

*Journal
of
Teacher
Education
for
Sustainability*

Volume 14, issue 2, 2012



Education and Culture DG

Lifelong Learning Programme



University of Crete

The publication of this thematic issue has been supported by the ICTeESD European Commission Programme (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC). This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

DOI: 10.2478/v10099-012-0007-7

Journal of Teacher Education for Sustainability,
vol. 14, no. 2, pp. 5–39, 2012

COURSE CURRICULAR DESIGN AND DEVELOPMENT OF THE M.SC. PROGRAMME IN THE FIELD OF ICT IN EDUCATION FOR SUSTAINABLE DEVELOPMENT

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Abstract

This paper presents the design and development of a VLE for a M.Sc. programme on information and communication technologies (ICTs) in education for sustainable development (ESD) driven by a learning paradigm that merges three theories of learning, namely: experiential learning, constructivist learning and transformative learning (ExConTra) funded by the European Commission. Learning activities were designed to offer the chance for students to interact asynchronously and synchronously, negotiate meaning and reflect on their learning and viewpoints through collaborative problem solving. The ExConTra learning process is also based on an interdisciplinary approach addressing the four pillars (environment, society, culture and economy) of sustainable development and makes use of an online course design methodology that uses four phases: needs analysis, curriculum design, development and formative evaluation. The VLE that encompasses both the curriculum programme and the online platform with its tools and online technologies merges ICTs with ESD in three ways: a) providing opportunities to target groups for reflective practice; b) using open source ICT tools and ESD-related learning objects available in the Web; and c) using ICTs to develop interactive, interdisciplinary and cross-disciplinary ESD learning activities.

Key words: *curriculum, ICT, online learning, education for sustainable development, masters programme*

The challenges of ICTs in education for sustainable development

The increasing rate of information and communication technologies (ICTs) development and their widespread implementation across all sectors of the economic and social life

brings about radical changes in the way we work, think, learn and communicate. There is not, however, a universally accepted definition of ICTs due to the fact that concepts, methods and applications related to ICT are constantly evolving and can be contextually interpreted and applied. A broad definition of ICT is concerned with the distinction between “old or traditional technologies” (radio, television, video, DVD, telephone, computers) and “new or modern technologies” (video conferencing, e-mail, cellular telephones, weblogs, Web 2, and other social networking software). An “old or traditional technology” might be a driving force for transformative change in its right context as a “new or modern technology” could be a driving force in another context. No matter of technology development, educational systems, worldwide, face the challenge of preparing citizens who need to be equipped with the necessary skills and competencies to transform current unsustainable practices. In this context, teachers are increasingly called upon to switch from roles of being knowledge transmitters towards taking an active role as curriculum developers, knowledge constructors and transformative learning agents.

To prepare teachers to function within these roles, they have to receive an appropriate take off training and be prepared to on-the-job self-professional development. They should also be committed to play a leading role in promoting other teachers’ professional development in their own schools, acting as resources and facilitators for service learning (Makrakis, 2006). Shifting from content-centred curricula to competence-based and life-skills curricula goes in parallel with shifts from teacher-centred teaching to student-centred learning enabled by ICTs. A competence is often associated with an individual’s knowledge, skills, and attributes in an effort to differentiate high performers from average performers and to develop their potential (Garvin, 2000; Daley, 1991). Drawing on the OECD DeSeCo work, Rychen and Salganik (2003, p. 43) defined competence “as the ability to successfully meet complex demands in a particular context through the mobilisation of psychosocial prerequisites (including cognitive and non-cognitive aspects” and as the “internal mental structures in the sense of abilities, dispositions or resources embedded in the individual’ in interaction with a ‘specific real world task or demand”. Another widespread classification refers to key or generic competences and disciplinary or specific competences.

In relation to sustainable development, there is extensive literature on what should be taught and learned in terms of knowledge, skills and values associated with sustainable development (Makrakis, Kostoulas-Makrakis, & Kanbar, 2012; De Haan, 2006; IAU, 2006; Seitz & Schreiber, 2005). The classical Brundland (WCED, 1997) definition for sustainable development is “development that meets the needs of the present without compromising the ability of the future generations to meet their own needs” (p.43). In a panel review of 37 experts, sustainable development was consensually defined as “to making informed, contextual and conscious decisions driven by the principles of solidarity, justice, accountability, equity and transparency for the good of present and future generations, locally and globally and to act upon those decisions for advancing social, economic and environmental wellbeing” (Makrakis, 2011b, p. 411). Sustainable development is viewed as a dynamic, evolving and contested concept and practice for and within education, but as Vare & Scott (2007) suggest, “whether we view sustainable development as our greatest challenge or a subversive litany, every phase of our education system is being urged to declare its support for education for sustainable development” (p. 1). Education for sustainable development

(ESD) or education for sustainability (EfS), used interchangeably, was also defined by the 37 panelists “as the learning needed to maintain and improve our quality of life and the quality of life of generations to come. It is about equipping individuals, communities, groups, businesses and government to live and act sustainably, as well as giving them an understanding of the environmental, social and economic issues involved” (Makrakis, 2011b, p.411). ESD/EfS represents a new vision of teaching and learning, a vision that helps people reconnect with nature, by addressing the complexity and interconnectedness of sustainability issues such as poverty, peace and international understanding, sustainable consumption and production, environmental degradation, climate change, water protection and health (UNESCO, 2005). This vision of education emphasises a holistic, interdisciplinary and cross-disciplinary approach to developing the competences needed for building a sustainable future. However, ESD, as a cross-curricula theme, is often marginalised in national curricula, which in turn reproduces and perpetuates academic divisions of knowledge that separate the natural and social sciences and the humanities, and fails to acknowledge lay and tacit knowledge (Huckle, 2008).

An ESD student competence framework was developed, validated and implemented among 3.760 higher education students in 11 European and Middle East Universities within the framework of a European Tempus initiative entitled “Reorient University Curricula to address Sustainability” (RUCAS) (Makrakis et al., 2012). The ESD student competence framework based on generic and disciplinary competences structured along five clusters was also used as a guide for curriculum design and development (Figure 1).



Figure 1. The five ESD clusters of competences

Learning and behavioural change are essential for achieving sustainable thinking and living (learning to live sustainably), which is inextricably connected to transformative perceptions of learning (Makrakis, 2012). Transformative learning focuses on learning-based change that involves ‘learning to know’, ‘learning to do’, ‘learning to live together’ and ‘learning

to be' (UNESCO, 1996). It is a shift of consciousness that alters: our way of being in the world (learning to be), our way for discovering others by discovering ourselves (learning to live together), our way of learning how to learn as well as acquiring, constructing, disseminating and managing knowledge (learning to know) and our way of putting knowledge into action (learning to do). It is above all learning that "transforms problematic frames of references— sets of fixed assumptions and expectations – to make them more inclusive, discriminating, open reflective and emotionally able to change" (Mezirow, 2003, p. 57–58). Learning to transform oneself and society has been added by UNESCO as a fifth pillar of learning along with the previous four pillars advocated through the Delors report.

These five clusters of ESD competences applied in Higher Education supported by developments in ICTs, and Learning Management Systems, can open many more opportunities for course developers to introduce innovative teaching and learning methods enabling students to study in their own time and space. The Internet and especially the WWW is increasingly being used as a vehicle for open and flexible learning without geographical and time constraints, reaching greater numbers of socially, culturally and economically diverse students. Taking into consideration the unprecedented expansion of ICT-enabled distance education, it is a great challenge for promoting education for sustainability anywhere, anytime and any place.

The link between ICTs in education and sustainable development is being addressed by extensive debates and research which recognise the challenge ICTs bring to the reorientation of education towards learning to live sustainably (Makrakis, 2011a; Makrakis, 2008; Paas, 2008; Makrakis, 2006). ICTs can help learners explore concepts, engage in problem-based and authentic learning, enhance meta-cognitive skills and present information using multiple media (Makrakis, 2011b). All these are closely related to the goals, themes and learning objectives addressed by education for sustainability (UNESCO, 2010, 2005; Wals & Corcoran, 2006; Summers & Kruger, 2003; Fien & Tilbury, 1996; Huckle, 1996). Indeed, three of the major forces shaping and driving the 21st century education are: 1) the development and diffusion of Information and Communication Technologies (ICTs); 2) the increasing demand for new educational approaches and pedagogies that foster transformative and lifelong learning and 3) the reorientation of educational curricula to address sustainable development (Makrakis, 2011b).

Although the use of ICT can offer exciting new possibilities to promote the changes called for developing knowledge and skills needed for a sustainable future along with changes in values, behaviour, and lifestyles (UNESCO, 2003), simply merging ICT to the transmissive teaching and learning practices will not work to achieve sustainability. Such a teaching model is principally based upon an objectivist approach that is seeing knowledge as something stable to be replicated in learners' minds, decontextualised from social reality and perceived as existing independently from learners' personal experiences. In decontextualised learning, school curricula and teaching methodology are mainly used in the context of instrumental rationality and technical interest in knowledge, which does little to develop human self-realisation and critical discourse (Makrakis & Kostoulas-Makrakis, 2005). Instruction that is confined to a limited range of contexts leads also to inert knowledge in which facts and procedures remain isolated and are not activated in different problem-solving situations (Hasselbring & Moore, 1996).

Previous research (Makrakis, 2006) shows that despite technological progress and infusion of ICT in schools, the teachers' involvement with ICTs falls between prospective and occasional users. It is estimated that a 'take off' towards an innovative user stage, will take place when 40 to 50 percent of teachers will have reached the stage of engaged ICT users. Teachers' ICT uses seem to focus more on surface techno-centric skills associated with applications that do not integrate deep learning and reflective thinking. In general, teachers tend to use more frequently computers for low level uses, such as preparing student tests, demonstrating information for a lesson and less on more cognitive level uses related to creative thinking and problem solving. These results largely reflect the kind of training these teachers have received, as well as the ways in which new technologies are perceived and implemented in schools.

Summing up, the following are major challenges that need to be addressed when attempting to merge ICTs in ESD.

- Education sectors are lagging behind to capitalise on ICTs potential in promoting ESD.
- ICTs can empower and help to facilitate greater access to ESD learning by disadvantaged people, marginalised groups and communities. However, the "digital divide" still remains a major challenge.
- ESD planning with new pedagogy is an essential part of building a whole school approach to ICT-enabled ESD.
- Dissemination and communication of information on innovative ICT-enabled ESD examples and practices may provide opportunities for embedding ESD in the curriculum supported by ICT.
- A vision that facilitates an education model responsive to the development of ICT-enabled ESD is often missing among education planners and policy makers.

While many nations around the world have embraced the need for education to achieve sustainability, only limited progress has been made so far. Some of the more prevalent challenges are: a lack of or inadequately trained professionals to provide inspired ESD; disciplinary boundaries between subject areas persist as well as lack of educational leadership to support transformative pedagogies to address sustainability. Our state-of-the-art reviews on Master degree programmes in the field of ESD show that the great majority:

1. focus on the environmental pillar of sustainable development, neglecting the other three pillars (social, cultural and economic);
2. do not exploit the potential of ICTs in addressing sustainability issues, especially Web 2 technologies and use of open education resources (learning objects) available in the Web; and
3. employ techno-centric approaches, meaning that curriculum is developed by experts without the end-users' inputs.

There is thus need of Master Degree programmes that are participatory, holistic, interdisciplinary and contextual, making use of ICTs both as learning pedagogies and means of delivering at a distance or through a blended mode. As a response to these challenges, seven European Universities, namely: University of Crete, Dublin City University, Daugavpils University, Frederick University, Open University of Cyprus, University of Graz and Uppsala University with considerable experiences in the fields of ICT and ESD formed a Consortium to propose a project entitled “ICT-enabled Education for Sustainable Development.” This project aimed to develop a joint Master degree (deployed on an advanced virtual platform) in ICT in ESD which will be offered in English. The course targets experienced practitioners in schools, community education, NGOs, government bodies and development agencies, who want to play a key role in moving forward the issue of ESD in their working environments. The specific objectives were to:

1. develop a joint Master on ESD supported by ICTs consisting of interdisciplinary modules amounting to 120 ECTS. A Diploma Supplement will also be issued with the joint degree.
2. develop course modules addressing the environmental, social, cultural and economic pillars of sustainable development supported by social software tools and infused by open source learning objects.
3. develop a virtual learning platform for uploading course content, enrolment and maintenance of student records, academic profiles, scheduling of units, course monitoring, liaison etc. combining two open source platforms (Moodle 2.0 & Mahara).
4. develop an online training toolkit addressed to university staff who, want to infuse ESD into their teaching and courses and/or apply virtual tutoring modalities.
5. implement the training toolkit with 25 university staff from partner institutions to support the running of the joint master.

The place of ESD in higher education is not one of integration as a stand-alone subject, but rather one of innovation that will generate deeper changes in all practices and structures of higher education institutions. Addressing and promoting ESD in higher education institutions would require a new conception of the triangle ICT, curriculum and pedagogy.

Conceptions of ICT, curriculum and ESD pedagogy

It is often said that education plays a dual role. On the one hand, it reproduces certain aspects of current society and, on the other hand, it prepares students to transform oneself and society. Although, these roles are not necessarily mutually exclusive, curricula tended in the past to reproduce an unsustainable culture rather than empowering citizens to think critically and learn to transform oneself and society. This is largely due to that many still equate a curriculum with a body of knowledge-content to be transmitted to students by applying the most effective teaching methods (curriculum as product). The product model of curriculum can be traced to the work of the writings of Tyler (1949; cited in O’Neill, 2010) who

greatly influenced curriculum development worldwide. In a product model, behavioural objectives are pre-specified in a way that can be objectively measured. This leads to a focus on the parts rather than the whole; overlooking learning that is occurring as a result of the peoples' interactions with their environments. Behavioural objectives that can be measured provide the foundations on which the curriculum as a product is built. The intended outcome of a learning experience is thus prescribed or pre-specified in advance. The idea of curriculum as a product has been contrasted to two other types: curriculum as process and curriculum as praxis (Grundy, 1987).

The curriculum as process is being considered more open-ended than the product curriculum. In a process model, instead of prescribed and measurable learning objectives, intentions or more flexibly formulated objectives, mostly negotiated with learners are set. Curriculum as praxis is, in many respects, a development of the process model. However, while the process model is driven by general constructivist principles and places an emphasis on interpretation, judgment and meaning making, it does not make explicit statements about the interests it serves. Grundy describes that to understand the terminology of curriculum, it is important to pay attention to the theory of 'knowledge-constitutive interest' or 'action-constitutive interest' developed by Habermas (1971). Habermas's distinction goes back to the classical Aristotelian contrast between *techne* and *praxis*. For Aristotle, *praxis* is guided by a moral disposition to act truly and rightly (*phronesis* – practical wisdom); a concern to further human well being and the good life (Aristotle 2004, 209). The Aristotelian conception of praxis, referring as *poiesis* is about acting upon something that does not entail conceptions of empowerment and emancipation, that *praxis* aims to. Technical interest is an interest to control, predict and manage the environment deeply-rooted on modes of inquiry, curriculum and pedagogy in the "empirical-analytic" or positivist sciences. Practical interest rooted in the interpretive-hermeneutic sciences is an interest of mutual and self-understanding in the conduct of life driven by modes of action-orienting (inter)personal understanding. Finally, the emancipatory interest is an interest of critical self-reflection, leading to empowerment, praxis and emancipation that aim to free science from its positivist illusions. It may, for example, be used in such a way that does not make continual reference to collective human well-being and to the emancipation of the human spirit (Makrakis, 2012; Smith, 2000; Grundy, 1987). In this approach the curriculum itself develops through the dynamic interaction of experience, action and reflection. "That is, the curriculum is not simply a set of plans to be implemented, but rather is constituted through an active process in which planning, acting and evaluating are all reciprocally related and integrated into the process" (Grundy, 1987, p. 115).

When relating Grundy's curriculum typology and the three Habermasian knowledge-constitutive interests to ICTs in education, several points may arise. First, the emergence of ICTs as learning technologies have coincided with a growing awareness and recognition of alternative theories for learning that go beyond pedagogies rooted in the empirical-analytic paradigm, driven by a technical interest. ICTs driven by constructivist learning theories have contributed to shifting curriculum as a product to curriculum as a process. Through ICTs-enabled and enriched learning settings students take responsibility for their own learning instead of being consumers of a prescribed curriculum. Constructivist principles posit that learning is achieved by the active construction of knowledge supported by various per-

spectives and social interactions that play a critical role in the processes of learning and cognition. ICTs enable people to undertake education anywhere, anytime and any place and in this way fill various gaps and satisfy special needs, despite the fact that the so-called digital divide is still present. However, although ICTs give people the power to freeing themselves of routine works, be engaged with more cognitively demanded tasks, they cannot be seen as emancipatory tools unless an explicit statement about the interests ICTs serve is made. The praxis model of curriculum theory and practice applied to ICTs makes an explicit commitment to their true emancipatory potential. Thus, the concept of praxis is not simply using ICTs to freeing people from lower cognitive demanded works, but a commitment to use ICTs as enabling tools to turn people able to act as agents of change (Makrakis & Kostoulas-Makrakis, 2012ab). This kind of agency enabled by ICTs can be seen in various levels and directions.

ICTs enable instructors to transform their teaching practices by facilitating student-student and student-teacher interactions and collaboration in meaningful or authentic learning settings. Transformative learning is a process whereby “we transform our taken-for-granted frames of reference to make them more inclusive, discriminating, open, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action” (Mezirow, 2000, p. 214). In other words, “Transformative learning involves experiencing a deep, structural shift in the basic premises of thought, feelings, and actions. It is a shift of consciousness that dramatically and irreversibly alters our way of being in the world. Such a shift involves our understanding of ourselves and our self-locations; our relationships with other humans and with the natural world” (O’Sullivan, 2003, p. 327). Freire’s (1993) emphasis on praxis- action and reflection- is pedagogically illuminated by Kolb’s (1984) active learning cognition theory that gives due emphasis on experiential learning. Different online communication tools and learning environments enabled through Web 2.0 technologies offer the potential for new forms of experiential, constructivist and transformative modes of learning. Such learning “would develop sustainability literacy (their ability to read the symptoms and causes of unsustainable development and write more sustainable futures) whilst also contributing to political literacy and the development of identity” (Huckle, 2012, p. 135). This approach to the theory of curriculum, because it places meaning-making and thinking at its core and treats learners as subjects rather than objects, if coupled with the human agency perspective, can lead to curriculum constructions that facilitate learning to transform oneself and society. ICTs can be used to transform learning experiences but that this depends to a considerable extent on the way the curriculum is conceived and how it is enacted through the processes of teaching and learning. The focus on linear pedagogies and pre-specified curriculum goals may lead both educators and learners to overlook learning that is occurring as a result of their dynamic interactions enabled by ICTs. Learning and curriculum in this sense must not only be planned and structured by a participatory design approach, but also by the tasks and learning situations and the interaction with the social environment in which learning takes place. Thus, the conception of curriculum as context should be also added to the three previous curriculum conceptions, if the content of the knowledge produced and disseminated is sufficiently responsive to the problems and needs of the targeted populations and their societies. ICTs can thus be a context for ESD as well as ESD can be a context for ICT. More specifically:

- ESD themes integrated into the school curricula could provide a worthwhile context for ICTs in education. For example, social, economic and environmental issues can provide meaningful and challenging contexts for developing a wide range of ICT skills.
- ESD methods are conducive with constructivist and transformative learning theories, which can provide a context and rationale for using ICT-based learning tools such as concept mapping, modelling, social networking.
- When considering areas such as cultural diversity and intercultural understanding, health, HIV/AIDS, governance, natural resources, climate change, rural development, sustainable urbanisation, poverty alleviation, corporate responsibility and accountability, there is potential to assess the impact of ICTs in these key sustainable development areas.
- However, the so-called digital divide, especially for women and other disadvantaged groups, is still a problem that challenges educators and policy makers.

