dealing with differences between schools and individual teachers (which is even more explicit at a national level) and with priorities that cannot necessarily be tracked using other research approaches (Dick, 1999). This was especially relevant in the case of sustainability.

The complex science educational program worked with six priorities, of which some were more and some less, easy to measure. As for the science learning elements, the research team conducted a public Delphi research resulting in 10 success criteria, which served as a starting point for evaluation (Delbecq et al., 1986). Other tools measuring inquiry skills, scientific thinking and students attitudes were also adopted. The presence of inclusion, ICT and international perspectives in the learning environments could also be estimated, using clear criteria and checklists for observation (Dick, 1999). In the case of sustainability, the research team faced greater challenges in evaluation, despite the decision to adopt the criteria used by the Hungarian eco school network (which is based on the quality criteria proposed by Environment and School and Initiatives (Breiting et al., 2005)). As for sustainability learning, defining the need in a curriculum is already a challenge in itself, and top of that, local and individual indicators of learning and achievement can also vary a great deal. As our aim was to create a practical curriculum for schools, which was flexible enough not to be restrictive, but that would inspire teachers and students, space had to be reserved for local collaborations and approaches. At the same time, it was important to examine whether these local approaches still matched the sustainability framework and current values associated with sustainability.

This account is more a description of the learning pathway (and the engaging process) than of the actual result, which is best manifested in the actual educational program created in the project.

FRAMING THE RDI PROJECT USING SOFT SYSTEMS METHODOLOGY

One of the key perspectives of SSM is taking part in its practice in order to "understand and enjoy benefits" (Checkland, Poulter, 2006). SSM is about dealing with so-called problematical situations. These are complex settings of circumstances and actors who have different worldviews and try to act purposefully in a way that enquires about the problematical situation with the intention of identifying models

of purposeful activities within the context of certain worldviews. These may later serve as banks of meaningful questions that lead to a consensus of both feasible and desirable interventions:

> *"SSM is an action-oriented process of inquiry into problematical situations in the everyday world; users learn their way from finding out about the situation to defining / taking action to improve it. The learning emerges via an organised process in which the real situation is explored, using as intellectual devices – which serve to provide structure to discussion – models of purposeful activity built to encapsulate pure, stated worldviews" (Checkland, Poulter, 2006, p. 22)*

In the case of designing educational programs the traditional approach is to define pedagogical aims and/or development goals, sometimes using participatory processes. The next step is to design the curriculum and to measure learning outcomes or other indicators connected to the success criteria originating from the pedagogical aims. Instead of this "clear approach" of designing a system based on pre-defined needs, the science education team in OFI chose a more dynamic approach. Based on experience from previous curriculum design and implementation processes, more effort and attention was put into defining needs before examining how elements of existing good practices and innovation that fit in the pedagogical framework could be integrated to the program. Finally the adaptation of various program elements in different settings was piloted and negotiated. This approach, similar to utilisation-focused evaluation (Patton, 2008) was already close to that of SSM, which translates into education as described below.

Although it might be an acceptable approach to construct a framework and then design a curriculum based on this framework, there is a risk that it might not respond to the cultural diversity of users and the systems dynamics of implementation (Kaufman and Herman, 1991). Usually this approach brings a danger of a deficit-policy, focusing on what is missing from the system at the time of creating the curriculum, and possibly neglecting some of the exiting needs and strengths of the actors in the system (ibid). In other words, curricula developed within this paradigm prove to be truly successful only provided that the system in every one of its elements corresponds to its initially supposed qualities - a lucky constellation of learning environments, student groups and teachers. Furthermore the deficit of knowledge-skills-competences should also consociate with challenges reflected by the development tasks in the curriculum.

In less fortunate cases when all these factors do not match properly, further efforts are required for implementation. Even provided that these are sufficient, cases may emerge when the culture of a learning community makes it difficult for the curriculum to work efficiently (Patton, 2011). Therefore, in a process that allows more flexibility for a curriculum and that includes practical approaches to tailor it to social and local aspects of the learning environment, the implementation of an educational program might mean fewer challenges. Additionally, in the case of sustainability, these aspects represent a substantial role in shaping an appropriate learning environment. On top of these, integrating sustainability as a priority area in an educational program involves future thinking, which by its own nature questions the relevance of pre-defined solutions.

SSM as a framework offers solutions to describe models through exploring the state-of-the-art and current practices, using divergent approaches to become suitably cohesive (Checkland, 1991). It also means that SSM does not offer one solution or the only solution that solves a challenge once and for all. Rather, it assesses possible solutions, the adaptation of which can lead to a continuous progression towards desired changes.

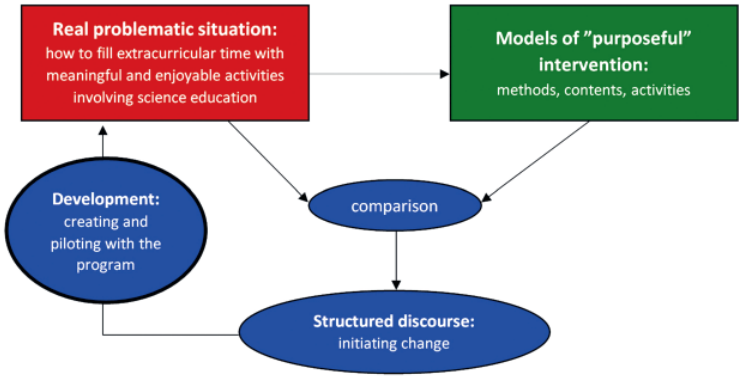

Figure 3. Soft systems methodology translated to creating an educational program

The overall learning journey taken by the project is shown in Figure 3 where the need for complex educational programs is represented as the real problematic situation. The purposeful activity models include good practices recognised in the system, together with elements such as didactics, teaching methods, useful contents

or project ideas that can be attained by teachers when adapting the modules of the educational program. Another element that can be included here is assessment.

The desired change is a flexible framework of teaching-learning sequences. In this case these are modules, individual units of learning cycles, ready to be adapted by teachers. Also included is a supporting framework for adaptation made up of a complete pedagogical concept and tools such as checklists, evaluation grids, assessment framework, and a set of tools guaranteeing a systemic approach of professional learning. These offer meaningful solutions to the extracurricular time in all-day schools and focus on inquiry-based science and sustainability learning in an inclusive manner.

Methodology

Peter Checkland described SSM as a process consisting of multiple iterative cycles (Checkland, 1972). Since this initial description, SSM has become a divergent concept and because, according to Poulter and Checkland (2006), a number of "misunderstandings and inaccuracies" (Poulter, Checkland, 2006) have crept into the process it was decided to use the original concept to guide the project. It was also decided to include a number of other research tools and techniques at points where more clarification or a more thorough investigation was needed in order to refine the results. This section gives a brief overview of how SSM was applied in this project, together with description of the other tools that enriched the inquiry journey. Four steps are described:

1. Explore a problem situation and existing activities, including influential factors such as cultural and political aspects. When engaging in SSM, the researcher facilitates the learning procedure of the groups constituting the system, while continuously and systematically observing and reflecting on the process, the progress and the dynamics. This can be summarised as a set of four main steps. It should be kept in mind that these steps are not linear, but are interconnected iterative cycles and in practice it might be needed to revisit a certain stage several times during the process. This was the experience of this project where steps 1 and 2 were revisited a number of times.
2. Define relevant activities and interventions and create intervention or activity models from these. Beyond making a root definition SSM uses different tools for establishing the model such as the PQR formula (do P by Q in order to contribute to achieving R), assessing CATWOE (Customers, Actors, Transformation process, Worldviews, Owners and Environmental constraints), and the 3E model (Efficacy,

Efficiency, Effectiveness). These serve as organising principals for a matrix of solutions.

3. Pose questions and test the model against the problematic situation. Detect answers and explore directions of development.
4. Establish feasible and desirable activities and interventions. As all of the above involve changes in the problematic situation itself, it also means that at this point it is possible to withdraw further work using SSM. This will not stop the process as an iterative cycle can start at this point.

In this project, in addition to applying traditional SSM tools, other research tools were also used. In a classical approach these can be seen as pre-intervention, process-embedded and post-intervention research activities. In the case of this project they all contributed to a more profound understanding and reflection on the SSM process.

Before starting the actual work in partner schools and in order to better explore the problematic situation, data available online was collected from 800 schools in Hungary, structured interviews with school principals were held and focus groups interviews with teachers were conducted. An environmental scan using Manninen et al.'s model of learning environments was also undertaken (Manninen, et al., 2007). The information gathered proved to be useful in the diagnostic phase of the participatory action research. This data was also used to establish different degrees of participation. Ten success criteria for science learning in primary schools in Hungary were also identified, using a public Delphi research. These criteria served as a reference point as well as a basis for reflective tools for teachers.

Partner schools were committed to participate in the collaboration and were provided with some financial support as well as professional guidance as part of their contract with the Hungarian Institute for Educational Research and Development. With the participatory action research (PAR), the Deakin model was used (Denzin, Lincoln, 2011), with the aim being to conduct at least two waves of research consisting of three cycles in each partner school. In some schools, where the organisational culture and former experience allowed, up to six waves of PAR were conducted, with up to five teachers participating in each. All in all, 22 teachers from 8 schools participated in the PAR, conducted by 4 researchers. In the planning phase of PAR, educational programming (Duit, 2005) was used as a framework for dialogue between researchers and teachers. It was also decided to use convergent interviews (Dick, 1990) in order to gain data about the changing culture and politics of the problematic situation and to gain an insight

to different the worldviews that effect those changes. PAR resulted in a rich set of data, which helped to revisit previous stages of the development (McIntyre, 2008), including reflections on (and refining modifications of) the pedagogical concept, the professional learning framework (concerning reflective tools, for example), the approach used for assessment and evaluation and the tools needed for successful adaptation (guidelines, checklists, hints and ideas) (McKernan, 1991, Rearson, Bradbury, 2008).

Meanwhile, teachers participated in a professional development course. Feedback from the course was provided using a set of reflective tools, an online questionnaire and deep interviews about the culture of professional learning they recognise and apply. After a year of fruitful collaboration with partner schools another research strand emerged: using grounded theory in which a team member explored teachers' declared pedagogical aims.

All this information contributed to another phase of piloting involving 6 schools from the original 8. The main challenge for re-starting the SSM cycle was to provide meaningful reflections on the whole educational program and to further pilot, with opportunities to adapt the modules to specific educational settings in primary schools (grades 1-8). Revisiting the program led to a firmer basis of recommendations. (Patching, 1990)

The learning journey of addressing sustainability via science education

The main challenge in creating the educational program was therefore how it is possible to activate and build on existing elements of good practice professed by partner schools and which also corresponded to international trends, steering documents of educational policy, and last but not least the Ministry of Education's expectations of such educational programs. Although the priorities remained unquestionably relevant, the first phase of SSM identified a number of tensions and gaps between these theoretical models and their representation in actual classroom practice. This called for many cycles of refining the desired interventions during the SSM process. These perceived tensions also led to a re-designing of the RDI framework with the participation of partner institutions.

This process itself modified the root definition of the problematic situation. The main challenge became, how the modules or the core elements of the educational program could be developed in collaboration with the teachers of the partner schools in a way that they refer to the success criteria and the six priorities of

the pedagogical concept: scientific literacy, inquiry based learning, ICT, inclusion, sustainability and international perspectives.

Figure 4 shows the process of SSM from sustainability learning aspect.

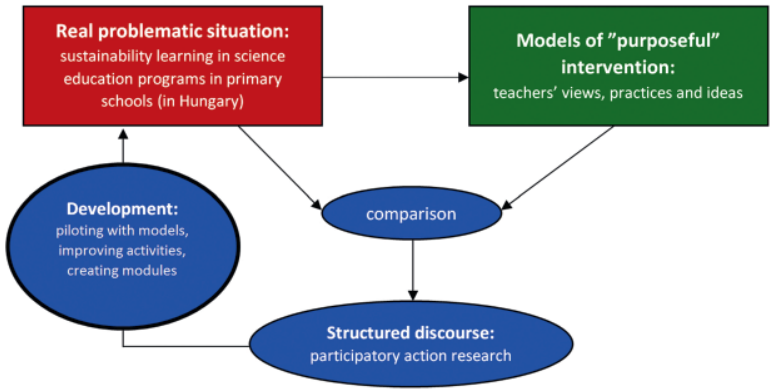

Figure 4. Soft systems methodology translated to sustainability in the science educational program

In each school the practical work started with a group discussion between the researchers and teachers involved in the collaboration, reflecting on the priorities and the overall approach presented by the educational program. Then the teachers decided on the topics they wanted to work with, and using a template called a target document, drafted the pedagogical aims, main development tasks, indicators and key steps of the inquiry cycle. This document was revisited by the group of researchers and teachers and as a result a lesson plan emerged. The teachers then piloted the lesson with one class, after which they reflected on their experiences with the guidance of two other templates. Based on this reflection as well as peer feedback from colleagues present at the pilot lesson, they finalised their lesson plan. In this way, 160 modules were prepared (each covering 3-5 lessons) during the year of collaboration. Out of these 160 modules, 34 were developed in PAR. In addition, each teacher was asked to pilot 10 modules prepared by a colleague from another school and use the same reflective templates.

The research team then assessed the reflective templates, which again led to a reconsideration of the problematic situation. During this process the points at

which further assistance or guidance was needed became increasingly clear. It also became apparent which were the most challenging aspects of such an educational programme for teachers.

As for sustainability learning, environmental awareness was strongly present in the modules as well in the reflections, while social responsibility and community learning were less emphasized. It also seemed that individual learning and affective elements of sustainability learning are clearly and strongly present in the first grades of primary schools, but after that they diminish and by grades 7-8 practically disappear. This might be due to the fact that in grades 1-4 an integrated, complex approach is taken to natural sciences that also includes elements from humanities, social studies and individual development, whilst in grades 5-6 there is a more specific focus on natural sciences, and in grades 7-8 students learn the distinct subjects of Biology, Chemistry and Physics.

Another challenge was opening to local communities. It seemed that some schools have already established a practice of inviting representatives of the local community to participate in and enhance the learning process of the students. In these cases, the regular practice served as a good basis for initiating collaborative learning linked to science education and sustainability. However, even in these cases, partners failed to recognise the potential of collaboration in creating mutual learning experiences for all partners involved. In other schools, where the link to local communities was not explicitly present, it seemed to be a question of transforming the school politics (of empowerment and responsibility) concerning efforts to initiate such learning occasions.

These examples illustrate some of the challenges faced during the learning journey. In the educational program these were addressed using assessment tools and checklists concerning the learning environment (especially the social and local aspects), the collaboration culture and the inclusion. In addition reflective tools were also offered to school principals and teachers in these areas. However, it was decided not to prescribe a specific degree of participation or collaboration in the teaching-learning program. Instead, a showcase of many possible levels in the 80 modules of the educational program was presented, leaving it to the schools and the teachers to opt for the ones that best served their needs and intentions. Moreover, empowerment and genuine learning experiences in the professional development and mentoring program were also offered.

In addition to creating inspiring learning environments, which extracurricular programs are especially capable of doing, even in regular formal school settings (Dumont et al, 2010), other issues emerged. One of the most important of these was the teachers' diverse understanding of sustainability. An interesting aspect of this was, that while they are aware of the global context of the local problems observed, other aspects (such as regional, national or European) were not at all present in their declared teaching aims or reflections. Another aspect of sustainability involved addressing complexity. While teachers were well aware of different aspects of sustainability (such as economic, social, environmental and cultural), in the proposed activities usually only one, or in best cases two were explicitly present, usually with the intention of "not to confuse students". It also seemed that in lower grades teachers had to put a considerable effort into understanding transdisciplinary issues due to lack of sufficient subject knowledge. This is in contrast with teachers of grades 6-8 who often possessed the necessary subject knowledge but lacked the intention to think in a transdisciplinary manner. These teachers often claimed that it was "the curriculum which prescribes this", despite the fact that the Hungarian national core curriculum is organised around cultural domains, not in school subjects, and that in this project the aim was to develop an extracurricular program. Complexity also seemed to be a sensitive issue in terms of assessment, especially by subject teachers who were uncertain whether they were qualified and responsible for assessing aspects of learning other than those related to students' learning outcomes in their subject areas.

An ongoing debate was generated about whether or not certain topics might qualify for both science and sustainability with often the claims being that they were not "scientific enough" (for example, in the case of transport) or that they fell into another related cluster of education, such as environmental education, social learning or global education. It seemed that these labels often disempower teachers. Therefore, it was decided not to use the originally intended "education for sustainability" label, but to propose leading questions to consider whether or not the teaching-learning material had this aspect.

It was also interesting to observe how the emphasis differs between the three aspects of sustainability in teaching-learning contexts: regular eco-school activities or science learning; regular classes or extracurricular activities; only school activities or school-community collaboration; different age groups; homogenous or heterogeneous (mixed) groups of students and classroom or situated learning. It seems that teachers have strong hidden curricula for these different educational settings. At

the same time it was found, that loosening the framework and settings helps teachers overcome these mental barriers. When working in out-of-school settings with external partners (including members of the local community such as experts of any kind or parents) and/or heterogeneous groups of students, teachers seem to be more open to complex issues, while being more able to tackle the transdisciplinary approaches and the assessment topics emerging from these.

SUSTAINABILITY AS A PRIORITY IN A SCIENCE EDUCATION PROGAM

Through some of the results of this SSM research, a number of challenges linked to incorporating, integrating and implementing sustainability elements in a science education program have been highlighted. The team did not intend and never managed to provide a recipe for achieving this, however, the results have demonstrated the following:

1. Sustainability can be an integral element of a science education program.
2. Topics related to sustainability are not only relevant for science education but offer a new way for teachers to engage students in science learning.
3. An action-oriented approach offers ways to include a diversity of students, as well as the affective elements of sustainability learning. Based on student interviews and pre- and post-intervention tests it can be claimed, that low-achievers, students from disadvantaged backgrounds and those from minority groups engage in learning more effectively when sustainability aspects are present in science learning.
4. Students realise the relevance of science learning much more effectively if confronted with local sustainability issues. This experience becomes yet more relevant if they also have a chance to engage in problem solving.
5. Empowering teachers in experimenting with open learning experiences and diverse, non-conventional learning environments leads to a better addressing of sustainability learning issues.