The question which arises is: what curriculum type to choose for developing the M.Sc. program? Our standpoint is that in practice, there is a continuum between the three curriculum types, despite their fundamental differences in ontological, epistemological, methodological and axiological level. The complementarity of the three approaches, in terms of their methodological dimension, does not degrade the important differences and the entailed consequences for the design and the use of curricula enabled by ICT tools. In other words, the questions of “what to teach?”, “what to learn?” and even “how to learn?” should not be put in practice in an early stage of the curricular development process, which would exclude at a starting point the targeted students and the main actors to be involved in its implementation. The curriculum “is not simply a set of plans to be implemented, but rather is constituted through an active process in which planning, acting and evaluating are all reciprocally related and integrated into the process” (Grundy 1987:115). Our major assumptions on ICTs, curriculum and ESD pedagogy that provided guidance to the process of curriculum design were:

- We do not see curriculum as a simplification of a linear process that dictates what is to be learned and how it will be learned without taking into consideration those concerned.
- The environment or context in which learning will take place is a critical component of the course curriculum design process.
- Emphasis should be placed on reflective problem-based learning enabled through tools and services that facilitate “social networking” for virtual collaboration and virtual peer mentoring amongst learners and e-tutors.
- Knowledge is seen as a process of making meaning through interaction. In this sense, the curriculum is viewed as a process shaped by the interactions of those involved, whose needs and interests matters.

- Putting strong emphasis on transformative pedagogies and a commitment to promote the values and principles of education for sustainability is a condition for building a sustainable society.
- While we are committed to a critical and transformative learning paradigm, we assume the complementarity of the opposite paradigms, in cases that their contribution adds value to our philosophical and methodological commitments.
- Course curriculum design integrates actions for: embedding critical literacies and learning in complex, realistic and relevant environments; applying social negotiation as an integral part of learning; integrating multiple perspectives and the use of multiple modes of representation; encouraging ownership in learning; providing adequate time for problem-based and inquiry-based learning.

The underpinning learning philosophy for designing the M. Sc. programme

Teaching and learning that underpins the design of a course programme is not free of values. Especially, to design teaching and learning that aims to turn learners able to transform themselves and society, it implies that designers must not only adhere to certain values, but also to articulate them and reflect on them and the choices for actions that necessitate. After, presenting our major theoretical standpoints with respect to curriculum theory, it is necessary now to expose the learning theory, that explicitly or implicitly, has been guiding us in the design and development of the M.Sc. program on ICT in education for sustainable development.

Despite variations of learning theories within specific learning paradigms, there are three basic categories of learning theory that are driving instructional and learning design models: 1) instructive; 2) constructive and 3) transformative. The first is based on behaviourism and partly on cognitivism (labelled also as objectivism); the second on interpretivism and partly on cognitivism and the third on critical constructivism and critical pedagogy. The main goal of instruction for behaviorism and cognitivism is to prescribe learning goals and observable/measurable outcomes and to transfer or banking knowledge to students, taking thus a teacher-centred and mechanistic/ deterministic approach to human learning. Freire (1993) refers to this as a “banking model” of education and criticises it for its view of learners as objects of learning. However, the cognitivists stress the acquisition of knowledge and internal mental processes and structures, while behaviorists focus on external environmental conditions through the organisation of stimuli-response-reinforcement association to modify behaviour in the desired learning direction. In other words, cognitivism defines learning more broadly to include the role of mind as a schematic network and memory in storing and retrieving knowledge as well as a change in thinking, beliefs, attitudes, and values, while behaviourism defines learning more narrowly to include mastering of prescribed learning outcomes.

In contrast, to instructive learning, constructive learning environments are characterised as being open and flexible, learner-centred, less prescriptive. The teacher is viewed as facilitator/mentor and learners are actively involved in making meaning and constructing knowledge. In other words, learning is deemed as social (negotiated) active, contextual

(real-world based), authentic and meaningful. According to Cey (2001), authentic learning occurs when instruction is designed to facilitate, simulate and recreate real-life complexities and occurrences. Squires (1999) refers to “cognitive authenticity” through the articulation of ideas, experimentation and engagement in complex environments as well as ‘contextual authenticity’ through the relation of tasks to the real world. Meaningful learning occurs when students develop effective ways to resolve problematic situations that require knowledge to be constructed by the learner, not transmitted from the teacher to the student. According to Jonassen, Peck, & Wilson (1999), meaningful learning is:

- **Active (manipulative):** Learners interact with the environment manipulate the objects within it and observe the effects of their manipulations.
- **Constructive and reflective:** Learners reflect on their activities and observations, and interpret them to create a meaningful learning experience.
- **Intentional:** To experience meaningful learning, learners must be able to articulate their own learning goals and monitor their own progress.
- **Authentic (complex and contextual):** Learning is meaningful, better understood and more likely to transfer to new situations when it occurs by engaging with real-life, complex problems.
- **Cooperative (collaborative and conversational):** Meaningful learning requires conversations and group experiences.

Constructivism gives less emphasis on the sequence of instruction and more emphasis on the design of the learning environment and constructing knowledge through social negotiation and cognitive conflict as the stimulus for learning (Savery & Duffy, 1996; Jonassen, 1994). Philosophically, the strengths of constructivism lie in its emphasis on learning as a process of individual understanding and meaning making rather than the memorisation of facts (Jonassen & Reeves, 1996). In particular, the social constructivists based on Vygotsky argue that the structured and linear process offered by the objectivistic conceptions of learning is problematic (Kanuka & Anderson, 1999). As learners have different social experiences and levels of understanding, it implies that there is no one reality as objectivists assume, but there exist multiple realities of how the world works and multiple ways of interpreting these realities (Jonassen, 1991). Thus, constructing is a sociolinguistic process where there is gradual advancement of understandings built upon previous knowledge resulting in multiple dimensions of the truth (Spiro, Feltovich, Jacobson, & Coulson, 1992). Constructivist learning environments can be enabled by an abundance of ICT tools that can enhance communication, access to real-world examples, reflective thinking, multiple perspectives, modelling or problem solving by experts in a situated context domain. Situated learning as introduced by Lave and Wenger (1991) states the importance of knowledge acquisition in a socio-cultural context and that the integration in communities of practice enabled by ICTs may lead to active construction and reflection about knowledge. The idea of situated learning is also closely related to the ideas of “blended learning” and “learning on demand” especially in programmes targeting adults at their workplace (Oppermann & Specht, 2006). This notion of “learning on demand” coined also as “embedded learning”

(Straub, 2005, cited in Schmidt, 2008), “work-integrated learning” (Lindstaedt, 2006, cited in Schmidt, 2008) or “context-aware workplace learning support” (Schmidt & Braun, 2006) opens a space for contextualizing learning in the workplace, especially through the support of ICTs. What we actually need is learning on demand, embedded into work processes, responding to both requirements from the work situation and from employee interests, a form of learning crossing boundaries of e-learning, knowledge management and performance support (Schmidt, 2005). The contextualisation of the learning on demand can not only be seen from the point of view of an actual problem or learning situation but also in a longer lasting process of learning activities that are integrated (*ibid.*).

Marsick & Mezirow (2002) and Mezirow (2000) extend the assumptions made by constructivists by incorporating the transformative and political dimension in their views of teaching and learning. The questions of “what should be learned?” or to put it alternatively “what is the most valuable knowledge?”, “how should it be produced?” and by “what teaching and learning methods would it be used?”, all fall in the sphere of politics and ethics in education. Transformative learning originated as an adult education based theory that suggests ways in which adults make meaning of their personal experiences. Mezirow (2000) defines transformative learning as a process by which our taken-for-granted frames of references are transformed by making them more inclusive, discriminating, open, emotionally capable of change. Tilbury, Podger, & Reid (2004) are stressing the ‘conceptual congruence’ between ESD and transformative learning as the goals and objectives of both apparently coincide. The congruence between the aims of ESD and transformative education has also been highlighted by Walls & Corcoran (2006) and Svanstrom, Lozano-Garcia, & Rowe (2008). Svanstrom et al. (2008). Mezirow (2000) argued that transformations often follow some variation of the following phases:

- a disorienting dilemma;
- a self examination with feelings of guilt or shame;
- a critical assessment of epistemic, sociocultural, or psychic assumptions;
- recognition that one’s discontent and the process of transformation are shared and that others have negotiated a similar change;
- exploration of options for new roles, relationships, and actions;
- planning a course of action;
- acquisition of knowledge and skills for implementing one’s plan;
- provision trying of new roles;
- building of competence and self-confidence in new roles and relationships.

Thus, transformative learning is, in a sense, the deconstruction of learners’ prior assumptions or frames of reference (points of view, habits of mind, worldviews) through critical reflection (*praxis*) as well as the reconstruction of their assumptions through meaning making. For Tilbury et al., (2004), it is the emphasis on processes of critical and personal reflection, the focus on change and shifting of values and behaviours that are common features of both ESD and transformative learning. The emancipatory domain inherent in the transformative paradigm is the place where learners can free themselves from any restrictions and

actively question their assumptions through critical reflection and praxis. Elliot (2010) found that the key transformative shifts in ESD learning involve learning to value sustainable development and learning how to make it happen. McLaren (1994, p. 190) defined praxis as “informed actions” and stated that “actions and knowledge must be directed at eliminating pain, oppression, and inequality, and at promoting justice and freedom”. Darder, Baltodano, & Torres (2003) considered praxis as “all human activity... understood as emerging from an ongoing interaction of reflection, dialogue and action” (p. 15). Cranton (1994) concisely listed three types of reflection that involves movement toward the emancipatory domain: content, process and premise reflection. Content reflection is an examination of the content or description of a problem; process reflection involves checking on the problem; premise reflection happens when the problem itself is questioned.

Critical pedagogues perceive teachers as “transformative intellectuals” who are involved in developing a discourse that unites the language of critique with the language of possibility (Giroux, 1988). Teachers functioning as “transformative intellectuals” are giving students an active voice, making the political more pedagogical and the latter more political (Giroux, n.d.). McLaren (1994) argued that “teachers must understand the role that schooling plays in joining knowledge and power, in order to use that role for the development of critical and active citizens” (p. 168). Huckle (2012) suggests that teachers should be introduced to critical social theory that seeks to explain the role of Web 2.0 technologies in the recent wave of capitalist development that precipitated economic and ecological crisis, and their potential to bring about more sustainable alternatives. He argues that such alternatives will be based on more radical and deliberative forms of democracy and citizenship enabled by the new technologies. In this context, Huckle assumes that teacher education for sustainability should equip teachers to explore these through appropriate forms of citizenship education and model them in their classrooms via new forms of critical pedagogy. Besides creating a learning environment that encourages students’ active participation in the learning process, critical pedagogy extends participation to the co-construction of curriculum. In this way, it is believed that learners’ needs, interests and learning styles are meaningfully integrated into what they learn and how they learn it. Through this process and practice, the learning environment adopts distributed or shared responsibilities between teacher and students, which may facilitate the process of negotiating the curriculum structure, content and assessing criteria.

In trying to bring together the main principles of the constructivist and critical pedagogy theories, assuming that experiential learning is crossing the two (for instance, Kolb & Kolb, 2005), we have conceptualised a construct abbreviated as ExConTra, that corresponds to Experiential learning, Constructivist learning and Transformative learning depicted in Figure 2 (Makrakis & Kostoulas-Makrakis, 2012a).

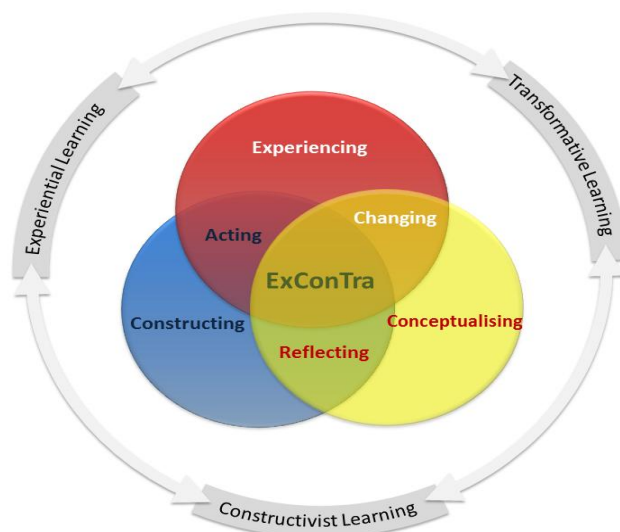


Figure 2. The ExConTra learning model

Beginning with *experiencing*, learners identify a realistic and authentic task associated with a sustainable development issue, and start collecting the information needed for their analyses, using various inquiry-based methods. Through *reflecting*, self and/or social, as well as through further reading and observing, learners organise and examine the collected data for the new experience from a variety of perspectives in order to find and make meaning. For learners to make meaning, either individually and/or shared, they need to reflect on their own experiences, leading them to develop more abstract understandings of their experiences (*conceptualizing*). Arriving at individual and shared meaning (*constructing*), learners need to get involved in a meaningful learning and shared inquiry enriched through continuous reflection, re-conceptualisation and active experimentation. Constructed knowledge and meaning is meaningful when it opens up opportunities for action. Merging knowledge and meaning with action (*acting*) leads to a change agency and active citizenship. Acting as change agents, learners are empowered to transforming experience through critical reflection and active experimentation. When critical reflection is transformed into an action it becomes praxis that turns learners able to transform oneself and society (*transforming*).

These processes can be enriched by ICTs as they provide many opportunities for experiential, constructivist and transformative learning experiences, especially by enabling learning to be related to context and to practice. ICTs provide an array of powerful tools that may transform teaching and learning processes and turn learners able to take greater responsibility for their own learning and constructing their own knowledge. The development of social media and networks has also led to a blurring between the public and private spheres, which has provided opportunities for communication, but also has brought dangers to some when private information has become public or when the virtual world has enabled people to practise deceit and deception (Wade, 2012). ICTs create the potential for new

modes of dialogic communication, empowerment and critical reflection that could enhance social learning for sustainability. Wals (2007) states that sustainability addressed as a social learning process is rooted in the life-worlds of people and the encounters they have with each other. Social learning theory is gaining prominence as a critical theory and research approach to studying ecosystems management, climate change and education for sustainability (Wals, 2007; Glasser, 2007; Wals & Heymann, 2004). Online collaborative discussions are increasingly notable for their role in social construction of knowledge by providing shared virtual workspaces for brainstorming, debating, discussing, or reflecting on issues of learning among learners, instructors or even invited guest speakers (Lim, 2007). Using social networking and video-conferencing programmes in conjunction with online courses offered through Learning Management Systems, such as Moodle is a means to expand student-student and student-tutor collaborative learning. Students' social learning for sustainability can be also enhanced through asynchronous discussion, which provides students the opportunity to post ideas and thoughts, read and comment other students' ideas. Both synchronous and asynchronous online discussions can foster critical reflection and create a foundation for transformative learning.

New approaches to content distribution, particularly the OpenCourseWare (OCW) and Open Educational Resource (OER) movements, promise to make a vast array of content open to instructors and students to reuse, revise, remix, and redistribute (Bush & Mott, 2009). OCW and OER can be labelled as learning objects (LOs) indexed and catalogued in digital repositories. The LOs either simple (for instance, pictures, documents, video, audio clips) or complex (for instance, Learning Management Systems, portals, chat software, blogs, wikis, discussion boards) that can be easily transferred for re-use and adaptation in another place. The concept of LO was borrowed from Object Oriented Programming to address the issues of learning resources deconstruction and their subsequent reuse to compose larger courses or learning units (Hudak, 2007; Lim, 2007). LOs should not be viewed as merely "containers" of content, but as distinctive attributes of learning that can be "granular, reusable, searchable and interoperable" across different systems" to support knowledge construction and application in learning (Lim, 2007, p. 45).

Course curriculum instructional/learning design

The designing of online courses requires a radical change in thinking in the way the instruction is designed and presented to the student. Much of the instructional design that has been applied to Web-based learning environments has been guided by the principles of instructional systems design (ISD) that is driven by objectivist conceptions of design (Roblyer, 2003; Duffy & Jonassen, 1992). Indeed, two of the dominant instructional design models that derive mostly from objectivist theories of learning are the Dick and Carey's (2005) ISD and the ADDIE (Analysis, Design, Develop, Implement, and Evaluate) model. The components of Dick and Carey's ISD approach are to: Identify Instructional Goals, Conduct Instructional Analysis, Analyze Learners and Contexts, Write Performance Objectives, Develop Assessment Instruments, Develop Instructional Strategy, Select Instructional Materials, Design and Conduct Formative Evaluation of Instruction, and Revise Instruction.

It is thus similar to the ADDIE Model in that it incorporates all of its phases of the ADDIE Design model. Vrasidas (2001) has described the objectivist-rooted ID products as prescriptive, formalistic, restrictive, and reductionist. A number of alternative to objectivist tradition instructional designs were proposed that were more open and flexible, placing less emphasis on the linear direction of the ID processes advanced by objectivists (for instance, Kenny, et al., 2005; Austin, 2002; Willis, 2000; Hannafin, et al., 1999; Jonassen, 1999; Mayer, 1999). As pointed earlier, open and flexible learning inherent in constructivist and transformative learning paradigm is a set of educational philosophies and systems, concerned with providing learners with increased choice, convenience, and personalisation to suit their interests and needs. In particular, flexible learning provides learners with choices about where, when, and how learning occurs (Makrakis, 2012; Shurville, et al., 2008). Current research findings show that integrating open-ended and flexible assessment activities that were relevant to real-world applications created a contextualised learning environment that facilitated learner autonomy and active cognitive engagement (Gikandi, 2011).

Pliner and Johnson (2004) and Scott, McGuire and Shaw (2003) provide an overview of Universal Instructional Design (UID) as an approach for addressing the diverse learning needs of students enrolled in institutions of higher education. The concept of UID is conceptually related to the principles and practices of multicultural education and social justice education. From a critical pedagogy perspective, Campbell, Schwier and Kenny (2005) propose a view of ID practice in which the instructional designer is an agent of social change at the personal, relational, and institutional levels. In this view instructional designers are not directed by managerial issues, but act in purposeful, value-based ways with ethical knowledge, in social relationships and contexts that have consequences in and for action. Shifting away from the decontextualised conceptions of objectivist IDs and the neglect of praxis from the constructivist conceptions of IDs, ExConTra IDs place due emphasis on values, ethics and change agency.