With this three-year project only a few steps have been taken so far, but the research team is convinced that the topics and pedagogical approach present in education for sustainability and related pedagogies may offer renewal and a way of re-defining its role for science education in the future.

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Education for Sustainable Development – how well is it working? A comparative study of schools in Poland and England

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ABSTRACT
This article is based on research into the reach and quality of Education for Sustainable Development (ESD) in one county in England, Shropshire, and one district in Poland, Siedlce. The two phase comparative research was undertaken in 2012. Questionnaires to all schools in both areas revealed that only a minority of schools could claim to approach Education for Sustainability in a significant way. Only around 10% of schools had a working ESD policy, ESD coordinators and serious approach to integrating ESD into the curriculum. For most schools, ESD was still project- and out of school based. This research was followed by detailed interviews with pupils and teachers in a small sample of schools in both countries which revealed that even in some of the 10% of schools, actual understanding of ESD was really quite weak. There was a stress on basic actions such as recycling and saving energy, but little critical understanding of sustainability as an approach and why certain activities were important. Polish schools showed less progress towards ESD than the English schools, but bearing in mind the investment into policies and curriculum support in England the difference was perhaps not as great as might have been expected.

KEYWORDS
Action, Competences, Critical thinking, Integration, Quality

INTRODUCTION
2014 was the official end of a major United Nations initiative, the Decade of Education for Sustainable Development (DESD). No doubt there will be different levels of evaluation of the decade and no doubt successes, failure and points for learning will be documented in detail. This article is one contribution to this process and one that it is hoped will provoke debate.

Action in the DESD seems to have focused in two areas. Firstly there has been emphasis on the creation of documents, strategies and policies and committees to provide a formal foundation for Education for Sustainable Development (ESD) in national education systems and schools, and secondly there have been a huge range of projects in schools, ranging from practical activities such as biodiversity conservation and increasing recycling, to more attitude and emotion based ones such as art related projects and musical celebrations. Many of these are described on the UNESCO web sites of good practice and the global Eco Schools Network also provides plenty of examples of the kinds of activities that schools are doing (Eco Schools, 2015; UN, 2015; Waszkiewicz 2004).

The Mid Term Report of the DESD (UN, 2009) concentrated on the first area, measuring whether documents and strategies had been produced by UN member states, where it painted a generally positive picture. This of course is to be applauded because policies are important foundations and building blocks for classroom and learning change. Also to be celebrated are the probably thousands of projects and actions of different scales that have taken place across the world during the DESD that have in some way touched the lives of millions of children and young people (UN, 2014). But - there are a number of "buts".

The problem is that measuring progress through the numbers of countries with ESD policies or strategies or the number of young people taking part in projects, activities and initiatives, or even the amount of energy saved or waste recycled is almost certainly going to give a misleadingly optimistic picture, for a number of reasons. Educators are aware of these but nevertheless they are worth restating:

- In many, if not most countries of the world, the gap between policy, no matter how good it is, and children's experience in the classroom, is huge and often never bridged.
- Projects are great at getting young people doing things such as switching off lights and saving energy and water because short term and simple practical actions are easy to do. Longer term change in both school systems and individual behaviour is more of a challenge.
- Simply taking part in an activity does not mean that young people really understand why they are doing what they are doing, whether they are doing the best thing, and how what they are doing links to global sustainability.
- There is a huge difference between what happens in a school and classroom and what behaviour young people adopt in their personal social and family lives.
- There is little emphasis on system thinking, or critical thinking. Young people switch off lights without asking "why?" and "is there something better we could be doing?"

- There is a tendency for evaluation of the DESD focus on case study "best practice" methodology, usually in the hopes of inspiring others, rather than "average practice" to really measure the current situation.
- Finally there is still confusion over what sustainable development (SD) really is, and the differences between sustainability and sustainable development. The result is that almost anything vaguely connected with our lives on planet earth is considered education for sustainability.

As a result more evaluation is needed that looks at:

1. The average picture in all schools;
2. The quality of what happens in our classrooms around the world and the impacts of our education for sustainability on longer term thinking and action.

The purpose of this research is a contribution towards filling those gaps.

What this research aimed to do was to look at all the schools in an area, not just the "good ones" to get a fairer and more reliable picture of the real situation in the school and classroom. In 2012 research was undertaken on the implementation of ESD in all the secondary phase schools in the country of Shropshire in England, and District or County of Siedlce in Poland. The secondary stage of formal education was chosen because in both in Poland and the UK schooling is compulsory up to this phase and according to the OECD the knowledge and skills of pupils at the age of 16 at the completion of this phase of education are a reflection of the effects of compulsory formal education that prepares students to take on social roles in adult life.

Two research approaches were taken. Firstly, to find out the situation across all schools a questionnaire was sent to all secondary schools in both Shropshire and Siedlce. The questionnaire was sent directly to the teachers most likely to be able to respond, usually the Geography Teacher. Secondly, the researchers visited a sample of the schools in Poland and the England to talk to students and teachers about their understanding of ESD and the implementation of ESD in their schools. As part of this visit students in the sample schools also completed a questionnaire.

MAIN RESULTS OF THE QUESTIONNAIRE OF SCHOOL PERFORMANCE

The first stage was undertaken through an online questionnaire and was based on the self-evaluation questionnaires found in the Polish Certification system of ESD schools "Green Certification" and the UK's "Sustainable School Self Evaluation" document. The survey was sent to all secondary schools in Shropshire and Siedlce, and 40 Polish and 34 English teachers responded. The research was done between April and June 2012. In Poland all the schools were state schools, whereas in the UK two independent schools were part of the questionnaire research. In Poland responses came from all schools and in England 80% of schools responded.

Of course there are challenges in doing these kinds of questionnaires because those completing them define the words used differently. When asked for example if a head teacher is "supportive" or whether ESD is given a "high priority" respondents will have different views on what those words mean. We had no control over who answered the questions either. In some cases it was the Head Teacher, but in most it was the teacher who was either formally or informally in charge of ESD. When this variation is added to the fact that many teachers will naturally and sometime unconsciously overestimate progress then it is clear that the results can be taken as only a general indication of the status of ESD. Where the figures between the countries are different by a large percentage then such result are likely to signify some contrasts between the two areas. Small differences are unlikely to be meaningful.

How important is ESD in your school policies and plans?	***PL (%)***	***UK (%)***
ESD is not really a priority or a low priority	*45*	*12*
ESD has a medium priority - in the curriculum	*40*	*76*
ESD has a high priority – in the school plan, curriculum and management	*15*	*12*

Is the Head Teacher committed ESD in your school ?	***PL***	***UK***
The head teacher does not give a high priority to ESD.	*15*	*12*
The head teacher is not personally involved, but supports teacher initiatives	*85*	*78*
The head teacher places a high priority on ESD	*0*	*6*

How do you classify the coordination of ESD in your school?	***PL***	***UK***
ESD activities are inconsistent and uncoordinated	*15*	*0*
ESD activities are run mostly by enthusiastic teachers	*75*	*82*
There is a formally appointed ESD coordinator in the school	*10*	*18*

Table 1. School ESD policies

The results in Table 1 show that policy support for ESD is stronger in the UK than in Poland. A greater proportion of Shropshire Schools have an ESD policy, an actively supportive head teacher and a named coordinator. The biggest difference is in the emphasis given to ESD in school policies and plan where although the proportion of schools giving a high priority to ESD is about the same nearly 8% of English schools gave it a medium priority where as 45% of Polish school gave it a low priority. In terms of the role of the Head Teacher and coordination there is not so much difference. It is only in around 10% of schools where strong support and effective whole school policies can be found. Differences are more significant when it comes to participation in the Eco Schools programme where none of the Polish Schools were taking part whereas half the English schools are Eco Schools, and participation in training related to ESD where teachers in the UK had taken part. Although these differences might be expected given the energy and funding committed by the UK Department for Education to national Sustainable Schools Policies, it is perhaps surprising that only around 18% of schools having a formal ESD coordinator, only 12% considered that they demonstrated what might be thought of as a coordinated and integrated approach.

Do you include sustainability topics such as energy saving, recycling, healthy eating, climate change, biodiversity, cultural diversity in your curriculum?	***PL (%)***	***UK (%)***
Hardly at all	*5*	*0*
Occasionally	*25*	*24*
Quite often	*55*	*41*
Very strongly	*15*	*35*

Do teachers of different subjects coordinate sustainability across subjects?	***PL***	***UK***
Yes	*45*	*59*
No	*55*	*41*

Are issues of sustainability considered in your school during additional activities like eco-clubs ?	***PL***	***UK***
Sustainability is covered in extra activities and the curriculum	*95*	*82*
Sustainability is only covered in extra activities	*0*	*0*
Sustainability is not really covered in extra activities	*5*	*18*
Very strongly	*15*	*35*

Which of the following "real life" activities take place	***PL***	***UK***
Doing out of classroom observations	*60*	*76*
Special sustainability events for the whole school and parents	*50*	*36*
Special sustainability events for the local community	*20*	*24*
Cooperation with the local government	*25*	*12*
Using data (e.g. from the energy audit) for mathematics (or other subjects)	*20*	*35*

Table 2. Results concerning the curriculum

In terms of the curriculum, Table Two shows that around one third of schools in the UK and one sixth in Poland claim to integrate SD very strongly into the curriculum and that there is a slightly greater level of coordination between teachers in the UK. Nearly all the schools integrated SD into both the curriculum and extra curricula activities with no schools just taking the extra-curricular route. The most popular application of ESD to "real life" was through out of classroom activities, whereas only a relatively low proportion made sustainability links with the local community and local government. Most of the out of classroom activities were nature based and related to geography and biology and so focused on just one aspect of ESD. An additional question relating school ESD activities with business would have been useful, though would probably have also showed relatively low interaction.

	Not considered or just started		*Integrated into some lessons*		*Integrated into some lessons and practical projects*		*In School Policy, lessons and management*	
	Poland	*England*	*Poland*	*England*	*Poland*	*England*	*Poland*	*England*
Food and drink	*0*	*6*	*25*	*6*	*70*	*47*	*5*	*41*
Energy	*10*	*6*	*30*	*23*	*60*	*53*	*0*	*17*
Water	*5*	*12*	*60*	*35*	*30*	*35*	*5*	*17*
Travel to school	*35*	*12*	*20*	*30*	*30*	*41*	*15*	*18*
Purchasing	*35*	*35*	*10*	*12*	*50*	*47*	*5*	*6*
Waste	*5*	*0*	*10*	*0*	*70*	*47*	*15*	*53*
Decision making	*35*	*24*	*65*	*36*	*0*	*29*	*0*	*12*

Table 3. Results concerning school management

In terms of the application of sustainable policies into the management of the school it seems that UK Schools are significantly further ahead of their Polish counterparts. In the areas of food and drink, energy management, water conservation and waste management, a larger proportion of UK falls into the last category compared with Polish Schools. Bearing in mind that answers in this last category is an indication that strategic management decisions are being made, this is a significant difference. Having said that, it is only about 20% of schools that fall into the highest category and even in the UK only around 5% of schools have any meaningful sustainable purchasing policy. In addition it seems that that UK schools are further down the line of student involvement in decision making about sustainability issues. These differences are interesting and could be a reflection of the fact that in the UK there has been a drive towards sustainable management with support being provided for head teachers and school managers. Schools in the UK also have significant control of their own budgets, more so than in Poland, and hence can make decisions relatively easily. In Shropshire Local Authority as in many others, there is also coordination of functions at local government level. Hence over the past three years the sustainability team has been working with the education team to support schools in the reduction of their energy consumption.

RESULTS OF THE SECOND RESEARCH STAGE

The purpose of the second research stage was to investigate students ESD competences, in order to find out what quality of ESD is being delivered. A schools self-evaluation of its journey towards ESD is one thing, but how well students are being equipped to live and work for sustainable lifestyles is another. In other words, „what has changed as a result of the learning process at the individual level?" (SEED, 1999). Over the past DESD much thinking has been done on the topic of ESD competences. This work was largely started by Stephen Sterling in 1998 who prepared a report for the Panel on ESD in the UK which listed a number of generic learning outcomes (Sterling, 1999). He stated that by the time a student had reached 16 he or she should display competences related to the following areas:

1 - Interdependence of society, economy and the environment (from local to global).
2 - Citizenship - rights and responsibilities, participation and collaboration.
3 - Needs and rights of future generations.
4 - Diversity - cultural, social, economic and biological.
5 - Quality of life, equity and justice.
6 - Changes for sustainable development.
7 - Uncertainty and the precautionary principle.

This initial work by Sterling was influential on subsequent thinking about competences especially in the UK and had a significant impact on curriculum and policy thinking. It was a simple and understandable set of criteria and hence for this second stage of the research it was decided to link Sterling's competences framework with that developed by the OECD for the monitoring the implementation and evaluation of the DESD at an international level. These competences were developed throughout the DESD and the final report from the OECD describes them in more detail (Stevens, 2014). These competences were grouped into three areas and used as a basis for the student questionnaires and discussion questions. The questions were devised focusing on the following key ESD competences.

- **A holistic approach to the topic of SD.** The research was concerned to find out whether students made connections between daily activities (such as shopping, energy conservation and waste) and sustainability issues which are directly linked to these activities.
- **The "civic value" attitudes expressed by students and their willingness to work towards SD.** These questions assessed students' motivation and the kind of activities the students take part in.
- **The student's assessment of the current situation, their vision of the future, and the actions that should be taken to improve the natural environment and people's quality of life.**

The questions were asked in two ways to a sample of students; through a questionnaire and through structured interviews. In both Poland and England, 50 students took part in these interviews; five students in ten randomly selected schools from the total number in the region. The interviews last around an hour and teachers were not present in Polish schools but were present in three of the English schools. Some interesting contrasts were revealed in the questionnaire including:

- 80% of the UK students claimed to have heard of the phrase "sustainable development" compared with 38% in Poland though of those 20% in the UK and 63% in Poland couldn't give a meaning to the phrase. Of those that could define it nearly all said it was to do with creating a safe and healthy life for future generations. Very few made any direct links with development.
- When asked about global environmental problems in (respectively) Poland and England, 10% of students could not name any problems and 18% of students in Poland and 30% in England could only mention only one. Two or more were mentioned by 48% students from Poland and 44% in England. In both Poland

and England, students most frequently mentioned global warming (Poland 64%, England 84%). In Poland, others mentioned were acid rain (54%), the ozone hole (28%), smog (26%) and deforestation (18%).

- In England, other factors were mentioned by smaller numbers of students compared with Poland and included child labour (20%), low wages in poor countries (6%), child mortality (2%), and restrictions on access to water and food in poor countries (2%).
- When asked "why is it important to save energy?" most students (Poland 70%, England 76%) selected only one reason and explanations were very simple and did not engage with the complexity of the issue. Two of the threats, the "depletion of energy resources" and a "concern for the environment" were most often mentioned (24% in both countries). Of the students who gave two or three arguments, four students from Poland and nine students from England mentioned the need for energy conservation for future generations.
- When asked what waste should be collected for recycling the large majority of students mentioned glass, metal, plastic and paper. Around one third of Polish students mentioned electronic waste compared with 6% of English students with the proportions being the other way round for organic waste.
- When asked why recycling was important three quarters used the general phrase "protecting the environment" and only around a quarter (more though in the UK) were able to make the links with materials recovery and saving resources.
- In terms of who was responsible for implementing sustainability English students rated politicians and business people having a high responsibility than individuals. In Poland individual responsibility rated the highest.
- When asked what they were doing to help the environment 16% of Polish students and 8% of English students didn't mention anything. Of the rest, most students listed the segregation of waste (Poland 78%, England 72%) and energy saving (Poland 22%, England 32%) . Travelling bus or walking were also mentioned, but by very few (Poland 8%, UK 16%) as was giving money to charity (Poland 8%), donating clothes to the relevant causes (Poland 6%) and buying Fair Trade products (England 6%). Interestingly none of the students in either country mentioned the possibility of reducing consumption of things like clothes, electrical goods and so on.
- In Poland 50%, and in England 30% of students could not name any environment or development organisation. Among the most well-known international organisations Greenpeace was the most common (Poland 36%, England 38%), however students from England were most familiar with Fair Trade Organization (Fair Trade) mentioned by 54 %.

- In Poland only 30% gave schools as the main source of environmental information whereas the figure was 60% in the UK.

Furthermore, the interviews with the students were focused on their attitudes towards SD. The discussion revealed some interesting outcomes:

- Students were asked to talk about the impact of their personal shopping habits on sustainability. In both countries most students were unable to explain any impact their purchases had on the environment and the quality of life of people in different countries of the world. A few talked about the cost and impact of transport and packaging.
- Most students from both countries do not read labels and making product selection seems to be driven only by taste, fashion and price. A number of students said that they did look at information on the label but not to find out how the product affects the environment. In the discussion a number of students from English schools admitted that they knew the "fair trade" label and that they sometimes bought fair trade products.
- In both Poland and England all the students gave the reason why so many products are made in China as cheap labor. A few students developed the idea by talking about undermining the domestic economy, China gaining employment and earning an income from the goods made and if we stopped buying from China they would lose their jobs.
- In the discussion about the increasing use of paper there was a clear difference between the students. All the Polish students said that the impact of paper consumption on the environment was that trees were cut down and that this was generally a bad thing though could not explain why. English students on the other hand considered that paper consumption has no negative impact on the environment because actions are taken to reduce the impact of cutting down trees to make paper. One of the students pointed gave more detail „Consuming large amounts of paper contributes to the cutting down of trees. If they are from certified tree it should be ok. Trees absorb CO_2 and produce oxygen".

CONCLUSIONS

What are we to make of the conclusions of this research as a whole?

From the questionnaire to schools the main conclusions are that only around 10% of schools have integrated ESD into their schools policies in a meaningful way and that although ESD does appear in lessons this is only in between 40-60% of the

schools and varies tremendously according to the topic. Schools still rely largely on projects and out of school activities to deliver ESD. When it comes to the school demonstrating sustainability through practical action there is a similar imbalance with only a small proportion having policies on energy use and other areas of sustainability. Waste is the biggest focus. Polish schools tend to lag behind UK schools in most areas of both policy and practice, though an interesting anecdotal comment made by a teacher in Poland who has experience of teaching in both England and Poland is that because of the bigger resource focused approach to teaching in England (photocopied handouts, electronic whiteboards, larger numbers of computers and so on) and the fact that most children travel to school by car, the ecological footprint of a Polish school is likely to be much lower than a comparable English School.