The instructional design for online learning we developed is driven by the ExConTra learning paradigm and partly adapted from Nam & Smith-Jackson (2007). As seen in Figure 3, this model consists of five design phases – needs analysis, curriculum design, development, formative evaluation and implementation – each of which has its own design processes. These phases, although, placed sequentially, in practice, there is much interaction among them. For developing the M.Sc. programme as a system, we have integrated some characteristics of objectivist ISDs in order to respond to adults' preferences for a goal-oriented curriculum. The developing of course curriculum, however, is based on critical adult education (for instance, critical reflection, experiential, situated learning, praxis) that is in alignment with the ExConTra learning paradigm. Critical adult education, as a learning approach, is well situated to influence instructional design and instructional methods, that can further serve foundational principles of ExConTra learning and create space for promoting education for sustainability enabled by ICTs. Abdullah, Parasuraman, Muniapan, Koren, & Jones (2008) summarising from other studies state that: 1) Adults are autonomous and self-directed; 2) have accumulated a foundation of life experiences and knowledge; 3) are goal-oriented and practice oriented. Thus, their perspectives about what to be trained should be taken into consideration; recognise the value of experience in learning; know what will be able to do after training; acknowledge the wealth of experiences that they

bring to the learning process. They also need to be engaged in learning by doing, problem-solving tasks and activities, and critical reflection during and after their activities (Frey, & Alman, 2003).

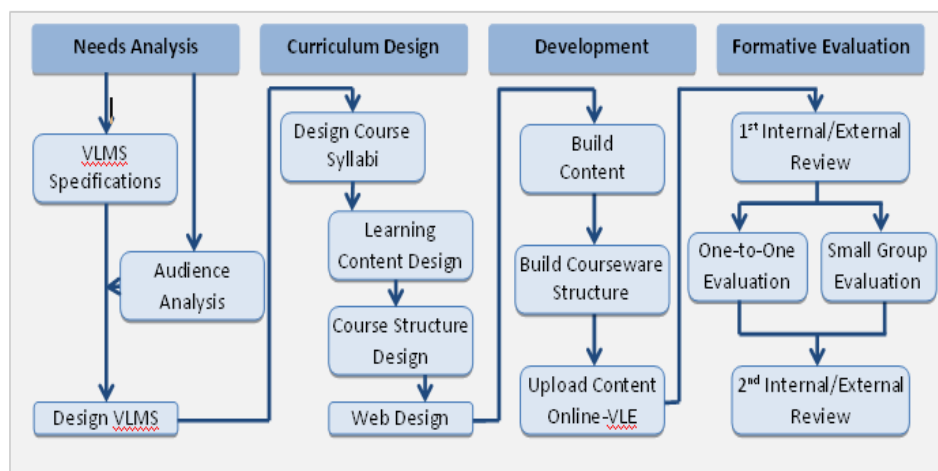


Figure 3. A model for designing course design and development

We have also identified a number of key elements related to the ExConTra learning model or paradigm and the online course design process, as exemplified in the following figure.

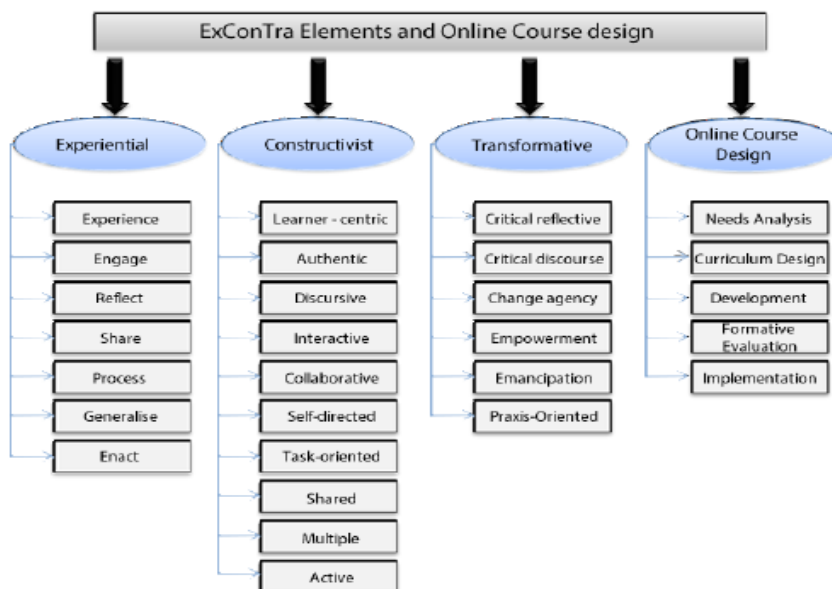


Figure 4. The ExConTra learning and online course design processes

Examples of how ExConTra learning paradigm can be implemented in online course design include the following:

- using Web-based authoring tools and scripting languages to develop learner-centred and self-instructional modules;
- providing Web-based resources using hypermedia and multimedia links to support students' experiential, constructivist and transformative learning activities;
- providing links to online databases, experts, virtual laboratories and knowledge repositories dealing with sustainable development issues;
- providing web-based distributed learning activities that allow learners to brainstorm ideas, negotiate, reflect, peer critique, debate, construct knowledge and develop action competence;
- providing synchronous and asynchronous communication tools that help the knowledge construction process through self/group critical reflection;
- incorporating learning principles and strategies that include active learning, collaboration and cooperation;
- engaging students in the application of knowledge through: inquiry-based learning; problem-based learning; higher order thinking; inter/cross disciplinary learning and authentic learning;
- identifying the learning domains and complex problems or cases to be explored within the identified learning domains;
- acknowledging learners' thoughts, experiences, ideologies and biases, and encouraging them to get involved in dialogue and meaning-making, especially through student-led online discussions;
- encouraging learners in integrating LOs in the course while working with it, thus taking into consideration their needs and interests as well as their various learning styles.

In this context, a number of questions need to be posed and taken into consideration in the design process, such as: What tasks will the e-tutor complete prior to starting the learning activity? What will students have to do to prepare for the learning activity? What administrative steps will be necessary for e-tutors to take in order to manage the online learning process? What responsibilities and modes of behaviour students need to have in online learning?

Applying the ExConTra instructional/learning design model

Phase 1: Needs analysis

Needs identification is strongly linked to an analysis of a set of tasks carried out in order to respond to the needs of the targeted audience. *Needs analysis* was concerned with gathering, analysing, and summarising information necessary to build the Virtual Learning Man-

agement System (VLMS). This phase is consisted of three design processes: VLMS specifications; audience analysis and VLMS design. Comparative analysis of the most common virtual platforms was carried out to identify strengths and weaknesses in terms of the needs and priorities of the ICTeSD project. We decided that Moodle is the most suitable online platform. Moodle is one of the most user-friendly and flexible open source courseware products available. It has excellent documentation, strong support for security and administration, and is evolving towards Instructional Management Systems/Shareable Content Object Reference Model (IMS/SCORM) standards with platform (Apache, PHP, and MySQL). The key to Moodle is that it is developed with both pedagogy and technology in mind. Moodle can also be supported by Mahara, which was found to be suitable as an e-portfolio.



Figure 5. Introductory information screen of the Virtual Learning Environment

A semi-structured questionnaire was also delivered to a purposeful sample (N=37) prospective students to elicit various types of information such as learning styles and profiles, previous experiences with e-learning tools, learning needs, ICT literacy, technology use, etc. Small group discussions were also carried out to enable people to talk and share ideas and experiences. The information gleaned from the needs analysis helped us to define educational goals, which were stated as specific learning outcomes in the phase of curriculum design and development. In other words, this phase functioned as the foundation on which we developed course syllabi and course modules.

Phase 2: Course curriculum design

In our case, curriculum was designed and interpreted in a four-stage process: 1) design of course syllabi; 2) learning content design; 3) course structure design and 4) web design. These processes provided the foundation for the course modules development exemplified in the development phase. The first stage of the process of course curriculum design and

development consisted on an extensive literature review that led to an exhaustive, as much as possible, identification of a group of themes, concepts, technologies, analysis methodologies linked to ICT and ESD. In order to ensure that the literature review would cover the main themes, an extensive review of Master courses related to the field of ESD was carried out in each country and region of the partner universities. A similar review was also carried in other regions worldwide. After that, another literature review was made, this time taking into consideration more specific works that allowed for a more in-depth analysis of themes and subjects identified in the previous stage.

A critical decision was made for the structure of the course curriculum. It is structured by merging vertical and horizontal modes of course curriculum design. The vertical integration represents continuity and structures the content in sequence from core to more complex and specialised or directed to specified streams. This provides a clear picture to learning, as students are able to understand how the knowledge is developed and organised in the course. In addition, it can help students to learn concepts and principles, to develop cognitive skills, to make choices and to develop attitudes and values that will be important to them in the working world. The vertical integration also assumed that there were discrete courses which combined content from two or more subject domains.

The horizontal integration brings about more breadth of curricular contents of different disciplinary areas and knowledge domains, especially through an interdisciplinary approach within the course areas. In this sense transformative learning cut across all the five competences (learning to be, learning to know, learning to live together, learning to do and learning to transform oneself and society) and thus it requires infusion among the disciplines, the university and the wider community, in order to function as agents of change. An interdisciplinary approach always consciously combines two or more subjects, while it keeps them distinct and in focus. Horizontally, the courses were built conceptually upon five main themes: Sustainability Theory; Educational Research; ESD pedagogy; Educational Policy and Leadership; and Information & Communication Technology (ICT). The emphases were on: 1) inter/cross-disciplinary content by merging concepts from the main themes and 2) multidisciplinary content by integrating multiple teaching methods and learning technologies. In this context, ICTs and ESD form the integrating “backbone” across all course contents. The design of the online curriculum components departed from the students’ needs that were contingent on the needs analysis processes. Twelve course syllabi were developed using a template for designing online course syllabi.

Table 1. The course structure of the master programme

PROGRAMME OF STUDY	ECTS
Year 1 Semester 1	30
Sustainability Theory, Systems Thinking and Transformative Change	10
Approaches to Educational Research for Sustainable Development	10
ESD Pedagogy and ICT	10
Year 1 Semester 2	30
Appropriate Technology, Active Citizenship and Education for Sustainable Development	10
Action Research and Participatory Action Research for Sustainable Development	10
ICT, Instructional/Learning Design and Education for Sustainable Development	10
Year 2 Semester 1 (to be chosen 3 out of 6)	60
Educational Policy and Planning for Sustainable Schooling	10
ICT, Climate Change and Geo-spatial Tools	10
Bio-cultural Diversity and Education for Sustainable Development	10
e-Learning, Virtual Worlds and Education for Sustainable Development	10
Teaching to Live Sustainably through the Earth Charter	10
Sustainable Leadership, Inter/Cross Cultural Communication and Planning for Sustainability	10
Year 2 Semester 2	30
Dissertation	30
Total for the Master degree	150
Total for the Master degree needed	120

Phase 3: Development

Learning content was based on an instructional design process for curriculum development which involved a systematic approach to establishing course modules' goals and objectives, selecting educational strategies to meet goals and objectives, the use of media and technology as well as designing learning activities for the online environment. Course structure process was based on breaking-up the course into manageable and meaningful modules and units, taking into consideration the weekly topics designed in the corresponding course syllabus. An example of a course modules template is provided in Figure 6. To achieve this purpose, first, the course was logically divided into modules, each module containing units, learning outcomes and learning activities that open space for learners to control their learning and enrich the content of the course enabled by appropriate online technologies.

Course	TITLE	
Module 1	Title	
Key Concepts		
Overview		
Aim		
Learning Outcomes		
Units		
Readings		
Activities	Overview	
	Explanation	
	Module 1	Time-load
	Directed Learning Online <input type="checkbox"/>	
	Dynamic Interaction online <input type="checkbox"/>	
	Assessment <input type="checkbox"/> [Note: Time allowed for preparing Assessment work can vary from 1-7 hours on average per module]	
Independent Learning <input type="checkbox"/> [Note: Time available to spend on Independent learning can vary from 1-7 hours on average per module]		
Total Time for Module 1		

Figure 6. The template for the course modules design

As pointed earlier, some aspects of the objectivist instructional design were adopted that were merged with ExConTra learning design principles. In particular, learning objectives for course modules were pre-specified, taking into consideration the needs analyses and group expertise from course modules' writers and designers. In consistency with the Ex-ConTra learning, activities were largely designed based on the choice of ill-structured problems that require the integration of several content domains. Asynchronous discussions are integrated within learning activities that can allow students time to read, think, reflect and reply. Indeed, peer discussion is one of the essential elements in ExConTra learning, especially in collaborative tasks.

The learning activities provide students with the capacity to explore, inquire and reflect on their thoughts, beliefs, values and practices enabled through synchronous and asynchronous communication tools. Such tools could be used to foster interaction and the sense of belonging in a learning community and minimise the sense that students are isolated from each other. Synchronous chat discussion groups are used for brainstorming, debating, clarifying values while the e-tutor functions as a coach and facilitator encouraging teams to reflect on their beliefs and to consider alternative interpretations of the issues and

problems studied. Particular emphasis was placed on integrating technologies (virtual worlds/games, blog, stream media) to encourage students create like-real situations. Students are also involved in reading and analyzing team members' responses and providing appropriate feedback. Peer-to-peer interactions and dialogue about challenging ESD concepts and problem solving is the focus of learning activities design enabled by ICTs. Students are encouraged to construct part of their knowledge via interaction with each other and this knowledge to be considered part of the course content. In this way, students are turned into co-constructors of what to be learned and how it would be learned. In order to provide proper scaffolding and coaching, the e-tutor is monitoring student-led team conversations as an equal partner in the learning process.

In order to prompt learners to investigate the problem, a list of focusing questions and information resources (for instance, suggested readings, links to related Internet sites and other information resources) are provided. As indicated in the ExConTra learning model, one of the key principle is collaboration and shared knowledge. In learning activities, the problem or case is presented as a collaborative team activity in which students are asked to set up teams, divide roles, share responsibilities and tasks in identifying alternatives, clarifying alternatives, comparing and contrasting alternatives before reaching a consensus for a decision. They are also presented with a complex or real-life problem by using learning objects as problem statements or scenarios. Simple and complex digital learning objects provided as open education resources and open source software are integrated in learning activities to activate ExConTra learning. Another powerful knowledge construction strategy integrated into learning activities is encouraging learners to construct their own learning objects enabled through various tools and online technologies. This generative strategy enables students to design and link interrelated content and ideas in the form of meaningful content structures. This gives more opportunities for: 1) integrating varied examples of how different disciplines can be merged within a single subject; 2) interacting during problem solving activities; 3) engaging in a reflective conversation and 4) selecting, re-using and adapting digitised learning objects identified in the Internet. The strategy to involve also students in team-based learning activities from different socio-cultural contexts, despite empowering them to reflect on their thoughts and practices and analyze their own lives, this involvement may break down the stereotypes that others may have of them.

e-Tutors' toolkit

With a growing number of courses and degrees offered through the Internet, there is a considerable interest in preparing instructors to teach online. A pedagogically meaningful and replicable toolkit for virtual training has been also developed and applied in training teaching staff to function as e-tutors for the joint Master degree programme. Building content included the development of learning activities, learners' assessment, types of learners' communication and interaction. Much of the course materials are based on learning objects which represent either autonomous learning and/or modified or newly developed. The ICT-eESD e-tutors toolkit targets prospective e-tutors nominated by the partner universities to support the ICTeESD M.Sc. programme on ICT in education for sustainable development.

The e-tutors toolkit is a self-development manual based on ICTeESD materials/tools and Open Education Resources supported by facilitators and designed to assist participants make the shift from face-to-face forms of teaching and learning to online learning. The toolkit has the following six modules, which are integrated into the main themes of the dedicated website.

Module 1: Getting started with the ICTeESD VLE

Module 2: Becoming an e-tutor

Module 3: Orientation to online teaching & learning

Module 4: Building a community of online learners

Module 5: Developing online activities

Module 6: Wrapping up all

Modules 1 and 2 provide participants with the competences needed to become comfortable with the ICTeESD Moodle-based Virtual Learning Environment and an exploration of the characteristics, roles and competences of being an e-tutor. Module 3 provides an orientation to the characteristics, pedagogies and technologies for online teaching and learning. Modules 4 and 5 integrated into the “Practicing e-tutoring” theme engage participants in designing, organising, scaffolding, communicating and assessing online learning. Finally, module 6 wraps up all, with an assessment of the whole training process.

The screenshot shows the introductory screen of the e-tutors toolkit. At the top, there is a navigation bar with the following links: Home, Overview, ICTeESD VLE, Becoming an e-Tutor, Online Instruction, Practicing e-Tutoring, and Wrapping Up. Below the navigation bar, the page is divided into two main sections. On the left, there is a sidebar titled "e-Tutors' Toolkit" with a list of menu items: Overview, ICTeESD VLE, Becoming an e-Tutor, Online Instruction, Practicing e-Tutoring, and Wrapping Up. On the right, the main content area is titled "Home" and contains the following text:

With a growing number of courses and degrees offered through the Internet, there is a considerable interest in preparing instructors to teach online. The ICTeESD e-tutors toolkit targets prospective e-tutors nominated by the partner universities to support the ICTeESD M.Sc. programme on ICT in Education for Sustainable Development.

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- ✓ Module 1: Getting started with the ICTeESD VLE (Week 1 & 2)
- ✓ Module 2: Becoming an e-tutor (Week 1 & 2)
- ✓ Module 3: Orientation to online teaching & learning (Week 3 & 4)
- ✓ Module 4: Building a community of online learners (Week 3 & 4)
- ✓ Module 5: Practicing e-tutoring (Week 5 – 8)
- ✓ Module 6: Wrapping up all (Week 9 – 12)

At the bottom left of the main content area, there is a logo for V-campus ICTeESD.

Figure 7. The introductory screen of the e-tutors toolkit

Phase 4: Formative evaluation

Formative evaluation refers to a process that provides a judgment of the strengths and weaknesses of all the activities involved in the online course across all design and developing stages to improve its effectiveness and appeal. The concept of formative assessment is underpinned by three defining processes: “establishing where the learners are in their learning [in relation to the expected learning outcomes]; establishing where they are going; and establishing what needs to be done to get them there” (Black & Wiliam, 2009, p.7). Effective integration of online formative assessment has the potential to facilitate and sustain meaningful interactions among learners and the teacher, and in turn foster development of effective learning communities to support meaningful learning and its assessment (Sorensen & Takle, 2005). Moreover, this can provide a systematic structure for effective support and learning scaffold through ongoing monitoring of learning and provision of adequate formative feedback.