The overall results from the questionnaires and the discussions with students are interesting in that they reveal the quality of what is happening in ESD in schools. This compares somewhat unfavourably with the more positive conclusion that might be drawn about the state of ESD if simply the results of questionnaires were taken as evidence. When this level of detail is examined, the relatively low state of ESD of schools becomes even more worrying as even those schools in the top 10% as it were reveal a fairly basic approach to ESD.

Firstly, the detailed schools based work revealed a relatively low level of knowledge, understanding and application of environmental and development issues. A second conclusion is that students mainly related sustainability to basic activities as sorting waste, saving water and energy but without really understanding the links between these activities and broader sustainability issues. Thirdly, students did not relate their consumer habits with the impact on the state of environment and the quality of life of other people. For example, although students thought that recycling was important, very few made the link between personal consumption and their production of waste with recycling. Finally, most students did not think critically about sustainability issues and only seem to be able to manage to think about one aspect of sustainability at a time in a very general way.

It seems that Polish students' understanding of sustainability is at a lower level than those from England. The Polish students generally took a narrower and largely ecological view of sustainability, found it more difficult to link local with global quality of life issues and their own personal consumer habits with sustainability and found it challenging to explain why they followed certain environmental behaviors. Even in the UK only a minority of students had what might be called a good understanding of sustainability. It appears that students in both countries find it challenging to link sustainability issues and different aspects of SD and understand the sometimes complex problems that are causing an unbalanced functioning, and even more challenging to put principles into practice in their own consuming lives. So are we to be depressed by the situation? Well – yes and no. There are two main concerns. The first is that it is fairly easy to get students to do basic environmental behaviors such as recycling, and saving energy. However, without broader understanding of sustainability and why these actions are important, these habits are accepted uncritically by students as the best solution. Such an approach does not lead to a reduction in consumption as a method to eliminate the harmful effect of overconsumption on the environment and implicitly also sanctions the phenomenon of consumption – as long as it is recycled. Unthinking habits also rarely give young people the skills to be able to think for themselves in different situations or come up with new solutions. A second concern is that these results are also worrying because this research was undertaken with 15/16 year old students, a large proportion of whom would be leaving school after completing their full time education. The low level of understanding is also of concern for those that remain in full time education because after 16, subject choices are limited and might not have sustainability opportunities. The experience of these two parts of the European Union might not be typical of either their countries or other countries in the region. Further research of this nature and at this scale is required. Whether these experiences are encouraging or dispiriting also depends on what role people consider that education for sustainability has in driving forward more sustainable life styles in general and what the outcome of ESD should be. This is still a question that is hotly debated around the world.

NOTE

This article is a summary of a much longer paper. This paper is available to download free of charge at www.senseandsustainability.co.uk.

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An Appoach for the Analysis of Evaluative Discourse in International Networks on Education for Sustainable Developoment

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ABSTRACT

The research work presented in this chapter is focused on the evaluation activities that took place within the international Comenius Lifelong Learning Network on Education for Sustainable Development (ESD), called SUPPORT "Partnership and Participation for a Sustainable Tomorrow". The evaluation framework of SUPPORT was consistent with the 'socio-critical paradigm', which took into account the common ESD values shared by the participants and their vision of the 'quality' they wanted to achieve through the network. A Reflective Activity Report (RAR) was one of the tools for evaluating SUPPORT activities. The aim of a RAR is to promote reflection by the network actors. This chapter presents an approach for the analysis of evaluative discourse in ESD, which can be applied to the analysis of the evaluative language used in the RAR's. A qualitative analysis methodology based on Kaplan's Appraisal Theory was developed which takes into account the three meta-functions of language: the ideational, the interpersonal and the textual. In doing so, we want to claim the importance of the use of language when conducting evaluation activities and evaluative research on ESD.

KEYWORDS

Educational evaluation; Education for sustainable development; Socio-Educational Networks; Discourse analysis; Appraisal Theory

AIM AND OBJECTIVES

This chapter aims to present an approach to the analysis of evaluative discourse in Education for Sustainable Development (ESD) which was applied to analyse the language of the reflective reports written to evaluate activities of Comenius SUPPORT Network on ESD. Language is a means by which writers/speakers construct and interpret meanings in social contexts, i.e., it is conceived as a system of available

meanings that writers/speakers select and organize in such a way as to build the text in a situated context (Ghio and Fernandez, 2005). A Reflective Activity Report (RAR) is linguistic production that can be used to help construct the meaning of ESD through the use of evaluative language. This meaning is captured by the three metafunctions of the semantic system of language: ideational, interpersonal and textual (Halliday, 1985).

BACKGROUND OF THE SUPPORT NETWORK

SUPPORT (Partnership and Participation for a Sustainable Tomorrow) was a Comenius III Network running from 2007 to 2010, which is used as the context for this research. SUPPORT was established in order to address the need to enhance the quality of educational practices and material in line with the challenges of the Decade of Education for Sustainable Development (DESD). The overall objective was to promote ESD in European schools. The project brought concepts and issues of sustainable development (SD) into the education system by linking schools, research institutions and communities in a web-based network supported through ICT (Sandas, 2010).

SUPPORT involved the cooperation of actors from 21 countries and 40 institutions and different professional backgrounds, such as researchers, teachers, policy makers and environmental educators. Interaction and cooperation among key stakeholders and best practice exchange were facilitated by thematic conferences, workshops, a Comenius mobility seminar, Comenius school partnership contact seminars and Arion study visits. The activities were managed and coordinated through an annual steering group and partner meetings, and monitored and evaluated based on indicators. The Norwegian Directorate for Education and Training was responsible for the financial and legal matters of the SUPPORT network, and the Norwegian University of Life Sciences coordinated the SUPPORT network and was responsible for the management of the consortium (Sandas, 2010).

SUPPORT EVALUATION PLAN

The purpose of the SUPPORT Evaluation plan was to promote reflection, gain knowledge and make decisions so that the network reached its goals (Mayer and Espinet, 2008). In order to do this the network envisaged three evaluation strategies: Monitoring, Internal Evaluation and External Evaluation. These were coordinated by different people who maintained constant contact with each other.

The aims of the internal monitoring, internal evaluation and external evaluation conducted by SUPPORT (Benedict, 2008) were to:

- track the status of the project;
- ensure the quality of work, outcomes and products;
- provide the project with feedback during the process about how to improve project implementation;
- improve attainment of the project goals.

The internal evaluation was assigned to one partner, the Autonomous University of Barcelona in Catalonia, Spain. One of the authors of this chapter managed this process. The purpose of the Internal Evaluation was to provide the tools and processes for participants to reflect on, and learn from, each of the activities and events promoted in the Support Network (Espinet and Sabio, 2008). One of these tools was a Reflective Activity Report (RAR), which focused on the reflection of those involved in the coordination of activities and the coordination of the SUPPORT network.

THEORETICAL FRAMEWORK

The SUPPORT Evaluation Plan promoted the improvement of the quality of the Comenius SUPPORT network activities through the 'socio-critical paradigm', consistent with the complexity of both educational processes and the concept of sustainability (Mayer and Mogensen, 2007). This evaluation framework took into account the common values of ESD shared by the participants, their vision of the 'quality' they wanted to achieve through the SUPPORT network, the concrete activities and the products produced (Mayer and Espinet, 2008). In doing so, SUPPORT allowed the partners to develop a range of quality criteria to guide the network action and be the focus of the SUPPORT evaluation strategies. These quality criteria have been set as ‚Semantic Domains on ESD' in this research work.

The model of evaluation proposed by this work evolved from the general theoretical framework of Systemic Functional Linguistics (SFL) (Halliday, 1985) and dialogism (Bakhtin, 1981; 1982), by using Kaplan's Appraisal Theory (Kaplan, 2007). Appraisal Theory is concerned with the personal meaning of language by which writers adopt stances towards both the material they present and those with whom they communicate. It is concerned with how writers approve and disapprove, with how they align or do not align themselves with actual or potential respondents, and with how they position their readers/listeners to do likewise. It is concerned with the construction of communities of shared feelings and values through text, and with the linguistic mechanisms for the sharing of emotions, tastes and normative assessments (Martin and White, 2005).

Semantic readings of the contents and value positions constructed by writers are challenges aimed at by the Appraisal Functions within the Appraisal Theory approach. The writers in texts adopt three evaluative stances (figure 1): the attitudinal position and the dialogistic position are considered the primary modes of evaluative positioning. The intertextual position is considered a subtype of the dialogistic position (Kaplan, 2007).

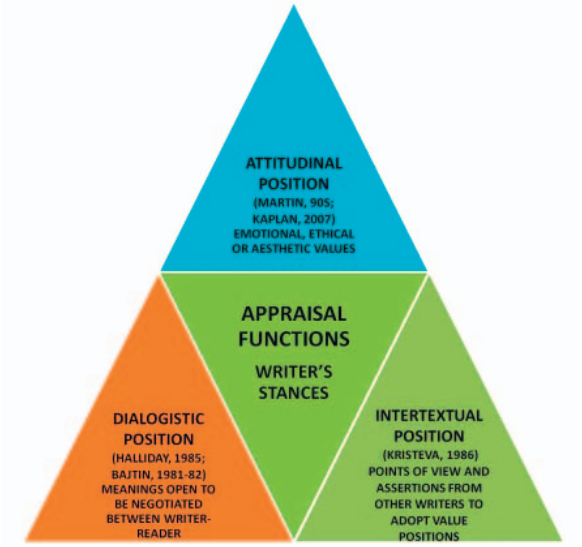

Figure 1. Appraisal Functions based on Appraisal Theory (based on: Kaplan, 2007)

- **The Attitudinal position** can be an emotional, ethical or aesthetic position and, ultimately, an ideological one. It refers to the meanings by which writers express their approval, their blame or responsibility addressed to people, places, objects, events and situations.
- **The Dialogistic position** is related to the writers' meanings that are negotiable. The statements are considered as responses to previous statements or used to anticipate possible objections or questions.
- **The Intertextual position** is linked to the meanings by which writers take evaluative stances from external propositions (views and assertions from others). Normally this position is reflected in the citations or references to the words or thoughts of others.

METHODOLOGY

This work has collected data from 11 out of the 15 activities organised by the SUPPORT network between November 2007 and September 2010. These activities were grouped into three different SUPPORT events: special events (workshops (WS), contact seminars (CS) and Arion study visits (ASV)), thematic conferences (TC) and partner meetings (PM).

The data collection tools were Reflective Activity Reports (RAR) written to evaluate the SUPPORT activities. The sample contained 13 RAR, which were written by different authors, in different geographical places and at different times. The text structure of the reports includes descriptive and reflective practices. Guidelines for writing an RAR were provided by the SUPPORT evaluators with an emphasis being made that the guidelines was or were a tool for inspiration and not a set of rules to follow. The main points of them are listed below: 1. Background; 2. Program; 3. Description of activities; 4. Internal evaluation questionnaire; 5. A reflection on the activity; 6. Annex. The RAR's were expected to be focused, and be written in first person using a free style.

RAR authors were the coordinator of the network (NC) and coordinators of the activity (AC). They were reflecting on and therefore engaged in the process of thinking and identifying the most important issues in relation to successes, weaknesses, and opportunities for improvement of the activity. There was a diversity in the topics the authors of the RAR's were asked to reflect on and themes included: the organisation, the venue, the visions on ESD, the learning opportunities, the establishment of partnership and the building of interactions of SUPPORT network.

A qualitative analysis methodology was used to study the meaning of the evaluative language in the discourse of the RAR so that the content and values used by the actors of international networks on ESD could be identified. The results of this work have been presented in depth elsewhere (Sabio, 2015).

ANALYTICAL APPROACH

The analysis of the evaluative discourse within the RARs identified three semantic domains. These are called ‚Semantic domains on ESD networks', and are related to the ‚Semantic system metafunctions of language' such as the ideational, interpersonal and textual (Halliday, 1985) (figure 2):

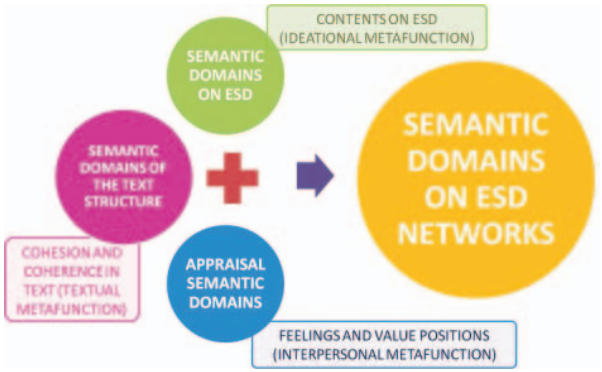

Figure 2. Semantic Domains on ESD Networks

- **Semantic domains on ESD.** These refer to the common values of ESD and the visions of quality of ESD network products, shared by SUPPORT partners. These domains are related to the Ideational metafunction of language including: interactions and exchanges, learning, new visions on ESD, facilities and special requirements, organization and time management.
- **Appraisal semantic domains.** These refer to the meaning of the evaluative stances adopted by writers in their text. These meanings were put into one of three evaluative positions: attitudinal, dialogical and intertextual (Kaplan, 2007). In their text, writers express their emotions, judgements and tastes, adopt a stance towards to these value positions and with respect to those they address, up-scale and down-scale what they want to say. These domains are related to the Interpersonal metafunction of language, and include: attitude, engagement and gradation.
- **Semantic domains of the structure of written text.** These refer to the meaning regarding the cohesion and coherence in the text related to the Textual metafunction. These domains update ideational and interpersonal meanings as a coherent language in cohesive text and include: background, summary, introduction, development, assessment of activity and conclusion.

An example of using this analytical approach in the RARs sentences can be appreciated bellow, in the first Partner meeting (PMI) of SUPPORT network written by the coordinator of the network (NC):

PMI RAR, by NC:

"A wonderful dancing and music social evening arranged by the hosts on Wednesday night, however, brought everyone together. The minstrel event and participatory music-making on Thursday evening was also fun and brought the group together laughing. This is important!!"

Semantic Domains identified: [INTERACTIONS AND EXCHANGES] [ATTITUDE] [DEVELOPMENT]:

- INTERACTIONS AND EXCHANGES (Semantic domain on ESD): *"...brought everyone together...and participatory music-making...brought the group together laughing..."*
- ATTITUDE (Appraisal semantic domain): *"A wonderful dancing...was also fun and brought the group together laughing. This is important!!"*
- DEVELOPMENT (Semantic domain of the structure of written text): It is a part of the text structure that describes the discourse, it is situated in the middle of text.

CONCLUSIONS

The analytical tool presented in this chapter positions the authors in front of language in a less naïve way compared with normal practise in the evaluation in ESD. The tools used for evaluation in ESD in general and ESD networks more specifically, seldom look at the language use as an essential element of evaluative practices. By adopting an approach to language use in ESD networks within the frame of systemic functional linguistics and more specifically of Appraisal Theory, the authors have attempted to provide a tool to understand evaluative practices in ESD networks in a more complex way.

Reflective Activity Reports build evaluative discourses on ESD networks which are situated, reflecting the sensitivity of the writer to negotiate the meaning with the reader, and adopt a specific open textual structure. Given that these evaluative tools are difficult to write as well as to analyse many ESD networks do not encourage them as regular evaluation instruments. However, the authors of the chapter support the idea that reflective writing such as the RAR is necessary to provide ESD international networks with the opportunity to build particular ways of understanding the what, how and why of ESD network activities.

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Assessment of a formative model that promotes the development of professional skills in sustainability education.

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ABSTRACT
This chapter describes an action-research project currently being developed in a non-formal education centre. The aim of the project is to promote a change process within an institution based on a formative model proposed by the Complex Research Group (CRG) of the Autonomous University of Barcelona (UAB). This research is in a developmental stage and dedicated to the establishment of a research base and action plan. The research examines i) whether the formative model brings significant changes in didactic approaches; ii) the distance between the theory of a formative model and its application in the classroom; and iii) the strengths and weaknesses in the implementation of the formative model in this type of educational context.

KEYWORDS
action-research, education for sustainable development, formative model, non-formal education

PROBLEM STATEMENT
There is worldwide agreement that overcoming the challenges faced by humanity depends largely on the action of citizens in all aspects of life. This means changes will have to take place in ways of thinking, living and acting. Changes that are produced in a socio-cultural context reveal a more and more evident global crisis emerging from the dialogue between different interrelated crisis of values and action, the crisis of the status of knowledge, and the socio-environmental crisis (Mayor Zaragoza, 2009).

In such a situation a rewriting of political models, of thought and education, of society and life in general is proposed through creative processes and transformations that permit the discovery of new opportunities. In a society of knowledge, human

development must move towards creativity (Innerarity, 2010). In order to face the challenges of the 21st century society professionals in different sectors of society and economy are being asked to add sustainability criteria to their professional activities and develop a competitive perspective. As a result educators whether in formal or non-formal institutions of Education, should play a fundamental role as formative agents of citizenship.

The way education happens within societies and communities is hugely varied due to the fact that it is not just the responsibility of just a few agents and institutions. The terms "formal" and "non-formal" are often used to distinguish different approaches but are not really appropriate to describe all the characteristics of education, such as exactly what happens during learning and how it happens (Hein, 1998 in Guisasola and Morentin, 2007). It is more appropriate to talk about a continuum, from perhaps highly structured scholarly activities at one end, through to open access and individual learning at the other. Other activities, e.g. related to leisure based learning or out of classroom learning could be found somewhere in the middle. This chapter is concerned with the latter approach to learning through the example of the Catalonia "Esplai Espurnes" group.

It is important to look for new methodologies that support the development of new approaches to teaching. The challenge is to define new formative models that favour the development of skills in education professionals that enable them to provide answers in different contexts.

This project has the title, "A formative model for the development of professional competences of teachers in education for sustainability: characteristics, application and evaluation". It has been developed by the Complex Research Group (CRG) within the Department of Didactics, Mathematics and Experimental Science of the Autonomous University of Barcelona. Its purpose is to define a framework of education for sustainability professional competences for educators in formal as well as the non-formal Education institutions. It aims to develop a formative model to advance curriculum greening (Bonil et al., 2012) through supporting the design of activities to develop necessary and appropriate competences.