Our purpose was to provide evidence to be used in making decisions about how to review and revise the programme while it is being developed. It is worth pointing out that our literature review that was carried in the need analysis phase in this field barely revealed any course curriculum design that has holistically integrated online formative assessment, especially from the perspectives of supporting meaningful learning. The formative evaluation process advanced in the ICTeESD project consisted of four processes: 1) 1st internal/external review; 2) one-to-one evaluation; 3) small group evaluation; and 4) 2nd internal/external evaluation. The 1st internal/external review is designed to take place up to the third phase, covering all processes involved. The one-to-one and small group evaluation processes make use of prospective students as subjects. It includes a series of usability tests, peer reviews or expert reviews in any of the previous phases and processes.

Quality Assurance

Quality assurance in the ICTeESD project has two directions. The first direction concerns the strategies to be adopted in order to ensure quality and the second direction concerns the process of accreditation and recognition of the Master programme. Both of these directions are not mutually exclusive, as the first is a condition for the second. One of the main concerns revealed in EUA (2006) Joint Masters Project (2002-2004) is the often weak anchoring of Joint Masters programmes within their network institutions. This is explained by the fact that such programmes are mostly initiated and linked to committed individuals, while the institution as an “outsider” has often provided difficulties to endorse the programme. Another important finding in EUA’s Joint Masters Project was the incompatibility of the national mandate of Quality Assurance agencies with the transnational nature of joint degrees. In addition, with regard to internal quality processes, the nature, maturity and standards of the institutions involved on which they are based vary across Europe. However, as the proposal for the joint degree is endorsed by all partner institutions, recognition of the degree may be made contingent on all member institutions or programmes of the group or consortium.

It was thus important to assure that the ICT in ESD master programme led by the ICT-eESD project coordinated by the University of Crete meets the qualities needed to gain recognition outside of those involved in its conception and development. A major effort was exerted in systematizing and organizing curricular contents in order to ensure that the curricular components are aligned with the learning activities, the curriculum global objectives and competencies to promote. This systematizing and organisation process of the curricular contents is not an easy task for various reasons. To this end a Quality Assurance Framework has been developed that illustrates a comprehensive coverage of key components of online course quality assurance depicted in Figure 8 (Makrakis & Kostoulas-Makrakis, 2012b).



Figure 8. Quality assurance framework

It serves as a blueprint for addressing the issues for online course design. The framework consists of six independent but interconnected components, which are further divided into relevant sub-components. Missing one piece means missing part of the puzzle that, when complete, provides an overview of quality issues in online courses.

Each sub-component includes a number of benchmarks that can be used as reference points for assessing the quality of every key component (Table 2). It should be born in mind, however, that the development of quality standards is a complex and not an easy task as the developments in the area of online education have still not reached maturity (Galloway, 2005). The need for standards that could guide online higher education and the design and delivery of online courses continue to be one of the most critical factors for open distance and flexible learning enabled through web-based and other advanced technologies (Allen & Seaman, 2005). There is clear agreement that online education has specific characteristics which should be considered in designing any Quality Assurance (QA) instrument for online course design and development.

Table 2: The subcomponents of the Quality Assurance framework

Instructional/Learning Design	Course Content Structure and Presentation
Students' readiness Course & module goals & objectives Learning activities Learning Strategies	Structuring the course Functionality and consistency Text structure and formatting Providing adequate feedback
Interaction, Feedback & Assessment	Institutional Policies and Technical Support.
Interaction among learners Interaction between learners and instructor Interaction between learners and instructional materials Feedback and assessment	Accessibility Authentication and security Copyright, netiquette
Web Design	Course Management and Organisation
Understanding user needs Navigation Visual appearance	Time Requirements Progression through course Providing adequate feedback

Concluding Remarks

Our focus in this paper was the design and development of a VLE for a M.Sc. programme on ICT in Education for Sustainable Development driven by a learning paradigm that merges three theories of learning, namely: experiential learning, constructivist learning and transformative learning (ExConTra). While, for example, ICTs can provide interactive mind/cognitive tools to support learning and develop new understandings and knowledge in areas of teaching and learning for sustainability, ESD themes integrated into the school curricula could provide a worthwhile context for ICTs in education (Makrakis, 2010abc). Such themes may include cultural diversity and intercultural/interfaith understanding, health, HIV/AIDS, governance, natural resources, climate change, rural development, sustainable urbanisation, disaster prevention and mitigation, poverty reduction, corporate responsibility and accountability, and so forth. In this sense, social, economic and environmental issues can provide meaningful and challenging contexts for developing a wide range of ICT skills. Activities were designed to meet students' various learning styles and encourage them to experience personal change towards learning to live sustainably. The questions asked of online tutors encourage students to express their thoughts, take the learning control, allows them to share their thoughts and ideas, listen to the perspectives of others, and critically reflect on their own viewpoints.

Using a participatory curriculum development approach ensures that all the groups and individuals who have a real interest in the programme are actively involved in some way in the project during various stages. In this way, prospective students, instructional designers, content experts, critical readers and prospective e-tutors were involved in the course curriculum development. Through this approach contextualised teaching and learning becomes more feasible, as those involved bring their own experiences to the learning process. Such

an approach is also conducive to the 'process' and 'praxis' curriculum approach that is characterised by the recognition of empowerment, emancipation, knowledge construction, meaning making and negotiation. A participatory and negotiated curriculum, however, does not necessarily imply that every facet of the curriculum is open to participation and negotiation.

This learning paradigm used allows both online students and facilitators to take advantage of ICT tools and the World Wide Web on making connections and making meaning in the learning process. Online students can collaborate by sharing their individual perspectives, ideas, and personal experiences, thereby deepening their understanding with increasing higher order thinking and greater personal satisfaction (Snyder, 2009; Engstrom, Santo, & Yost, 2008). When used in conjunction with instructional methods that promote inquiry and collaboration, technological solutions become important components to facilitating experiential learning (Meyers, 2008). A rich learning environment encourages shared meaning and shared inquiry (Novak, 1998) as well as multiple learning styles and multiple representations of knowledge (Kafai & Resnik, 1996). Pre-specified learning activities combined and enriched with those created materials by students cater for several learning styles, and interactions (student-teacher; student-student; student-content). The ExConTra learning process is also based on an interdisciplinary approach addressing the four pillars (environment, society, culture and economy) of sustainable development and makes use of an online course design methodology that uses four phases: needs analysis, curriculum design, development and formative evaluation. The VLE that encompasses both the curriculum programme and the online platform with its tools and online technologies merges ICTs with ESD in three ways: a) providing opportunities to target groups for reflective practice; b) using open source ICT tools and ESD-related learning objects available in the Web; and c) using ICTs to develop interactive, interdisciplinary and cross-disciplinary ESD learning activities.

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494)). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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ETHICAL-VALUES PEDAGOGICAL MODEL

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Abstract

This paper presents an ethical-values pedagogical model that emerged during the design of an online Masters programme, developed with the support of funding from the Erasmus multilateral programme. The authors are experienced in both the development and implementation of online learning, particularly values-based learning approaches in higher education, and are deeply committed to building alternate theoretical models that stimulate thinking about values-based learning within an online context. This Ethical-values pedagogical model thus represents an alternative theoretical resource for thinking about the role of ethical-values in learning. Garrison, Anderson and Archer's (2000) Community of Inquiry framework has been re-conceptualised and a new pedagogical model, titled the Ethical-values Pedagogical Model, has emerged. This model posits that a positive ethical-values presence is critical to sustaining teaching, social and cognitive presences, and thus the lynchpin for the enablement of appropriate and meaningful cognitive experiences. The ethical-values bases of learners and educators effectively filters the way in which the cognitive experience is created and the manner in which the individual learner makes sense and/or constructs meaning within the learning environment. As such, the ethical-values bases impacts significantly on the teaching, social and cognitive presences within the learning environment. The Ethical-values pedagogical model centres on the negotiation of an ethical-values basis as the initiator and driver of meaningful and appropriate learning experiences for the individual learner, communities of learners and educators. Therefore, the ethical-values presence is recognised as critical to the sustainability of appropriate, safer and meaningful learning particularly within the online context.

Key words: *pedagogical model, ethical values, online learning*

Introduction

The nature and processes of teaching and learning have changed in many ways in the past century. More recently the so-called era of globalization, in which our traditional concepts of learning and education have been turned on their head and neatly packaged ideologies and communities have been undone, has brought about a reevaluation of the traditional

concepts of teacher, learner and the learning context. There is a renewed focus on learner-centric approaches to teaching and learning, with an emphasis on facilitating situated, distributed, mediated, collaborative and democratic learning experiences. These require a re-examination of the role of values, identities and ethical bases in the process of learning, particularly within online contexts. Despite the availability of many different teaching and learning frameworks for online learning, the literature review undertaken in this study found no evidence of an online pedagogic framework or model that explicitly addressed ethical-values dimensions within a learning context. Furthermore, the literature review revealed that the constantly changing technological landscapes underpinning online learning environments can act as a double-edged sword. Thus, online technological advancement can provide new ways for learners to create, connect, communicate and collaborate (as highlighted by Redecker, Ala-Mutka, & Punie, 2010) but its prevailing culture of ‘openness’ and ‘informality’ also exposes learners to issues of safety and privacy and even the possibility of litigation. In the discussion that ensues, Holland, Mulcahy, Besong and Judge present their online pedagogical model that posits an ethical-values perspective and presence as central to the creation of meaningful and safer learning experiences for learners in the 21st century.

Background to the evolution of the ethical-values pedagogical model

The Ethical-values pedagogical model evolved from a critical review of the literature on the design and facilitation of online learning environments, and discourse with colleagues engaged in the design of an online Masters programme in technology-enabled Education for Sustainable Development, (which was developed with the support of funding from the Erasmus multilateral programme, between 2010 and 2012). The authors are experienced in both the development and implementation of online learning, particularly values-based learning approaches in higher education, and are deeply committed to building alternate theoretical models that stimulate thinking about values-based learning within an online context. This model thus represents an alternative *theoretical* resource for thinking about the role of ethical-values in learning, and as such represents a series of “ideas *for* practice, rather than ideas *in* practice” (Thomson, Lingard, & Wrigley, 2012, p.2).

In the review of the literature on pedagogical models used within online learning, Garrison, Anderson and Archer’s (2000) Community of Inquiry framework and Salmon’s (2000, 2004) Model of e-moderating came to the fore as the pedagogical tools of choice in the design and facilitation of many online learning environments. Neither of these, however, explicitly addressed ethical-values dimensions within learning. Through an iterative process of dialogue with colleagues and critical engagement with the literature, Garrison *et al* (2000) framework emerged as the most suitable basis for explicating the role of ethical-values in the process of learning. The discussion that ensues describes Garrison *et al* (2000) Community of Inquiry framework and explains its relationship to, and the emergence of, the *Ethical-values Pedagogical Model*, which posits an ethical-values presence as the lynchpin for the enablement of appropriate and meaningful cognitive experiences. It is

important to note here that ethical-values are implicitly assumed to guide learners towards *positive* actions.

Garrison et al (2000) community of inquiry framework

In 2000, Garrison, Anderson and Archer presented the Community of Inquiry framework, which was based on a constructivist and collaborative approach to teaching and learning. This popular framework comprises three elements: teaching presence, cognitive presence and social presence. At the centre of this model is the cognitive experience, where participants interact with the cognitive content and processes.

The teaching presence is described as the “design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes.” (Anderson, Rourke, Garrison & Archer, 2001, as cited in Garrison, Cleveland-Innes & Fung, 2010, p.32). The teaching presence involves the development of curriculum, teaching strategies and learning activities; and focusing the community and the individual learner and learners towards meeting the learning outcomes. The social presence can be considered as the level of awareness of other/s in an interaction and/ or the degree to which learners can project their “personal characteristics” (Garrison et al, 2000, p.89) into the community. Social presence within a community of learners may involve the development of, and appreciation for, meaningful interpersonal communication and relationships within the learning community. The social presence impacts on the cognitive and teaching presence, particularly with regard to the degree of cognition that occurs and opportunities. The cognitive presence is the process through which learners within a community of inquiry “constructs meaning through sustained communication” (Garrison et al, 2000, p. 89). In this regard, the cognitive presence may comprise learners engaging with a learning problem, exploring or challenging relevant information/ knowledge, making sense and integrating ideas, resolving the problem and reflecting on process.

Identities and ethical-values in an online learning context

Garrison *et al* (2000) framework has been useful in terms of understanding some of the elements that are pivotal to enhancing the educational experience. However, as mentioned earlier, it does not explicitly address the role of ethical values in influencing the teaching presence and in shaping the learning experience for the individual learner and communities of learner.

Values and identities in the past were located in a specific context and social milieu, but, in the age of online learning, are subject to multiple discourses, multiple agendas and interest groups. According to Zembylas and Vrasidas (2005) the capacity of the Web to facilitate learning environments that are populated by multiple relationships and hybrid identities poses the dilemma for online educators to provide an ethical pedagogy. In common with Ward and Prosser (2011) and Gomez (2009), Zembylas and Vrasidas (2005) turn to the work of the French philosopher, Levinas, to create a theoretical and philosophical underpinning to support the study of ethical values in online learning. Levinas postulated

the importance of Face in understanding the Other. By Face, he was referring to face-to-face communication. In designing this model for online learning, the authors identified the importance of an ethical values base to overcome the limitations of the lack of face-to-face communication. Viewed in isolation, the inclusion of an ethical value base does not resolve the ontological or ethical challenges posed by online learning environments but viewed in relation to the other components of the model, it creates a fresh opportunity to design curricula that challenge and demand a reflective approach to learning from all concerned. The building of Levinas' concept of a relational approach to knowing, needs the participants to focus on the other partners in the learning process and attempt to understand their diverse identities and approaches.

While there is general agreement on the need to include ethical values in the learning environment and while individually much has been written on both elements of this equation, very little work has been conducted on the actuality of ethical values bases and their impact on education and learning. Socratic approaches would suggest that as humans we all want and seek *the good* but we do not always succeed. If we accept Hill's (1991) assertion that a value is more than a belief and more than a feeling, then in designing online curricula it may be timely to consider the articulation of an agreed number of core values that will underpin this process. In addition subject specific values may be additional to the core set. For example work in the area of Education for Sustainability could include a particular set of ethical values related to sustainability.

Finally, the online learning environment does create a number of specific ethical risks. These have been well documented elsewhere and relate to issues such as plagiarism, identity theft, unsuitable posts, the use of unsuitable internet sites and gender and race bias. Through the use of the ethical values pedagogical model such ethical risks can be identified, named and highlighted as part of the forward planning for the curriculum.

Ethical values pedagogical model

In light of the issues identified above, Holland, Mulcahy, Besong and Judge (2011) reconceptualised Garrison *et al* (2000) Community of Inquiry framework and now present a new pedagogical model, titled *Ethical-values Pedagogical Model*, which posits a positive ethical-values presence as critical to sustaining teaching, social and cognitive presences, and thus the lynchpin for the enablement of appropriate and meaningful cognitive experiences. This section begins with an explanation of what an ethical-values presence is and then attempts to explain the interactions between the four presences and importantly how an ethical-values basis and presence is critical to the sustainability of appropriate, safer and meaningful learning within the online context.

The ethical-values presence is the values-bases and prioritised *goods* that direct the teaching, social and cognitive presences, and by default the cognitive experience. These are the ethics and/ or values that promote respect, equity, fairness, solidarity, and democratic actions and behaviours within the learning environment. For the individual learner, an ethical-values basis results in the development of learner's self-esteem and self-expression. For the educator/s, an ethical values-basis is critical to the creation of a democratic, col-

laborative and safe learning environment. For the community of learners, the ethical-values basis and presence denotes a community who value respect, mutual understanding and consensus building. The ethical-values pedagogical model, as illustrated in Figure 1 is guided by the ethical-values presence, which mediates the manner in which the three other presences (teaching, cognitive and social presence) outlined by Garrison *et al* (2000) are manifested within the learning environment.

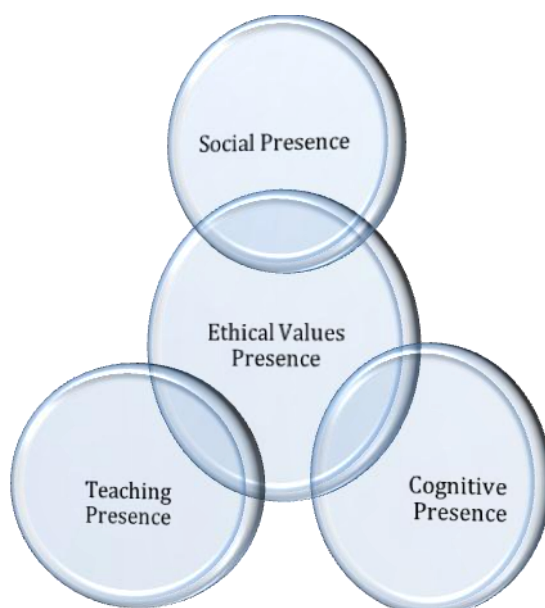


Figure 1. Ethical-values pedagogical model

The extent to which higher-level learning occurs for the individual learner is impacted by the quality of cognitive, social and teaching presences, which is evidenced by the degree to which the individual learner, community of learners and educator/s prioritises notions of what is of personal, community and learning value. These prioritised *goods* and values-bases constitute the ethical-values presence, and are to a great extent the driver for decisions by the individual learner, community of learners and educator/s on how to engage in learning and to what extent learning will take-place.

The ethical-values presence impacts on the social presence, by promoting consensus building within communities of learners, respect for difference and fostering a safe and inclusive learning environment. It impacts on the teaching presence, by the prioritisation of inclusive teaching and learning strategies and the recognition of the importance of negotiated, collaborative and democratic learning opportunities. Furthermore, it impacts on the

cognitive presence by giving the learner the confidence to interact and reason with the cognitive content and processes in a more critical manner.

The cognitive experience can be perceived as a fluid concept, where the individual learner, community of learners and educators engage in the co-construction of knowledge. The individual learner, community of learners and the educators are recipients and creators of information and actively engage in the dynamic construction and transformation of knowledge into learning. The ethical-values presence impacts on the cognitive experience by allowing both learners and educators to reach consensus on prioritised values and good practice necessary to the fulfilment of a democratic, participatory and safe teaching and learning environment.

Translating the model into practice in an online context

From the outset, the Ethical values pedagogical model has been presented as a *theoretical* resource for thinking about the role of ethical-values in learning, or more simply, as a guide *for* practice. This section describes how the Ethical-values pedagogical model can be translated into practice by online course designers, educators and learners. It is important to note that fostering a positive ethical-values presence is critical to the success of this model, and as such the discussion opens with an exploration of this aspect. The discussion ensues with clarification on how to enhance the teaching, social and cognitive presences within an online context.

Enhancing the online ethical-values presence

Online learning environments must accommodate multiple identities, complex discourse and multiple learner relations (Zembylas and Vrasidas, 2005). One of the key challenges in online learning is to design courses where learners and educators prioritise, actively promote and are responsive to an agreed core of positive ethical-values. An ethical-value expresses the appropriateness of specific ethical principles and practices, with the aim of determining which principles or practices are best to guide our actions. In the context of learning, it essentially involves learners and educators prioritising a series of positive values and actions necessary for participatory and democratic learning. These positive actions may take the form of valuing ‘others perspectives’ or ‘solidarity’ or ‘otherness’ and are central to the creation of a participatory, democratic ethos and culture, that underpins transformative learning environments.