FOCUS, AIM AND OBJECTIVES OF THE RESEARCH

The research took place in a specific non-formal education institution: the "Esplai Espurnes" group. This is a non-profit youth association from Esplugues de Llobregat (Barcelona) that has worked as a leisure time educational institution for children

and young people for more than 35 years. We consider that the formative model developed by the CRG offers an opportunity to achieve innovative formative processes, which encourage the development of professional skills in education for sustainability. At the same time, the model aims to support a change process in the "Esplai Espurnes" Group. The research plan therefore has two interconnected parallel processes, as shown in table 1.

	Change process in "Esplai Espurnes" Group	***Investigation process***
Period	*May, 2014 – June, 2015*	*September, 2013 – December, 2016*
Description	*Apply the CRG's formative model to address the need of teachers and students and especially to address the lack of reflection in the design and implementation of educational projects.*	*Document the change process and identify the aspects that may limit and/or contribute to the application of the formative model in this non-formal Educational context.*

Table 1: The research is developed in two parallel processes

The research had the following objectives:

1. To determine the relevance and transferability of the formative model proposed by the CRG in the design and development of formative activities aimed at non-formal Education Institutions.
2. To analyse what the formative model brings to the professional development of teachers as well as in the functioning of the institution to which they belong.

THEORETICAL BACKGROUND

Curriculum greening is a reflective and action based process aimed at integrating environmental education into curriculum development. This process also has a socio-cultural dimension in the search for coherent alternatives with sustainable values. Curriculum greening implies gaining the competences of complex and global thought in connection with the environment and, at the same time, encouraging responsibility, commitment and action by the education community towards the development of their environmental identity (Geli, Junyent, Medir & Padilla, 2006).

A process of curriculum greening, like any educational process, has to be grounded in a formative model that is also based on an environmental education model. In the case of this research a conception of environmental education conception that includes complexity principles was adopted (Bonil et al., 2010, Bonil et al., 2012).

A complexity paradigm is a rigorous, open and dynamic platform that can help individuals and institutions face the global crises in a creative and transformative way (Bonil et al., 2010). It proposes a change in the way the world is understood and as a result, of the processes needed to understand it (Garcia, 2004). The complexity paradigm is an alternative to the so-called simplifier paradigm (Mueran, 1982).

THE FORMATIVE MODEL PROPOSED BY THE CRG

Formative models are theoretical elaborations that education professionals put into practice in a specific context. They are interpretations and adaptations of theories that are mediated through the worldview of individuals and their beliefs about education and on the role the environmental education should have in educational institutions (Bonil et al., 2012).

The formative model proposed by the CRG aims at shortening the distance between the ideological approach of Environmental Education and its practical outcome in the classroom. It achieves this partly through ensuring that the activities are relevant to the specific situation (the 'moment'), to the individuals themselves, and that it has a relevance to and impact on the community.

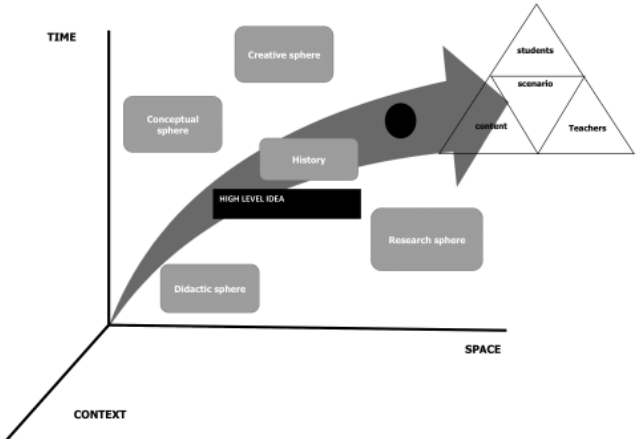

Figure 1: CRG formative model

The proposed model is based on an intersection of space, time and socio-cultural context where the formative activity is developed (figure 1). This point constitutes a system where the epistemic values of complexity enable the appearance of ideas relevant to the construction of an individual's worldview. These so called high-level ideas are the foundation of formative action. Ideas such as the 'unimaginable' or 'intangibility' to use two examples, provide opportunities that allow students to articulate worldviews that help them move towards more sustainable and creative societies.

The construction of the meaning of a high level idea and its connection to practice is shown in table 2. The process takes place through four spheres: conceptual, creative, didactic and research. Each sphere contributes to the meaning of the high level idea and to the design of the educational journey that orientates the educational action. To communicate the high level idea a story is used.

	Description
High level idea (HLI)	*The vector that orientates the process of the worldview construction – for example – unimaginability*
Conceptual sphere	*This sphere involves the reformulation of the HLI into a more specific component. The conceptual sphere should make a powerful statement that can be referenced throughout the educational activity. It should promote reflection on students' worldviews.*
Didactic sphere	*This sphere involves thought about the methodological decisions such as working rhythms, group dynamics and individual tasks of the educational activity.*
Creative sphere	*This is an emotional dimension and encourages a consideration of the beauty of the connection among people in the world. It has a strong metaphorical component. Decisions taken in this sphere orientate the design of the workspace.*
Research sphere	*This sphere should promote the educational activity as an opportunity to review different points of view and to give time for reflection and systematic analysis.*
Story	*The story is a chapter related to historical events that convey the meaning of the high level idea by giving emphasis to people and their cultural context.*

Table 2. The construction of the meaning of a high level idea

The design of this formative process is dynamic and constantly reviewed. The meaning of the spheres are related to each other and at the same time, together, all the spheres build a global meaning (Bonil et al., 2012). This model is useful for designing educational activities and also supports training for a sustainable and post cosmopolitan citizenship (Dobson and Bell, 2006). The content becomes a cultural asset that will facilitate participation in the decision-making at any level and in any context within their community.

METHODOLOGICAL APPROACH

The process of action-research was developed from the model proposed by Kemmis and McTaggart (1988) where it is described as a sequence of steps represented as a cycle or spiral. In this research, the first cycle was the establishment of the research base (figure 1) which is seen as the starting point to build the CRG formative model. It is important to point out that the process is not actually as precise as suggested in figure 2, as a result of the different overlapping steps of each cycle. The data collection methods includes audio recordings, field diaries and interviews with the stakeholders. Action research is characterised as being both participative and collaborative. It focuses on the educational practice and on the emancipation of the team of teachers. It makes a special effort to change ways of working (consisting of speech, organisation and power relations) and it is understood as a formation tool. It aims at the transformation of organisation.

This investigation aims to maximise the collective dimension as opposed to an individual one and was planned and executed by the stakeholders themselves. For this reason, teachers of the "Esplai Espurnes" group and researchers of the CRG make up the stakeholders in this double process. On the part of the "Esplai Espurnes" group the process was started with the participation of the group manager and the person responsible of group projects. From the CRG's side, the researcher acts as a facilitator. The collaboration between the facilitator and the participants allows for the negotiation and investigation of questions and issues of mutual interest.

The work of the stakeholders in the research took account of the power relations and the mutual exploitation of the specialized knowledge different groups in the Centre and GRC hold. The flow of information between them is of prime importance and a basic tool. It is therefore meant to start the development of a communication methodology and shared action while trying to establish the research group as an agent and as a research framework.

SPIRAL I DESCRIPTION: ESTABLISHMENT OF THE BASES OF THE RESEARCH

The research process is still being developed and as a result only the first spiral has been completed. The activities in this cycle and the results are described in figure 2, together with ideas for the continuation of the next spiral of research.
In the first cycle, actions related to the change process and the investigation process were progressed in parallel since the two processes are interconnected. Actions related to the steps proposed by Kemmis and McTaggart (1988) were taken.

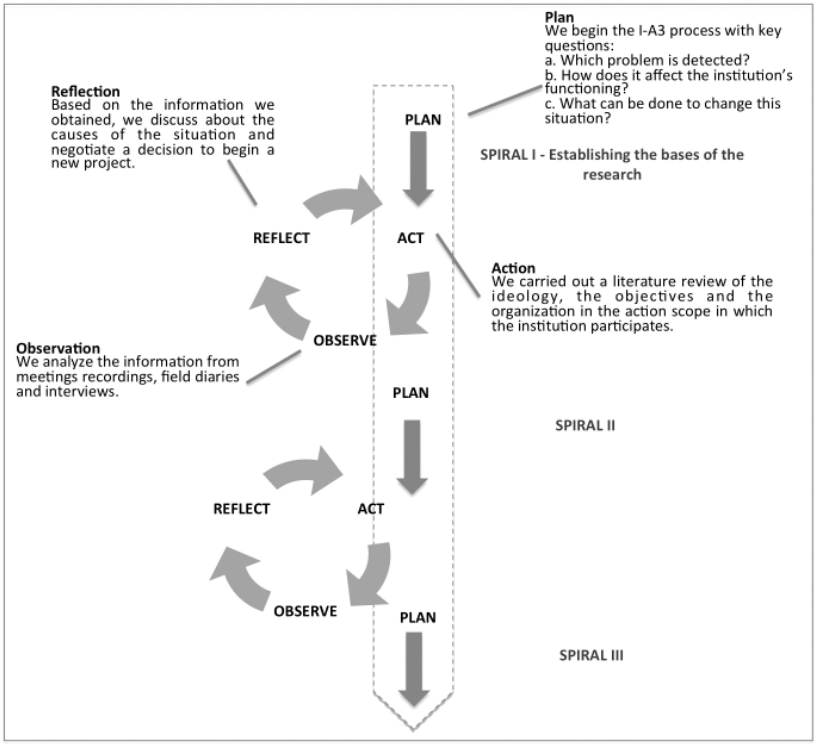

Figure 2: Description of Spiral I process

Planning:

The team of teachers at the Centre shared and debated ideas from the CRG. As a result the "Esplai Espurnes" team understood that changes needed to be made but were unsure about the process. The CRG suggested that the formative model represented an opportunity to implement change, though it was recognised that the models needs to fit a non-formal education context. Three questions were posed as a starting point before setting a plan of action:

a) What are the problems?
b) How do they affect the way the institution functions?
c) What can be done to change the situation?