It is important for the learner, community of learners and educators to reflect on how their ethical values bases enhances the cognitive experience of all within a learning environment. Figure 2 identifies a number of considerations that should be made by the learner, community of learners and educators to enhance the ethical-values presence within an online context.

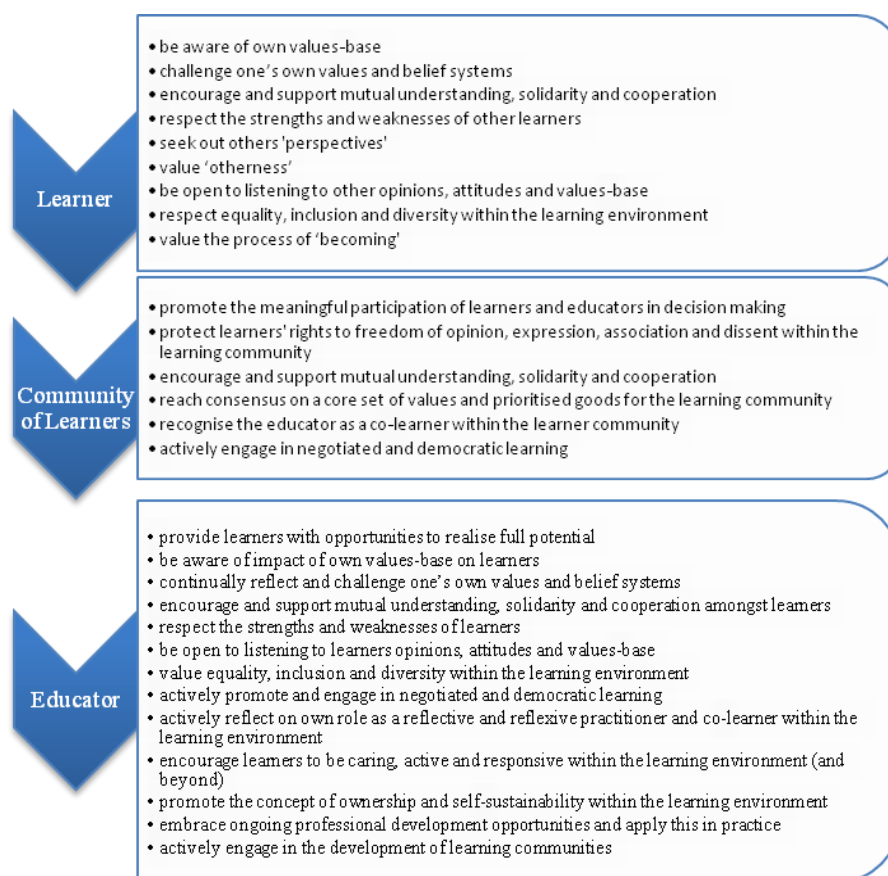


Figure 2. Guide to promoting a positive online ethical-values presence

A positive ethical-values orientation in learning calls for the awareness of the existence of the 'other' by the learners and the educators. Consequently, such awareness enables learners and educators to respond ethically to the others' experiences. The starting point for the learner in understanding ethical-values is to examine his/ her own thoughts, feelings, attitudes, beliefs and values-base. The learner needs to challenge own perceptions and assumptions, and actively seek others perspectives. From a philosophical perspective, the learner needs to understand that learning is a process of 'becoming' and that the ethical-values base shapes this process of 'becoming'. Zembylas and Vrasidas (2005) argue that "*knowing who we are does not necessarily assume that we know how to relate to others in an ethical manner*" (p.62). The learner needs to be open to listening to others' opinions, attitudes and values-bases; in this sense, the learner needs to value 'otherness'. This exploration of the value of otherness is facilitated through engagement with communities of

learners and educators. For the community of learners, reaching a consensus and actively promoting an ethical-values base is necessary for the promotion of a safe, inclusive learning environment. For the educators, reflective and reflexive practice is critical to understanding own ethical-values base and how this shapes the learning content, processes, interactions and ultimately, the learning of learners.

The ethical-values presence is evidenced in online learning through the choices, interactions and decisions made by the learner, community of learners and educators. In terms of the learner, the indicators for an ethical-values presence include learner's expressions of solidarity and willingness to actively seek out, listen to and challenge others perspectives. In terms of the community of learners, the indicators for an ethical-values presence include a self-sustaining community of learners that actively engage in negotiated, collaborative and democratic learning. In terms of the educator/s, an ethical-values presence would reflect in the creation of inclusive, participatory, negotiated, collaborative, transformative learning opportunities, transparency in learning and recognition of the educator/s as a co-learner in the learning process.

Enhancing the online teaching presence

The rapid change of technology (and in particular the integration of social media in the learning environment) offers new online (and off-line) pedagogical possibilities. There are a variety of approaches and basic principles in online pedagogy that impact on the teaching presence. These include the design of learning activities and choice of teaching strategies, each of which can impact for better or worse the learning experience. Good practice in online pedagogy promotes: learner centred approaches; active learning strategies; self-directed learning; interactivity, cooperative and collaborative learning; intercultural communication; and authentic situated learning. Thus, there is a need to allow a good degree of flexibility for learners in terms of the cognitive content and the teaching and learning strategies used to mediate learning.

The educator essentially sets the tone and visibility of teaching presence. The role of the educator is to guide, negotiate and advise learners towards the fulfilment of learning outcomes. The educator guides learning, develops learning strategies and organises the learning environment such that it enhances learners' critical thinking skills, self-organisation and self-directed learning. The educator also guides learners' activities towards cooperation, collaboration and interaction with the learning community, learning environment and the learning resources. The educator should use methods that build upon learners' experiences and knowledge base and provide opportunities for learners to connect prior knowledge with current learning.

Figure 3 provides guidelines on enhancing the teaching presence, particularly in relation to the aesthetic design, pedagogic design and the cognitive content of the online course. The aesthetic design refers to the 'look and feel' of the online course, and impacts on how the 'teaching presence' is perceived. The pedagogic design refers to the teaching, learning and assessment strategies that are promoted within the online course. The cognitive content comprises the learning content, activities and resources.

Aesthetic design	Pedagogic design	Cognitive content
<ul style="list-style-type: none"> • use standardized formats for content presentation • ensure the content is accessible and usable by learners • use local language where possible and necessary • use translations where possible • highlight important points • use images and/ or multi-media elements to add interest or to pose a question • use colour for headings or bands to break up content. • use clear and concise information in the navigation structure • use text, graphics or images, simulations, audio or video segments to enhance interactivity and visual display. • avoid putting in too many resources as this may confuse students • avoid a monologue writing style as this may discourage the students from engaging in the learning process • work within the bandwidth constraints of the web. • distribute online evaluation forms to gauge learner responses to aesthetic aspects of the course 	<ul style="list-style-type: none"> • provide opportunities for multiple forms of learning: case-study learning, inquiry-based learning, problem-based learning, interdisciplinary learning, service learning, discovery learning and ICT-enabled learning • encourage interactivity in the form of one-on-one interaction with a partner; with the teacher; in small groups; with the entire class; • design collaborative tasks • use online presentation tools like slide shows • Use online communication tools/ social mediadesign authentic situated tasks • take into account student prior knowledge, skills and aptitudes • allow opportunities for intercultural actions • encourage note making from online material using annotation tools • encourage group discussions, debates • provide interactive online assessment activities • guide the learners through the learning content • provide challenging learning activities to stimulate debate and critical thinking • use 'reflections' in order to situate learning • provide netiquette and interaction guidelines • provide prompt and motivating feedback. • use online surveys to elicit feedback on pedagogic aspects of course 	<ul style="list-style-type: none"> • Content needs to be goal-oriented, focusing particularly on meeting the learning outcomes • Select and sequence the content into discrete learning modules and clearly define the learning outcomes • Select content that is authentic, reliable and current • Select content that meets the needs of learners with different learning styles and preferences • Structure content so that learners can build on prior knowledge and experience, and move towards an understanding of an entire system • Integrate multicultural and multi-disciplinary perspectives in content • Re-use existing learning materials suitable within the online context • Provide links to journal articles and scanned readings for downloading • Check accuracy of content • Update materials and check if links are active • assign case studies to analyse • Provide a forum for gathering and sharing community resources • Provide interactive online assessment activities • Organise thematic content around content issues and materials and tools, with activities such as: action research projects and case studies

Figure 3: Guide to enhancing the online teaching presence

Enhancing the online social presence

The social presence in online learning is critical. There are a variety of factors that impact on the social presence. These include the creation and fostering of a community of learners, the role of the educator, the contributions from the individual learner and most importantly, the interaction of the learner, educator and the community of learners. Online courses can be perceived as ‘cold’ or ‘distant’. It is very important to design an online system that promotes communication and interactivity of all participants in the learning process. Figure 4 provides guidelines on enhancing the social presence.

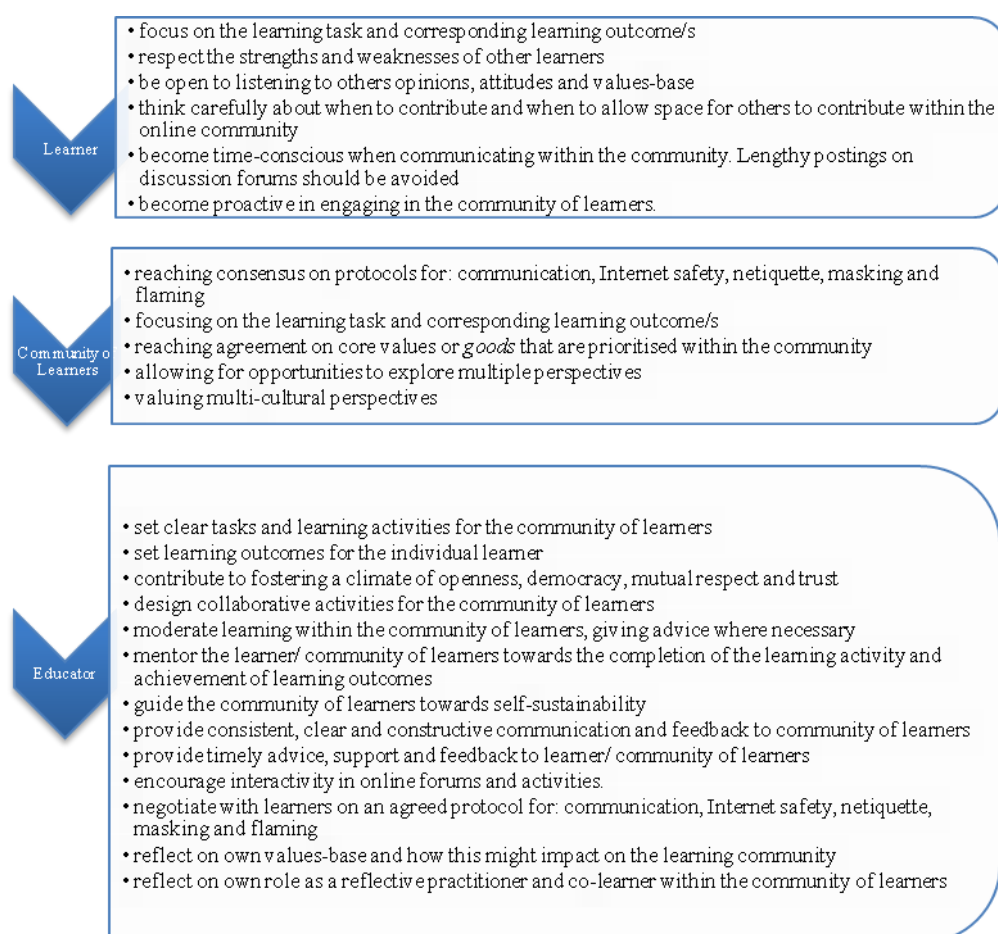


Figure 4. Guide to enhancing the online social presence

Enhancing the online cognitive presence

The cognitive presence can be perceived as the manifestation of a process through which the learner makes meaning of the cognitive experience. The degree of cognitive presence can be enhanced through self-reflection and through collaboration with other learners and/or with educators. Evidence of a cognitive presence can be seen through learner's interaction in the learning activities and processes. This can be in the form of engagement in discussion, peer review and self-reflection and / or in the co-creation of learning artifacts. Figure 5 provides guidelines on enhancing the cognitive presence.

Guide to enhancing the cognitive presence		
Learner	Community of Learners	Educator
<ul style="list-style-type: none"> • Focus on the learning outcomes • Pro-actively engage in the learning activity and processes • Reflect on role of own values base on the learning process • Critically engage with learning process • Seek out others perspectives • Challenge own values base and belief systems • Develop an understanding of own learning styles and preferences 	<ul style="list-style-type: none"> • Focus on the learning task and corresponding learning outcomes • Reach agreement on core values or <i>actions to be</i> prioritised within the community • Provide a safe environment where the learner feels free to contribute own perspective and challenge others' perspectives • Respect individual perspectives and contributions • Provide opportunities for individual learner to explore multiple perspectives • Challenge individual's perspectives and contributions • Value multi-cultural perspectives and collaborative interactions 	<ul style="list-style-type: none"> • Set learning outcomes for the individual learner • Contribute to fostering a climate of openness, democracy, mutual respect and trust • Mentor the learner towards the completion of the learning activity and achievement of learning outcomes • Encourage self-paced as well as collaborative learning • Provide consistent, clear and constructive communication and feedback to learners • Provide timely advice, support and feedback to learner • Encourage learner interactivity in online forums and activities. • Reflect on own values-base and how this might impact on the learning of the individual learner • Reflect on own role as a reflective practitioner and co-learner within the learning environment

Figure 5. Guide to enhancing the online cognitive presence

Conclusion

The Ethical-values pedagogical model as explicated, firmly positions an ethical-values basis as the initiator and driver of meaningful and appropriate learning experiences for the individual learner, communities of learners and educators. The ethical-values bases of learners and educators effectively filters the way in which the cognitive experience is created and the manner in which the individual learner makes sense and / or constructs meaning within the learning environment. As such, the ethical-values basis impacts significantly on the teaching, social and cognitive presences within the learning environment. Therefore, the ethical-values presence is critical to the sustainability of appropriate and meaningful learning within the online context. Research is currently being conducted on indicators for the ethical-values presence within the context of online learning and the outcome of this will be discussed in future publications.

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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ICT-ENABLED CLIMATE CHANGE EDUCATION FOR SUSTAINABLE DEVELOPMENT ACROSS THE SCHOOL CURRICULUM

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Abstract

A radical shift in pedagogy is necessary for information and communication technology (ICT) to enhance teaching and learning for sustainability. Climate change takes an inter/cross-disciplinary approach attempting to synthesise diverse ideas and observations concerning global warming. This paper deals with the integration of climate change across the school curriculum through a web-based hypermedia application entitled ICT-enabled integration of climate change education that is used as a resource for the EU-funded project ICT-enabled education for sustainable development (ESD). The web-based environment includes interactive activities and supportive material on climate change and is open to all the six forms at the primary school level. The methodological approach used merges ICT, ESD, critical pedagogy and climate change education principles and practices. Drupal (Content Management System) was chosen as the back-end system of our hypermedia learning environment. The main learning content is composed of Learning Objects (LOs) created through the authoring tool Adobe Flash. The combination of Drupal and Flash provides a dynamic and adaptable learning environment. Through this web-based learning environment that integrates six thematic areas supported by various ICT tools, learners are expected to gain insight into how climate change is altering the planet, potential impacts on the future, and how they can intervene to address its effects.

Key words: *climate change, curriculum, hypermedia technology, theme-based instruction, education for sustainable development*

Introduction

In recent years, humankind has faced a profound economic, social and ecological crisis that has its roots in the unsustainable ways people treated their environment for years. Sustainable development is generally perceived as an overlapping of four pillars (Figure 1), namely environment, society, culture and economy (UNESCO, 2008).



Figure 1. The four pillars of sustainable development

Climate change is currently at the centre of our day to day life as its impacts and consequences are being experienced in all regions of the world. When we talk about climate change, it refers to the alterations in the atmosphere that are over and above natural climate variation and that are a result of human activity. A situation that can be changed if human beings transform their ways of living to be more sustainable and friendly to the environment (Agostino, 2010). It is considered to be the most threatening global environmental problem of our time and has many repercussions not only in the environment, but also in economy, culture and society (UNESCO, 2010, 2002). It is important to state Article 6 of the United Nations Framework Convention on Climate Change deals with climate change education, training and public awareness. It has great importance for everybody, especially for young people, working on climate change education, awareness raising and training. It also has a great importance for organisations which want to see more young people being

part of official government delegations as representatives of the youth in their countries (Youngo, 2011).

Although the effects are uncertain, climate change is thought to have implications for arenas including food and water supplies, energy production and use, ecosystem and species survival, human health, social and political stability (Paterson, 1996). It is widely recognised that climate change is having a greater effect on vulnerable populations, groups and communities, this vulnerability being the result of different factors such as age, gender, geography, ethnicity and income group (Agostino, 2010). Despite a large degree of scientific consensus that global warming is occurring, there is less agreement, however, about both the consequences of unchecked global warming and the consequences of strategies to mitigate the negative effects (Houghton et al, 1996). Climate change, in general, has generated considerable scientific and political controversy (Singer & Seitz, 1998). Despite controversy over the issue of global warming and climate change, largely evidenced through natural disasters, caused by anthropogenic activities, such as burning fossil fuels and deforesting large portions of land, worldwide. Education systems everywhere will need to include a focus on the causes, consequences and solutions to climate change if we aspire to changes in people's ways of thinking and living sustainably. Addressing the causes and the consequences of climate change requires a shifting paradigm in content and methodologies in order to build the necessary capacity for mitigation, adaptation and transformation at the personal and societal level. In a study, while there was clear recognition that professional education for climate change adaptation was limited and urgently needed, it was strongly stated by the professional institutions and their members that it should be integrated with education about and for climate change mitigation as they are complementary and of equal urgency. The study recommends that education about and for climate change adaptation in accredited courses be addressed in an integrated way with education about and for climate change mitigation (Lyth, Nichols, & Tilbury, 2007)

Recently, climate literacy has received widespread recognition among educators, researchers and education planners recognising the importance of educating children to take a positive stance on social and environmental issues (Shafer, 2008; Stephens & Graham, 2008; Shafer, James & Giuliano, 2009; Dupigny-Giroux, 2010). The National Oceanic and Atmospheric Administration, in cooperation with AAAS and the National Science Foundation (NSF) in the U.S. A. defined a climate literate person as able to:

- understand the essential principles of all aspects of the Earth system governing climate patterns;
- know how to assess scientifically credible information about climate;
- communicate about climate change in meaningful ways;
- make scientifically informed and responsible decisions regarding climate and the impact of personal unsustainable actions on climate change (NOAA, 2011).