The answers given initiated a debate. Diagnosing the starting situation in particular is considered a priority in any improvement process.

Acting:
The plan of action agreed involved a review of the institution's organisational documents including the ideology of the centre, the objectives of the current course programme (2013-2014) and the organisation of the different fields of action in which the institution participates. Following these reviews, two meetings took place that examined the gap between what the policies and programmes stated and the reality of educational activities taking place.

Observing:
Through an analysis of the discussions possible reasons for the institution's current situation were identified that assisted in contextualising the change process. The observation stage pointed out that:

- The institution undertakes activities in many fields.
- The training of teachers at the centre is based on an out of date formative model.
- Taking into account the difficulty of coordinating schedules, the availability and responsibility of the teachers, it is not always possible to ensure a high quality of learning.
- The high turnover of teachers through the Centre creates instability and little solidarity in the team of teachers. An effect of this is that there is the need for a significant ongoing investment of time and resources in training new teachers. The increase of activity over the last few years has generated growth that is probably difficult to sustain. Every year new projects are initiated while previous ones are maintained.

Reflecting:
Once the possible causes of the problems were identified, a diagnosis was made and based on this a review made of the different areas of the Centre's work. The aim was to detect where it might be possible to introduce the formative model and initiate the change process. One of the key tasks in this process was to identity the most appropriate teachers to take part in the project. Once this was done an open research group was created with a permanent core of members together with the opportunity to include other teachers and different stakeholders such as experts and trainers that could contribute to the project on an ad hoc basis.
It was considered that such an open group would contribute towards the sustainability of the project outcomes through providing continuity during the proposed change process. The work of the open group is related to High Level Idea (Bonil et al., 2012) used to orientate the design and the development of the project through articulating the intended change process. This High Level Idea is one of the elements that will be reviewed in the following cycles of the process of investigation-action.

RESULTS OF THE FIRST PHASE
The results of the first spiral of the investigation led to a number of outcomes regarding the change process, the research process and the process of investigation and action.

Outcomes regarding the change process:
- Bearing in mind the out of dated model of teacher training at the Centre it is necessary to rethink the way in which new teachers are trained and the way that former teachers might be reintegrated back into the team should this take place.
- It is necessary to rethink the number of projects and activities that the Centre is engaged in so that they can be undertaken sustainably regarding the availability of human resources.
- Activities should start and end with the action. There should also be time for reflection about the design and the execution of activities. This reflection time does not currently take place.
- A common project should be designed that that involves the whole Centre and in which every member can make a meaningful contribution.

Outcomes regarding the research process:
- The formative model proposed by the CRG can orientate a change process but it needs adapting to a non-formal Education context.
- Using a High-Level Idea can support and accelerate this change as long as the teachers at the Centre are able to make it concrete, build on it and share it.
- Taking time to reflect on the professional skills of the teachers at the Centre is needed to develop innovative educative processes.

Outcomes related to the process of investigation and action:
- Careful consideration needs to be given to the people and institutions that participate in the research, the members of the permanent core of the open research team and the team will work with the Centre teachers.
- The focus of the investigation regarding the projects of the "Esplai Espurnes" Group.
- The continuity of the project - which cycles will be carried out next.

DISCUSSION AND RECOMMENDATIONS

The experience of the first cycle of the investigation-action allows decisions to be made about the continuity of the project. Bearing in mind the outcomes of the review, the continuity of the project can also be considered from a more global perspective that reflects on the performance of a project and in which all the teachers and stakeholders in the Centre feel represented.

In the future, the intention is to establish five phases of activity each following the spiral of investigation and action:

- **Phase 1 – Theoretical reflection:** This will involve discussions based on a selection of readings related to curriculum greening an the formation of educational teams in the context of a non-formal Education.
- **Phase 2 – Formative actions:** Following the theoretical reflection several formative actions will take place. These will include seminars developed by the CRG's experts and workshops in institutions where CRG's formative model has already been incorporated. These will be conducted by both the research team and the Centre teachers.
- **Phase 3 – Designing an educational project:** Based on the CRG's formative model and the reflections made in Phase 1, an educational project that fits with the Centres activities and based on a High-Level Idea is planned.
- **Phase 4 – Project Implementation:** the project is implemented over a period of seven months. Each part of the project activity includes the performance of the activity, a period of time after the activity to collect impressions based on the field notes and teacher interviews.
- **Phase 5 – Project Assessment:** Three feedback, review and assessment sessions are planned with the teachers where the project activity and follow-up are considered. A final assessment will also take place.

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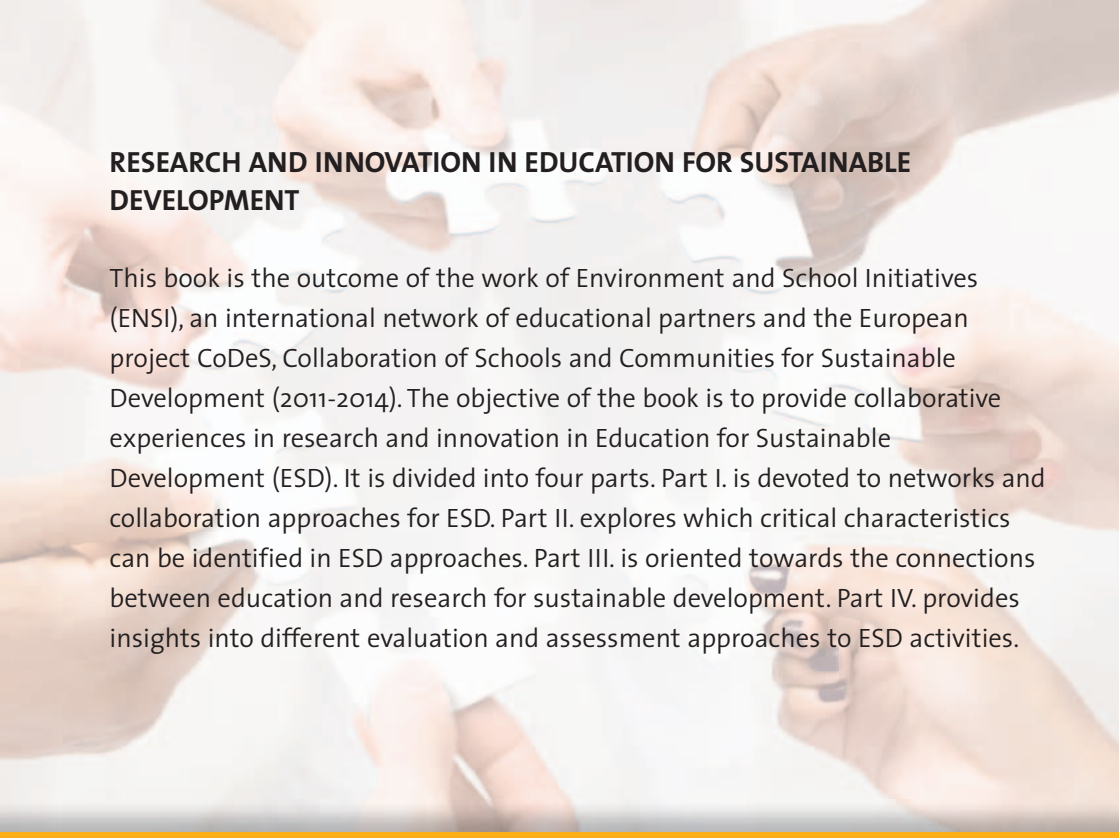

RESEARCH AND INNOVATION IN EDUCATION FOR SUSTAINABLE DEVELOPMENT

This book is the outcome of the work of Environment and School Initiatives (ENSI), an international network of educational partners and the European project CoDeS, Collaboration of Schools and Communities for Sustainable Development (2011-2014). The objective of the book is to provide collaborative experiences in research and innovation in Education for Sustainable Development (ESD). It is divided into four parts. Part I. is devoted to networks and collaboration approaches for ESD. Part II. explores which critical characteristics can be identified in ESD approaches. Part III. is oriented towards the connections between education and research for sustainable development. Part IV. provides insights into different evaluation and assessment approaches to ESD activities.

Lifelong Learning Programme

CoDeS is a Comenius multilateral Network with the support of the Lifelong Learning Program of the European Union

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