A climate literate citizen, in other words, should understand the influence of climate on oneself and society and how one can produce positive changes for a sustainable environment. From a teaching and learning perspective, it involves the competences of inquiry-

based and problem-based learning. In response to this, climate change education (CCE) is becoming increasingly relevant and a growing number of schools are seeking to embed CCE for sustainable development principles in curriculum planning (Henderson, Steven & Holman, 1993 Johnson et al. 2008; Shepardson, et al., 2009).

The International Alliance of Leading Educational Institutions (2009) has issued 8 climate change education recommendation.

1. Climate change makes sustainable development an urgent priority. Thus, policies which promote education for sustainable development (ESD) should play a key part in the negotiation of global agreements on climate change policy.
2. Societies need to change radically consumption, production and behaviour patterns to meet the challenges we face.
3. ESD will make demands on all of society but schools will play a critical role, through what they teach and how they model sustainable practices.
4. Whole-school approaches are promising: societies need to reorient schooling towards a stronger emphasis on interdisciplinary work, participation in authentic sustainability challenges and interaction with others outside school.
5. Universities should offer ESD courses for pre-service and in-service teachers.
6. Resources and time for experimentation are provided and the sustainability is integrated into the curriculum.
7. Interaction between researchers, teachers, non-governmental organisations, public officers and others in the field of ESD is essential. Regional Centres of Expertise on Education for Sustainable Development, which already exist at some places, may serve as models for this endeavour.
8. ESD research needs to be augmented. It should be focused on (1) documenting the state of practice and identifying promising practices, (2) exploring educational outcomes and their evaluation in respect of ESD, (3) identifying and explaining opportunities and problems of general relevance.

In this paper, we present an example of a Web-based application entitled “Climate change and me” that is one of the six thematic areas of a broader web-based learning environment dealing with climate change education across the Greek primary school curriculum. This work has been integrated as a resource in the development of one of the courses in the M.Sc. programme of the ICT-enabled ESD project.

Theoretical background

The learning paradigm

The activities developed in this application are based on the principle of ExConTra learning paradigm (Makrakis & Kostoulas-Makrakis, 2012). As depicted in Figure 2, this model is

based on three theoretical approaches to learning: experiential learning, constructivist learning and transformative learning.

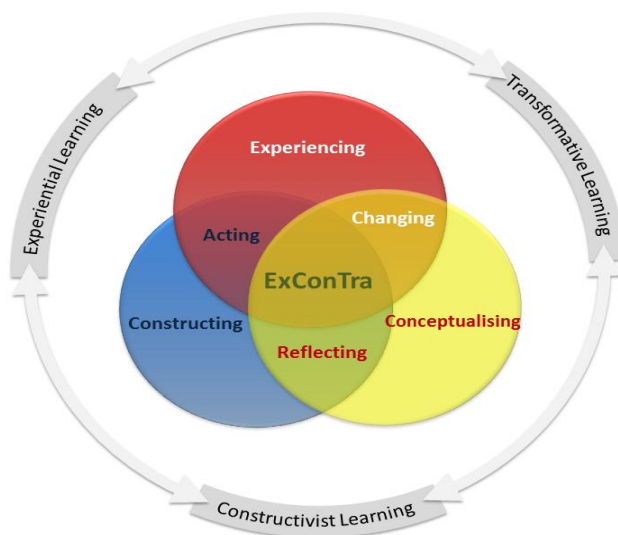


Figure 2. The ExConTra learning paradigm

beginning with experiencing, learners identify a realistic and authentic task associated with a sustainable development issue, such as climate change, and start collecting the information needed for their analyses, using various inquiry-based methods. reducing the production of greenhouse gasses and in preparing societies for adaptability to risk and physical environmental change, climate change education needs to be experienced-based and practice-centred. learning-centred actions for changing unsustainable practices are needed (for instance, learning to implement energy saving measures), so that learners can experience and reflexively review their values and practices in climate change solutions. through reflecting, self and/or social, as well as through further reading and observing, learners organise and examine the collected data for the new experience from multiple perspectives in order to find meaning. for learners to make meaning, either individually and/or shared, they need to reflect on their own experiences, leading them to develop more abstract understandings of their experiences (conceptualising). arriving at individual and shared meaning (constructing), learners need to get involved in a shared inquiry enriched through continuous reflection, re-conceptualisation and active experimentation. In this sense, learning is an active and contextualised process of constructing meaningful knowledge based on ones own experiences, rather than acquiring it from someone else. Constructed knowledge and meaning is meaningful when it opens up opportunities for action. Merging knowledge and meaning with action (acting) implies a change agency and active citizenship. Acting as change agents, learners are empowered to transforming experience through critical reflec-

tion and active experimentation. When critical reflection is transformed into an action it becomes praxis that turns learners able to transform oneself and society (transforming).

Central to the climate change processes of mitigation, adaptation and transformation are new values, creative thinking and problem solving skills. These skills require learners to engage in critical analysis of causes and consequences, and construct knowledge that may lead to action. This requires teachers involved in climate change education to integrate into their teaching and learning methodologies experiential, constructivist and transformative learning principles and values. Teachers need to shift from functioning as the sole source of information to becoming co-learners and facilitators using multiple sources of information and provide support and motivation in helping learners in the process of self-directed learning. Similarly, students' roles also need to change from passive recipients of climate change information to active learners who search, collect, analyse and interpret climate change data and collectively build up knowledge through inquiry and reflection.

The curriculum paradigm

Simply introducing new content about climate change, its causes, consequences and solutions will not be an adequate response to climate change education. A horizontal approach instead of a vertical is needed for curriculum planning. Such an approach to climate change curriculum planning describes how knowledge and skills related to climate change are clustered around areas or sub-themes (Makrakis, 2012). It is assumed that the integrated horizontal approach: 1) cross-fertilises knowledge within and between school subjects and encourages a holistic view of climate change issues; 2) enables students to situate their learning in meaningful contexts; 3) encourages the development of higher-level thinking skills and the exploration of inter/cross-disciplinary questions and issues; and 4) promotes team teaching and collaboration among teachers of different school subjects and collaborative learning among students. Thematic instruction can thus be a critical tool for reintegrating the curriculum and eliminating the reductionist nature of well-structured problems that have convergent solutions in contrast of ill-structured problems that favour divergent modes of thinking. Ill-structured problems are more suitable to thematic instruction and as pointed by Jonassen (1997) learning from ill-structured problems, students engage in a reflective conversation in a dialectical way. They are required to conceptualise the problem, recognise the divergent perspectives and multiple representations of the problem, determine what information and skills are needed to solve the problem, and synthesise their understanding of the problem. In doing this, Jonassen says that they have to: (a) articulate the problem space and contextual constraints, (b) identify and clarify alternative opinions, positions and perspectives of stakeholders, (c) generate possible solutions, (d) assess the viability of alternative solutions by constructing arguments and articulating personal beliefs, (e) monitor the problem space and solution options, (f) implement and monitor the solution, and (g) adapt the solution.

Cunningham and Billingsley (2003) identified a list of guidelines that we think can be used to enable a thematic approach to climate change education curriculum. These guidelines include:

- **Plan authentic activities** – Select activities that are similar to activities that students might encounter in life outside of school.
- **Promote self-directed learners** – Design activities that encourage learners to manage their own learning by allowing them to make choices about their use of time, topics or subject matter and possibly criteria for successful learning.
- **Go beyond one subject area** – Create activities that encourage the exploration of cross disciplinary questions and issues.
- **Use multiple approaches** – Plan a diverse range of activities and allow students to choose what kind of activity they believe will work best for them.
- **Go beyond retelling** – Include activities that require the use of higher-level thinking skills such as compilation, solving a mystery, designing a product or plan, building consensus, persuading, seeking self-knowledge, or making judgments.
- **Keep it simple** – Both teachers and students find simpler curriculum designs easier to use.
- **Borrow activity ideas from others** – Take advantage of the wonderful educational resources that are available on the web and don't feel like you have to create the materials for every technology-based learning activity yourself.
- **Touch imagination** – Give students opportunities to use their imaginations for wonder, creativity, or self-expression.
- **Build to promote intentionality** – Student learning activities should be designed and conducted with clear purposes that will help to achieve learning goals.
- **Engage the learner** – Design interesting activities that require learner participation and that will challenge the learner's current skills, knowledge and attitudes.
- **Build on controversy** – Build learning activities around controversial issues and offer students opportunities for accessing and comparing different views on these topics.
- **Use characteristics of the web** – Make use of web elements such as hypertext, multimedia, communication tools and interactivity.
- **Build activities around current events** – Design activities that include opportunities to learn about current events.
- **Use non-web materials, events, and locations** – Use the internet for some things, but not for everything.
- **Facilitate spontaneity and discovery** – Strive to find the proper balance between teacher control and student freedom.
- **Plan for open-ended inquiry** – Let students make choices within a set of educationally sound boundaries.

All these guidelines point to the notion of a recursive curriculum that finds its foundations in ExConTra learning theories. The rationale for teaching climate change thematically addresses situated-learning within a context that is more meaningful to learners than traditional or linear approaches to instruction. Meaningful learning requires knowledge to be constructed by the learner, not transmitted from the teacher to the student (Jonassen, *et al.*, 1998). The teaching of climate change thematically is aligned to the realm of ExConTra

learning because the content is embedded in sub-themes that serve as learning contexts for experiencing, constructing and transforming knowledge with action for change. The following description introduces the function of this Web-based learning platform for each stage of thematic learning (Figure 3).

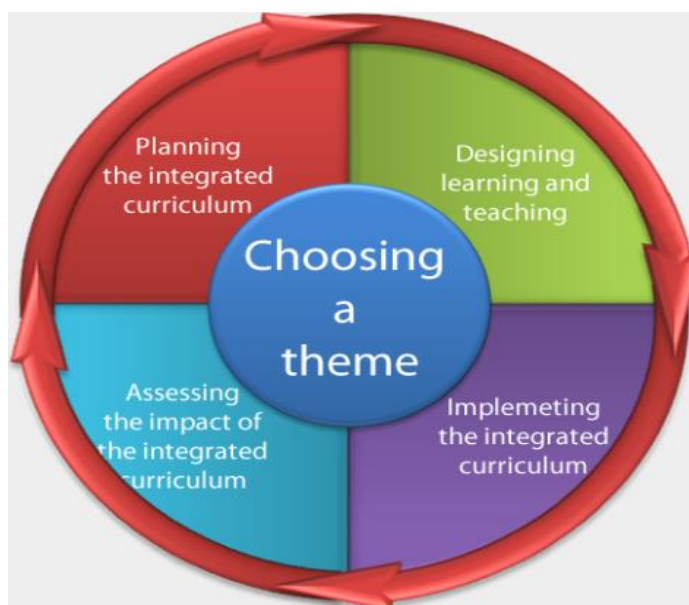


Figure 3. Steps in designing a theme-based instruction

Choosing a theme. This stage involves the choice of a large theme related to a compelling real-life issue, such as climate change which has meaningful connections in the broader framework of human experience that may connect family, school and community. In a recent study, it has found that web-based thematic learning has positive effects on learners' concept learning, provides learners with a framework from which develop the related concepts in a more stable learning mode and is suitable for students with different abilities (Liu & Wang, 2010).

Planning the integrated curriculum. In this stage sub-themes, in the form of thematic areas, such as "Climate change and me" are planned to integrate concepts, skills and strategies that give meaning and direction to the whole learning process of climate change. The teachers involved organise the climate change core curriculum (both process skills and content knowledge) and sub-themes in an open and flexible way to assure students' involvement at a later stage. Inter/cross disciplinary approaches are adopted in planning the integrated curriculum giving more emphasis in the processes involved rather than the outcomes. In web-based settings, particular emphasis is given to a variety of interaction choices for participants: teacher-to-student, student-to-student and student-to-resources and content. Additionally, a well-planned curriculum balances three types of activities: individual, small and large group activities. By ensuring multiple channels of communication, en-

agement, and collaboration within the design of a curriculum, providing a richly textured environment that can accommodate a full range of students' needs and learning styles, is of critical importance (Boettcher, 2007).

Designing learning and instruction. In a web-based learning environment, the learner interacts with the content, teacher and technology. This stage involves first the design of learning activities enabled by ICTs. Through designing learning activities suitable in web-based learning environments and driven by the ExConTra learning, the content becomes the means to an end and not an end in itself. In designing thematic learning and instruction, one approach that is consistent with the ExConTra learning principles is that a group of teachers can brainstorm learning activities using existing curriculum materials and be drawing directly from end-users' (teachers and students) ideas, interests and experiences during the formative evaluation process. In this process, involving community experts and other members could add value to designing meaningful and engaging learning activities. Strategies that ensure the reusability, adaptability and generalisability of teaching and learning materials should be planned.

Implementing the integrated curriculum. As pointed earlier, one of the most effective strategies for an integrated theme-based curriculum approach is to teach the subject climate change in conjunction with other subjects. This allows students to make connections between different areas as they explore a topic in detail and from a variety of approaches. Cross-curriculum projects allow students to see how knowledge and skills are connected in the various school subjects and how knowledge constructed and skills acquired can be transferred to other situations and real-life contexts. This step involves project-based learning as a model for implementing thematic learning activities. It is a shift away from the traditional classroom practices of short, isolated, teacher-centred lessons. Instead, it emphasises learning activities that are long-term, interdisciplinary, student centered and integrated with real-world issues and practices in which students plan, implement and evaluate projects that have real-world applications beyond the classroom. ICTs should be involved in such a curriculum in two ways. Firstly, technology can be used to support the instructional process, and, secondly, it should be a significant part of the content of the curriculum. The theme should provide a context for learning with ICTs and vice versa. Various ICT tools and Venn diagrams, like concept maps and semantic webs, help show the connection between related concepts and help learners explore meaningful learning experiences. Implementing the integrated curriculum in web-based learning settings with different tools and resources for retrieving content, using the online tools and facilitate interactions among teachers and students as well as other stakeholders, requires new instructional practices, such as peer tutoring and collaborative learning.

Assessing the impact of the integrated curriculum. In this stage, the information collected from evaluating a curriculum forms the basis for making judgements about how successfully has the programme achieved its intended outcomes and the worth or value of the programme. This process can be integrated into three interlinked assessment levels: 1) diagnostic, 2) formative and 3) summative. The term *diagnostic* refers to a process at the initial phase; *formative* refers to a process while developing the curriculum so that revisions to it can be made and *summative* refers to a process at the end/after the curriculum programme is implemented. A critical concept applied to these processes is authentic assessment that is

driven by ExConTra learning foundations. Authentic assessment to be incorporated in assessing the impact of the integrated curriculum include an amalgamation of tools and strategies that derive from ExConTra learning but also from objectivist learning theories if such tools contribute to the ExConTra learning principles. Among the most used tools include: multiple choice tests with extended responses to help students become aware of their own thinking processes; observation; checklists; portfolios; concept mapping and Venn diagrams; scenario building; reflection and reflexivity; journalising; simulation; case-study analysis. All the three levels of assessment are interlinked and in a way they provide a holistic framework for assessment. However, we consider formative assessment as the most critical process as it provides effective feedback and gives the opportunity for learners' and other stakeholders' active participation in the design and development of the integrated curriculum. Within this process, the use of concept maps and other structural knowledge representation techniques are very effective tools (Trumpowe & Shahzad Sarwar, 2010; Aberg, 2004). The process of formative assessment should enable students to self-monitoring progress, give regular feedback to students, support peer learning and assessment and design self assessment practice (Liang & Kim, 2004). Visualisation tools, such as conceptual maps, help students to process the abstract concepts or mental images that they depict and the more they work designing materials, the more they construct their own meaningful realities based to new knowledge (Jonassen, et al., 1998; Jonassen & Reeves, 1996).

A well planned programme of climate change education across and within the curriculum will provide pupils with opportunities to address the causes (mitigation) and the consequences (adaptation) of climate change by adopting a transformative learning approach. As the causes of climate change are basically anthropogenic, causes and consequences need to be identified and changed. Locally relevant solutions and adaptation practices are also needed, alongside efforts to share and transfer knowledge, social strategies, economic models and technologies that provide new solutions across the world. Practically, this necessitates learning processes and methods that turn learners of all ages able to reduce energy consumption, use renewable forms of energy, and change consumption patterns. At a societal and cultural level, this means changes in social, cultural and economy structures that are part of the problem. There is a need for a new paradigm in teaching and learning as well as in curriculum that will transform unsustainable values and practices that dominated in the 20th century. Climate change education requires people everywhere to understand and respond to the nature, causes and consequences of climate change. This requires climate change education for sustainable development programmes that attend to (UNESCO, 2012):

- clear distinctions between different scientific concepts and processes associated with climate change;
- knowledge and abilities to distinguish between, certainties, uncertainties, projections and risks associated with climate change;

- knowledge of the history and interrelated causes of climate change (which include technical, scientific, ecological and social dimensions; economic dimensions; and political dimensions);
- knowledge of mitigation and adaptation practices that can contribute to wider social transformation towards sustainability, including abilities to participate in such practices;
- knowledge of consequences and what is being learned about mitigation and adaptation to climate change;
- good understanding of the time-space dynamics of climate change, including the delayed consequences that current greenhouse gas emissions hold in store for the quality of life, security and development options of future generations;
- understanding of different interests that shape different responses to climate change (for instance, business interests, consumer interests, farmers' interests, political interests, future generations' interests, etc.) and abilities to critically judge the validity of these interests in relation to the public good;
- critical media literacy to address the causes of over-consumption and develop capacity to make better lifestyle choices and to participate in climate change solutions.

ICTs as enabling tools for climate change education

The link between ICTs and sustainable development is being addressed by extensive debates and research which recognise the challenge new technologies bring to the reorientation of education towards learning to live sustainably (Makrakis, 2006; Makrakis, 2010a; Makrakis, 2010b; Makrakis, 2010c; Makrakis, 2011). ICT-enabled CCE for sustainable development may help children to understand better climate change and motivate them to get engaged in actions to prevent climate change. ICTs are interlinked with climate change in various ways. They are most obviously used for data analysis and prediction, access to relevant information and raising awareness at the grassroots level. ICTs can also facilitate learning and practical knowledge, while empowering the poor and marginalised to raise their voice for their rights. Many educators believe in the immense potential of ICTs as enabling learning tools. However, to realise the potential of ICTs and GEO-spatial technologies as enabling tools for teaching and learning in general and in particular concerning climate change, we have to reconsider what we teach as well as how we teach, but most of all it is necessary to revise our understanding of how people learn. GIS are set of technologies which allow users to view, understand, question, interpret and visualise spatial data in many ways that reveal relationships, patterns and trends in various form. It helps enhance spatial reasoning and support problem solving in the classroom. In addition, the proper implementation of GIS instruction may promote climate change literacy and inter/cross disciplinary learning in the classroom. In general, GIS offers a powerful decision-making toolkit that helps students understand content in a variety of disciplines, such as geography, mathematics, social studies, history, language arts, environmental studies, chemistry, biol-

ogy, civics. The Internet also offers many outstanding resources on climate change that can be assessed and used to support climate change education in the classroom.

In developing the web-based learning for climate change education, Drupal was chosen as the back-end system of our hypermedia learning environment. Drupal is a free open source CMS (Content Management System) written in PHP (Hypertext PreProcessor) and distributed under the GNU General Public License. Some key advantages offered by CMS solutions are low development time along with a high reliability and a wide variety of useful tools for educators such forums, wikis, blogs, quizzes, polls, sweepstakes and many other robust social networking modules. The main learning content is composed of Learning Objects (LOs). Learning objects are digital pieces of learning content that may comprise text, images, hyperlinks and also audio, video clip or animation as well as web pages. Learning objects can be produced, re-used, modified taking into consideration of copyrights (Wiley, 2000, 2011). Each LO is constructed from various media assets, such as text, video, animation, charts and sound narration all gathered under a simple graphic user interface (Schreurs et al, 2009). The authoring tool that was used to create and modify LOs used and reused in our web-based learning environment is Adobe Flash. The combination of Drupal and Flash provides a dynamic and adaptable learning environment. Moreover, the learning environment is enriched through the integration of various ICT tools, such as concept maps (Text2Mindmap), spreadsheets (Zoho Sheet), presentations, paint tools (Pixlr), word processing (Zoho Writer) and a modern Greek online dictionary. Any supplementary material needed include relative web pages, web articles, case studies, videos, animations, general ideas or advises and help for teachers and students. There is also a glossary including difficult terms. Students search the web and create their own material engaging with the suggested activities and save it through an electronic portfolio. They can also create pages, comments, blogs and forums, send emails and be directly connected with social networks.

Structuring the learning content across the curriculum

As pointed earlier, the “Climate change and me” is one of the six key areas of the web-based learning environment targeted to primary school curriculum from grades 1 to 6 (Figure 4).

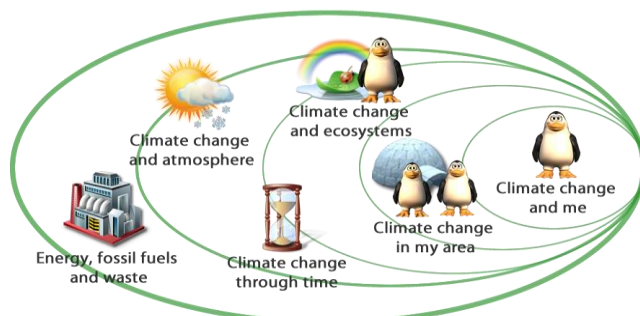


Figure 4. The curriculum areas of the ICT-enabled Climate Change Education

In the area “Climate change and me” children investigate about what climate change has to do with them (their school, family, nutrition, health, etc.) and what they can do in their everyday life (in school, home, neighborhood, local area) to face climate change using the media, the internet, arts and sports. Then, children can move to the area “Climate change in my area” and investigate how climate change can affect their local society and economy, the employment, the transportation, etc. The next area “Climate change and ecosystems” gives children the opportunity to explore their local and national ecosystem and the repercussions climate change brings upon it. In the next area “Climate change and atmosphere”, children learn about the physics of the phenomenon of climate change in the atmosphere. The following area “Climate change through time” gives children the opportunity to learn about climate change in the past, in the present and in the future. They study scenarios and prepare themselves for the future, having the knowledge from the past. Finally, in the area “Energy, fossil fuels and waste”, children investigate about what climate change has to do with energy, fossil fuels and waste. They search for ways to make a sustainable future, using renewable sources of energy and new ways to handle waste. Students can choose any of these units to start with and engage to its activities. In these units, children deal with what climate change brings upon them and their local environment and how children can act in order to protect their environment. Alongside the activities conducted in the classroom, many activities outside the classroom are suggested, referring gradually from the local to national and global level (Figure 5).

The learning activities are written with the developmental needs of the learners in mind, recognising that adaptations will be necessary depending on their characteristics and circumstances. This curriculum is intended to be flexible, allowing the teacher to select some or all of the activities in order to develop together with his/her learners their own learning activities. We also tried to develop learning contents in the form of units that are not dependent on previous units. Thus the units and activities may be implemented either sequentially and/or according to the existing curriculum organisation of content and needs.

Curriculum areas	Integration Across School Subjects										Sciences
	Language big little Environment	Mathematics	Environmental studies	History	Religion	Geography	Arts	Health Education	Physical education	Citizen's education	
Climate change and me	✓	✓	✓		✓		✓	✓	✓	✓	Biology
Climate change in my area	✓	✓	✓	✓	✓	✓	✓			✓	Biology, Meteorology, Evolution
Climate change and ecosystems	✓	✓	✓	✓	✓	✓	✓				Geology, biology, Meteorology, Evolution
Climate change through time	✓	✓	✓	✓	✓	✓	✓				Physics, Chemistry, Meteorology
Climate change and atmosphere	✓	✓	✓				✓	✓			Physics, Chemistry
Energy, fossil fuels and waste	✓	✓	✓				✓	✓		✓	Physics, Chemistry

Figure 5. The cross-disciplinary structure of the ICT-enabled climate change education curriculum

The structure of the area “Climate change and Me” as in any of the rest areas is based on three levels: 1st–2nd forms (6–7 year olds), 3rd–4th forms (8–9 year olds) and 5th–6th forms (10–11 year olds).

1st–2nd Form Level Units

1. ***Me, the child.*** Students discover how climate change can affect children all over the world through a case study and a video. Then, they take action to help children that are affected by climate change either by establishing collaboration with relevant organisations or by acting appropriately in their ordinary lives.
2. ***My house and my school.*** Children investigate which daily behaviors either in their school or in their house connect with and deteriorate climate change. Then, they act in order to make their school and their house friendly towards environment.
3. ***Our nutrition.*** Children discover how climate change can affect the quality and quantity of food. They also learn what they should eat according to a healthy diet and which food choices can affect climate change. In the end, they act in order to help children that are hungry because of climate change’s repercussions in agriculture.
4. ***Sports and health.*** Children learn that a healthy organism in good physical shape is more prepared for climate change consequences in health and nutrition. Then, they organise athletic events to promote their fight against climate change.

3rd–4th Form Level Units

1. ***Media, internet and climate change.*** Children find out how climate change is presented in the media and the internet. Then, they gather and evaluate information about climate change in the media and the internet. They also learn about the hazards of the use of the internet. In the end, they use the media and the internet in order to promote their actions relating their fight against climate change.
2. ***Climate change and arts.*** Children learn new ways to express themselves and send messages about climate change through arts. They use recycling materials to create art. Children also post and promote their art in electronic galleries. In the end, they attempt to create a new art wave to move people about climate change.
3. ***How to help each other.*** Children take action in order to help other children in their country or in other countries fight starvation and poverty. They also create and organise a social group of people that will help one another according to their abilities.
4. ***Consumerism and climate change.*** Children realise how they decide to buy goods. Then, they learn about fair trade and how to reinforce the local market and

the local goods in order to fight climate change. In the end, they seek ways to resist consumerism.

5th–6th Form Level Units

1. ***Social impact of climate change.*** Children discover about the social consequences of climate change, such as the lack of food and water, the need to emigrate and the deterioration of human health. Then, they make a relevant presentation for smaller children and generally motivate others to engage in actions against the social consequences of climate change.
2. ***Politics, economy and climate change.*** Children find out the role of politics and economy in the climate change issue. They learn about the economic repercussions of climate change in their country and abroad. They also discover how politicians make decisions according to their economic interest. Then, they investigate how climate change is related to the world financial crisis. In the end, they try to act organising a school conference where children take decisions about climate change in the future.
3. ***Disease and climate change.*** Children learn about the diseases that climate change can bring upon humans through articles and case studies. Then, they study how health security systems will be affected in poor and rich countries. In the end, they seek measures to alleviate people affected and ways to inform others about climate change and disease.
4. ***Family, emigration and climate change.*** Children explore how climate change can make people emigrate. They learn about environmental emigration and environmental refugees. They also seek ways to help emigrants who moved because of climate change.
5. ***Climate change caused by human activity.*** Children investigate if and how human activity contribute in global warming and cause climate change, studying diagrams, relative articles and interviews by scientists. They also evaluate the opposite view (that climate change is not caused by human activity) and debate about it.

Concluding remarks

Climate change as pointed is a global issue. Addressing it is a shared responsibility. Yet it is increasingly apparent that failure to act will render the environments of millions of people and their families at a high risk. This paper deals with the integration of climate change in school curriculum through a web-based inter/cross disciplinary hypermedia application entitled ICT-enabled Climate change Education. In particular, this paper explores the “Climate Change and Me” which is one of the six areas of this application. The web-based environment developed includes interactive activities and supportive material regarding to information, changing attitudes and actions on climate change and is open to all primary school forms. The methodological approach used is based on ExConTra learning paradigm that integrates critical pedagogy, critical constructivism, ESD and hypermedia technology.

The activities are based on authentic learning situations, experiences and problems that may be encountered by students in their daily life, about what may happen to them and their family due to climate change and what they can do to change it. The main tools used in the activities are conceptual maps, text editors, spreadsheets, painting tools, discussion forum, etc. Children are engaged in real-life problems, studying stories, case studies, websites, articles or videos and developing activities using various tools and digital learning objects. A critical driver behind this web-based learning environment for climate change education is the availability of open, flexible, e-learning opportunities and affordable ICTs that enable time- and place-independent learning. By providing opportunities for enabling climate change education through ICTs in which learners are allowed and expected to develop their knowledge and understanding, the shift to transformative learning seems to become easier. To conclude, ICTs are used in this web-based environment as cognitive tools and opens students opportunities to merge theory with praxis.

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494)). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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TRANSFORMING THE CLASSROOM INTO A REFLECTIVE COMMUNITY. A BLENDED LEARNING INSTRUCTIONAL APPROACH

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Abstract

Critical and reflective thinking is acknowledged as one of the key skills within Education for Sustainable Development (ESD) whereas sustainable development requires a shift in the mental models which frame our thinking and inform our decisions and actions. This paper describes the implementation of a blended learning lesson unit which aimed at activating pupils' reflective thinking in order to negotiate the controversial topic of Genetically Modified Food (GMF). It describes a small case study that was implemented in a semi-rural school in Chania, Crete, with the participation of 23 sixth grade pupils. Specific changes in the pedagogical practices were adopted, pertaining to content, time and space conventions, and the use of online learning activities. The instructional design incorporated a five stage instructional session, which started by the introduction of a problematic situation, continued with the infusion of cognitive dissonance procedures and ended with a reflective evaluation activity. The pupils' stances towards the open learning procedure and the integration of online activities were positive, while certain changes in their beliefs about the issue of GMF were observed, due to the design of the learning approach.

Key words: *blended learning, critical thinking, reflective thinking, education for sustainability, problem-based learning*

Introduction

As Meyer (1977) points out, schools are organized networks of socializing experiences which prepare students to act in society. Education is a very important component in the public biography of individuals, affecting their life options and playing a crucial role in the formation of their personality. It is also a central element in the general framework of organization of the society, constructing competencies and helping create professions and professionals. Educators, who are accustomed to linear approaches in their pedagogy, often find it difficult to create truly integrated approaches to learning about sustainability issues due to its multi-dimensional complexity. With the expansion of the World Wide Web

(www), new paradigms for teaching and learning about such complex issues arise. As a generation of pupils emerges, possessing greater technological knowledge and acceptance, the presence of the Internet in the classroom will probably increase. This transition requires much more than the development of software devices while its effect on the learning process must be closely examined, especially by the teachers.

Teachers, as professionals, are charged with the main responsibility of the learning process which can effectively facilitate students' learning and frame their personality traits. According to their pedagogical and philosophical dispositions, teachers perceive education either as a taken-for-granted concept or as a political act that helps pupils liberate their creativeness and promote critical reflection through democratic procedures in the classroom. Political acts reflect power and authority issues. By giving pupils the opportunity to reflect on their experiences and their prior knowledge and by challenging them to question their pre-assumptions, rather than urge them to take in information without question, teachers give in authority and power, while pupils take part of the responsibility for their own learning. Should we acknowledge the association between education and society, which necessitates the integration of learning procedures that interact with the world in which learners live, we must admit that there is a need for an alternative pedagogy (Cummings, 2000). A pedagogy that is geared towards creating a society, in which humans can live in harmony with their environment and respect the next generations' needs, taking into consideration the postmodern reality of uncertainty and complex relationships. Therefore, educators have the choice to transform the classroom into a community that a) develops personal and collective consciousness, b) provides the necessary emancipatory tools and c) engages students in personal and social transformative action (Fernandez-Balboa & Marshall, 1994; Fernandez-Balboa, 1998). These approaches have in common a recognition that individuals need to foster their abilities, in order to reach a state whereby they can take personal responsibility for establishing a reflective practice of their own.

The concept of reflection lacks definitional clarity; yet the core areas of agreement among researchers seem to be that reflection: a) is a deliberate action; b) is stimulated by a problematic situation; c) involves an inward examination of personal knowledge with reference to the problem situation and d) leads to new insights (Rogers, 2001; Lim, 2009). Dewey defined reflection as "*active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusion to which it tends*" (Dewey, 1997, 6). Mezirow (1997) prefers the term 'transformative learning', referring to a procedure that fosters critically reflective thinking and imaginative problem posing, a structure, in which dialogue is learner-centered, the lesson takes place in participatory and interactive frameworks and involves group deliberation and group problem solving. Mezirow's model (1991) proposes four levels of reflection, the lowest of which is 'Habitual Action', that is, actions done out of routine practice, without having to think about what is done, or questioning the grounds for that action. 'Understanding' is the next step higher up from Habitual Action; at this level, the learner acts to comprehend what has been learned but does so, only within the limits of the given context, without consideration of personal meanings and applications to extend learning. 'Reflection', the third step, involves a re-assessment of an action or an idea, in light of the problem or situation. When engaged in Reflection, learners assess their learning experience, to evaluate their actions for

future improvement, as well as consider various possibilities as solutions to problems. However, it is only when learners bring into question the very assumptions and beliefs which underlie their chosen paths of action, or the knowledge and ideas which seem to be widely accepted, that 'Critical Reflection', the final step, is demonstrated.

Critical and reflective thinking is acknowledged as one of the key skills within Education for Sustainable Development (ESD). Sustainable development requires a shift in the mental models which frame our thinking and inform our decisions and actions. Thus, the attainment of sustainable development requires transformative change at social and cultural level; a change that involves experiencing a deep, structural shift in the basic premises of thought, feelings and actions about our being in this world. This requires building the confidence and skills to support engagement among students and the community, in order to improve their own and others' lives, livelihoods and environments (UNESCO, 2011). There is no doubt that achieving sustainable development is essentially a process of learning. Thus, it is important to find out alternative pedagogical frameworks to integrate curriculum, teaching and learning in ways that promote a radical view of ESD that generate economic welfare and social justice within ecological limits (Kostoulas-Makrakis, 2010). Education, therefore, should aim at developing self-paced learning, judgment skills, solidarity, desire for action and critical thinking. Pupils should learn to make judgments and decisions and not simply acquire knowledge in meaningless contexts. They should be given opportunities to test assumptions, juxtapose statements and construct their personal conceptual representations about the world and its relations. It seems likely that this process will have application outside the school and later in their lives (Makrakis & Kostoulas-Makrakis, 2005). According to Chapter 36 of Agenda 21, on Education, Awareness and Training, reorienting education towards sustainable development requires a new vision for education. "Education, including formal education, public awareness and training, should be recognized as a process by which human beings and societies can reach their fullest potential. Education is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. Both formal and non-formal educations are indispensable to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns".

During the last decades constructivist approaches have replaced instructional methods as the focus went away from the teacher and has moved to the individual learner. Learning is seen as a social and collaborative activity that is facilitated rather than directly exerted by the teacher (Paavlova & Hakkarainen, 2009). Building on theories, where students are involved in knowledge construction and shape their own cognitive representations, social constructivism adds an interactive dimension (Laurillard, 2008). Many researchers have argued that technology can serve as a catalyst for such changes in the content, roles and the classroom climate that are required for a shift from instructional to constructivist practices (Collins, 1991; Garner & Gillingham, 1996). We are entering a new phase in the use of technologies, particularly with the emergence of Web 2.0, which has been identified as a more interactive, peer-generated and collaborative Internet. "The new knowledge-based society must be an inclusive society. Here too, the Internet offers tremendous possibilities; anyone who can use a computer can participate in society at the click of a mouse" (Euro-

pean Commission, 2002, 4). Under these circumstances e-learning is being more rapidly adopted by educational institutions and has a potential to become a larger part of the educational experience of children, as the world moves into a phase that is widely referred to as a knowledge society (Kalantzis, 2004). Web 2.0 tools encompass a variety of different meanings that include an increased emphasis on user generated content, data and content sharing and collaborative effort (Franklin & van Harmelen, 2007). The rapid evolution of blogs, wikis and other social networking applications, offer rich user experiences where the process of knowing is a community-based, collaborative endeavor. Taking into consideration the affordances of these new cutting edge technologies, teachers can organize activities and learning environments that include opportunities for acquiring basic skills, knowledge and conceptual understanding, not isolated in the boundaries of the classroom. Communication channels can be enhanced and pupils are no more seen as individual learners but rather as more effective participants in the meaningful social practices of their learning communities in school and elsewhere in their lives. To glance a learning environment outside the confines of the classroom, in terms of space and time, is to see a social environment undergoing profound change through a tsunami-like flood of innovative tools and services that foster new modes of collaboration and social organization.

This paper presents an e-learning instructional model, which is based on the concept of instructional design. Instructional design is a technology, which incorporates known and verified learning strategies into instructional experiences which make the acquisition of knowledge and skills more efficient, effective, and appealing (Merrill, 1996). Information and Computer Technologies do not promote learning per se. It is not multimedia resources that make a difference in training, it is how they are used (Merrill, 1997). We believe that collaboration is developed when the teacher includes activities, which are designed to create a social environment that acts as a scaffold for collaborative learning and dialectical constructivism (Palloff & Pratt, 1999). Taking advantage of the affordances and opportunities that Learning Management Systems offer, we attempted to put into practice a learning sequence that expands the boundaries of the traditional classroom, in terms of space and time, and transforms the pupils into inquirers and reflective practitioners, taking into account their prior knowledge, perceptions and beliefs about a real life problem such as the proliferation of Genetically Modified Food (GMF). As it is presented more explicitly in the methodology unit, we tried to motivate pupils by challenging them to brainstorm, state their predispositions and search for information and evidence on a dilemmatic issue, by stating, on the one hand the advantages that GMF offer and on the other hand the dangers that they pose, using online activities and reflecting in real time face to face discussion sessions. On the final stage the pupils were asked to contemplate on the facts and information they have found and their personal dispositions, and give their point of view, without trying to suggest a solution. The window of learning was kept half open. The aim of this study was to examine if reflective thinking through bended learning procedures, with the use of Learning Management Systems, can be an effective approach in order to infuse problem-based learning sequences in primary education.

Methodology

In order to involve pupils in reflective action we chose to negotiate the topic of Genetically Modified Food (GMF). The main goal of this project was not to instruct pupils on the issue, but to set the grounds to promote reflection. Over the past half-century, there has been a shift among philosophers and sociologists of science, away from seeing science as a purely empirical process, to seeing it as a social process of knowledge construction in which imagination and argument play an important role (Seethaler & Linn, 2004). It is our belief that reflective thinking can be promoted through controversial issues that pupils encounter in their everyday lives, although we acknowledge that contents play a crucial role in the procedure, by framing the learning sequence and helping pupils to stay focused. Contents are the vehicles that lead to reflective action; the procedures are the main characteristics that help nurture reflective and critical thinking. Therefore GMF was chosen because a) it is a topic that students encounter in their everyday lives; b) it is a highly controversial issue with ethical, religious and political dimensions; c) it is a topic that shapes a sustainable future in agriculture, health and economy and d) it offers opportunities for dialogue, juxtaposition and reflection. The instructional model proposed, is based on the principles of problem-based learning (PBL). The ability to apply our thinking and draw on a range of resources to solve complex real-life problems is, in our opinion, a basic principle of education. Simons and Ertmer (2006) suggest that PBL designs are characterized by student engagement with ill-structured problems, introduction of the problem prior to acquisition of relevant content knowledge, collaboration, instructional support during the problem-solving process and the facilitation of learner reflection.

Procedure and tools

This small case study was conducted at a primary school at the suburbs of Chania, Crete, with the participation of 23 6th grade pupils, 12 girls and 11 boys. The great majority of the pupils were very well acquainted with the use of internet tools, as 19 of them (10 girls and 9 boys) possessed a computer at home and had broadband internet access, while the others had received instruction at school, during the previous year, since ICT, as a subject, is part of the school's curriculum. The learning procedure lasted approximately four weeks, at the beginning of the school year 2011-2012, from September, 19th to October, 20th 2011. Specifically, we dedicated 8 school hours, 4 two-hour sessions, including an hour to present the learning environment, through which the learning procedure would take place, that is LAMS (Learning Activity Management System).

LAMS is an open source online learning environment for educators, which affords them with means to design, manage and deliver online collaborative learning activities. LAMS development began in 2002 by Macquarie University in Australia and was released as open source software in 2005. It is now supported by a wide learning community (<http://lamscommunity.org>) and it can be used either as a stand-alone system or in conjunction with other Learning Management Systems such as Moodle, Sakai, Blackboard, etc. It can support a wide range of pedagogical approaches, giving the opportunity to educators to

select the activities that match their preferred style. The activities can include a variety of individual tasks, small group work or whole class activities based on both content and collaboration. By using such new generation learning design tools, learners - whatever their preferred learning style – may become actively engaged and challenged. Once a sequence is proved to be effective, it can be redistributed for use in different contexts through an active online community; thereby creating a repository of effective templates. Taking advantage of the shared experience and creativity, instructors can save time and reduce the workload necessary for planning and developing e-learning sequences. LAMS provides three environments in order to a) author learning sequences (Author Environment), b) implement them (Learner Environment) and c) monitor the learners' online activities (Monitor Environment).

The instructional module.

The instructional module, which was implemented, encompasses four consecutive instructional components, followed by an evaluation activity. The four components were:

1. Problem Presentation.
2. Prior knowledge activation.
3. Dilemmatic negotiation.
4. Synthesis.
5. Evaluation.

The learning setting included an online animation character, Sifis the panda, which urged pupils to join him in his quest to unravel the controversies of GMF. Pupils would write down their ideas, prior knowledge, opinions and arguments in online forums, online question and answer activities and vote for or against certain statements related to GMF. Taking the pupils online comments as primary raw material, the teacher would establish an open dialogical framework in the classroom, in order to stimulate the pupils' imagination and high order thinking skills. The teacher was a facilitator, a person who would encourage pupils to brainstorm, to express arguments, to challenge and stimulate heretic points of view, to scaffold and foster metacognition. The online environment helped to give voice to all pupils and create a starting point for face to face dialogue and argumentation, taking advantage of both online and face-to-face practices. The pedagogical framework had the characteristics of blended learning approaches.

Blended learning, a combination of face to face and online procedures.

The Web is increasingly used as a resource in K–12 education. Almost all the schools in Greece are connected to the Internet and the Ministry of Education encourages the use of Internet in education. Yet, the communicative aspect of the web has received little attention among teachers of the Greek Primary and Secondary Education Sectors (Papastergiou &

Solomonidou, 2005; Aslanidou & Menexes, 2007). Today, children can browse the internet and search for resources, communicate and share ideas with their schoolmates and teachers, upload assignments and conduct research. Taking advantage of the new Web 2.0 technologies, teachers, on their side, can seize opportunities of transferring part of the learning workload, outside the physical boundaries of the classroom at an online environment. Online learning has its drawbacks, the main of which is the lack of physical and emotional interaction, something that is taken for granted in conventional learning settings. The need for a compromise between the conventional face-to-face settings and online learning, led to blended learning, a new approach to teaching and learning.

Blended learning should be viewed as a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment (Dziuban, Hartman & Moskal, 2004). It converges online and face-to-face education providing opportunities to foster reflective thinking, facilitate communication and collaboration, give voice to all the pupils, extend the lesson in space and time, help the construction of knowledge through inquiry-based activities and promote learner control, through open learning environments. For a learning environment to succeed, teachers need to change their traditional role of information delivery to effective scaffolding that supports students in integrating and applying ideas. In this type of learning environment, students also undertake new roles. The main characteristics of blended learning are (Dziuban, Hartman & Moskal, 2004):

- A shift from lecture- to student-centered instruction in which students become active and interactive learners;
- Increases in interaction between student-instructor, student-student, student-content and student-outside resources;
- Integrated formative and summative assessment mechanisms for students and instructor.

The learning journey

The pedagogical framework chosen is in tune with the characteristics of Kostoulas-Makrakis (2011) process for radical sustainability transformation which focuses in procedures that radically revise our view of learning. From a process which acts on individuals' characteristics in order to change the world, to one which challenges individuals' views of the world as a means of influencing their characteristics and hence ways of thinking and living (Huckle, 2006). According to Kostoulas-Makrakis four interactive stages are entailed in the pedagogical perspective that fosters reflection within the context of radical sustainability transformation (Figure 1):

1. Getting started (reflection, activation, problem identification and problematisation, disorienting dilemma).
2. De(re)construction (reflection, reformulation, reassessment).
3. Getting involved (reflection, knowledge construction, transformation).

4. Learning-based change (learning by action, change).
5. Through this model the learner is viewed as an active agent in a change process. Participants get engaged in discourse and critical self-reflection, using various activating events and disorienting dilemmas, through which they come to critically examine their personal views and, therefore, open themselves to alternative views and practices.

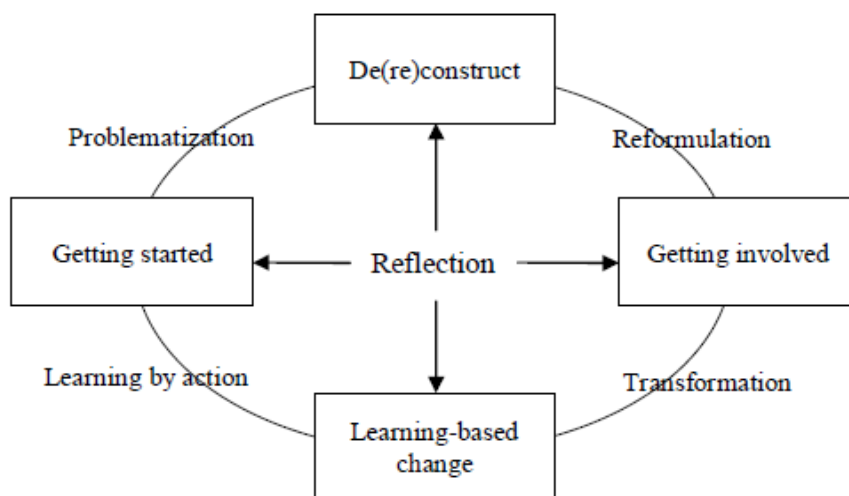


Figure 1. A methodological approach to infuse a radical view to education for sustainability (Kostoulas-Makrakis, 2010)

After dedicating one school hour in order to familiarize pupils with LAMS, each pupil entered the Learner's environment with his or her codes. The first learning component called "*Presenting the problem-Motivation*" included an introductory narration, which aimed to introduce the topic and motivate pupils to express their ideas. An animation character, a panda, introduced himself and asked pupils to join him in an inquiry and reflective journey about GMF (Figure 2). The animation helped to create a friendly and safe environment, trying to motivate pupils. The educator then asked the pupils to say what they knew about the topic in face-to-face settings, creating a starting point for the procedure.

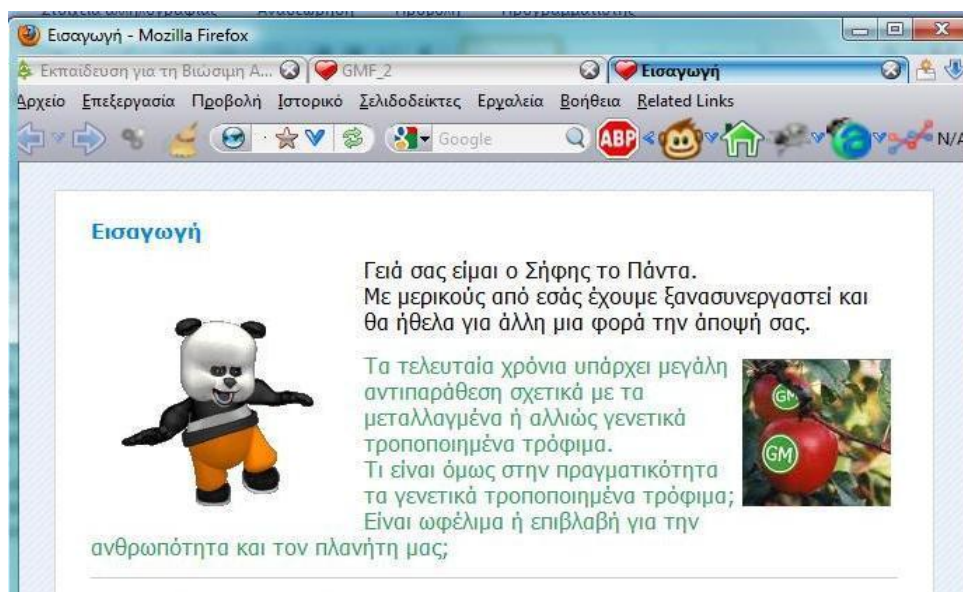


Figure 2. Presenting the problem-Motivation

The second component called “*Prior Knowledge activation*”, integrated an online forum where pupils would share their knowledge about the topic, brainstorm and express their first arguments about GMF. The conventional setting of the classroom doesn’t offer enough time so that everyone can contribute to the dialogue. Inevitably, pupils that are introversive or haven’t acquired adequate language skills, seldom participate. Forums give the opportunity to pupils to take their time, contemplate on their classmates’ comments and voice their points of view. They can answer at a specific comment or express an alternative view in collaborative settings. The online dialogical framework gave a starting point in order to expand the conversation, in the classroom, where the teacher can provoke cognitive dissonance and challenge the pupils to reason and think critically. The teacher didn’t, under any circumstance, reveal his dispositions towards the topic, asking the pupils to express, freely, their opinion and encouraging them to search for evidence. Almost all the pupils tried to acquire data from the internet, while some asked their family to enlighten them about the issue. Negative predispositions prevailed, while the alteration of the DNA chain and the negative effect such products have on health, were the main characteristics mentioned.

The third component called “*Dilemmatic negotiation*”, on the one hand, offered a scaffold to pupils, by presenting specific core data about GMF while on the other hand asked them to make decisions that are for or against them. It was consisted of four activities, all online:

1. **Resources for GMF:** Presenting basic facts advocating use and proliferation of GMF. The main arguments that advocated them were a) Mankind has been modifying genes for thousands of years in breeding; b) the world can be saved from

- global famine through greatly improved crops; c) GMF can be pest or disease resistant and reduce or eliminate the need to use pesticides or herbicides.
2. **Voting activity:** After contemplating upon the given facts, pupils vote if they are predisposed for, against or if they are not sure about GMF. The options available were: a) I believe that GMF are unfairly accused and should be seen with an optimistic view; b) I believe that GMF are dangerous for humans' health and the environment therefore should be banned; c) I'm not sure yet, I need more evidence.
 3. **Resources against GMF:** Presenting facts that oppose GMF use and proliferation. The main arguments posed against them were: a) They have been proved to be detrimental for human health; b) They could lead to even stronger and resistant pests that would necessitate even stronger pesticides; c) it is unethical to intervene in the nature's function; d) the main motive for GMF development is peoples' arrogance and lust for money.
 4. **Voting activity.** Applying the same voting activity in order to challenge pupils' views about the issue, after seeing the opposite point of view. It was interesting to see whether pupils would change their first options.

The aim of this component was to cause cognitive dissonance and push pupils to think and evaluate critically their options. The results of the voting activities are depicted in Figure 3. As we can see there was a shift to the choices of the pupils, from the first voting activity to the second. At first, many pupils, influenced by the facts that advocated GMF, were skeptical about the use of such products. Specifically, 13,04 % (3 pupils) voted for them, 47,82 % (11 pupils) voted that they are dangerous for humanity, while 39,13 % (9 pupils) were reluctant to adopt a clear stance. After reading the arguments that opposed GMF, there was a great shift towards opposing them, as 73,91 % (17 pupils, a rise of 26,09%) voted that they are dangerous for humanity, while only 4 pupils (17,39%, a decline of 21,74%) didn't adopt a clear stance. Most of those that voted for GMF (2 out of 3) still kept their option.

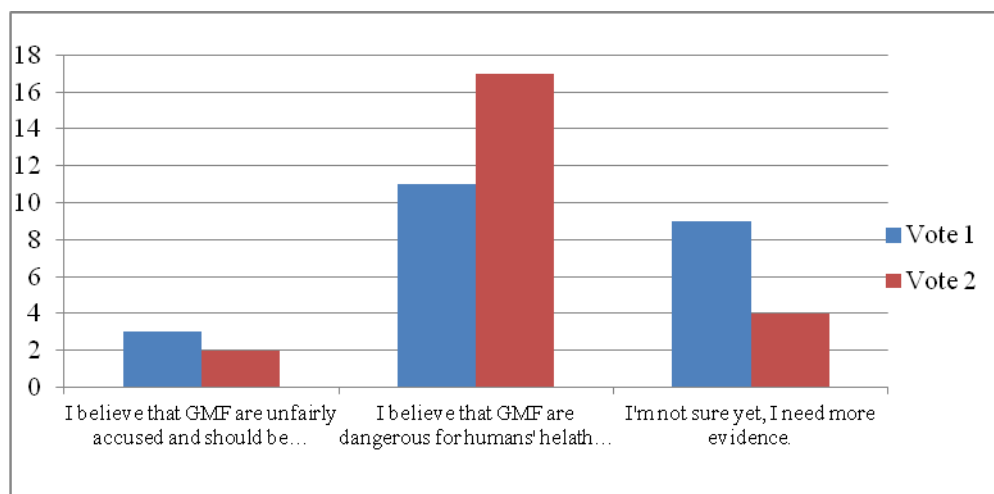


Figure 3. Results of the two voting activities

The last component called “*Synthesis*” included two online activities followed by a discussion phase in the classroom. Having acquired a first order knowledge about the topic, pupils are fostered now to search for more details through the internet. Pupils were divided in groups of four and fulfilled the two activities within their subgroups. The two activities were:

1. **Searching for resources about GMF.** LAMS offers a “Share Resources” activity, which offers the ability to navigate the internet and propose URLs with digital resources, such as web pages, videos, online documents and blogs that can be shared among the other learners. Pupils act as nascent researchers, practicing searching, elaborating and evaluating data skills.
2. An online **Question and Answer** activity that asks pupils to write down their points of view about GMF after having conducted their own research. The question posed was “Depending on the information you have gathered state your personal opinion, whether GMF are dangerous for humanity and the environment or if there are some advantages that should be taken into consideration”. The answers could be viewed from all the members of the subgroups, in order to provoke dialogue and communication.

Pupils proposed a wide range of resources including text, pictures and videos, while their answers denoted the fact that GMF could become a plague for humanity and our planet. Through the final conversation, in the classroom, the common conclusion, which was unanimously accepted, was that although there could be found some arguments that advocate GMF, by weighing the tradeoffs it is difficult to predict the long-term effects of GMF, which at this time seem to be catastrophic and lead to a road with no way back.

The tools used to evaluate this intervention were a) the teacher’s observations, who acted as an insider and b) the e-portfolio of the class, a tool offered by LAMS, which is a compressed folder, with all the online interactions of the e-classroom. We ended the lesson posing a reflective question that asked the pupils to write down their impressions about this innovative form of lesson.

Today, despite the web revolution, learning in Greek schools is still pursued inside the walls of the classroom; pupils are rarely challenged to contemplate on what they learn, while communication is basically achieved between those that are in tune with the existing culture and are rather extroversive. And it is not always the teachers’ choice to adhere to such approaches, but a 45 minute lesson doesn’t offer enough time for pupils with different learning styles to exert communicative abilities and practice reflective skills. Online activities offer time to contemplate on what each pupil wishes to say. They open the lesson outside the classroom walls, while the infusion of face to face activities, through blended procedures, advances the interactive stance of the lesson. The characteristics of our reflective blended learning approach in comparison with the conventional settings of the everyday lesson in the classroom, according to what the author has elicited from the pupils, are depicted in Table 1.

Table 1. A comparison of conventional and the blended-learning reflective classroom settings.

Characteristics	Conventional lesson	E-learning reflective approach
Space and time	The lesson is fulfilled in the classroom, throughout the school hour.	The lesson is fulfilled either in the classroom and home or in the school's lab. Pupils enter the online environment at any convenient time. They can fulfill collaborative activities from home.
Self-paced learning	Learners have to fulfil their assignments in the given time or respond to conversations in the classroom settings.	Pupils take their time, communicate through the asynchronous online tools and fulfil their assignments according to their personal pace.
Dialogue	In classroom, time is not sufficient for every pupil to express his point of view, so introversive individuals usually stay on the fringe.	Dialogue is enhanced through multivariate communicative paths. It is commenced through online forums and conversations and is expanded in face-to-face settings. Every pupil has expressed his opinion in such online tools, so the teacher can make use and encourage introversive individuals, as he has at his disposal the written comments of all pupils.
Contents	Pupils reproduce the given contents. Reproduction is the aim of the typical lesson.	Pupils search for data by themselves; they are challenged to test their validity, construct and give meaning to what they have read. There is no one solution to the problem; the window of knowledge is always kept half-open. Contents are the vehicles for reflection and metacognition.
Articulation	Pupils have to express given facts and knowledge, according to the school book.	Pupils express their own point of views, without fearing to be wrong. Emphasis is given to why they express an idea, how did they reach to a conclusion, how they feel about it and what were the criteria for their choices.

The most common answers pupils gave to the evaluation question at the end of lesson, was that they liked this kind of lesson because it involved computer and internet use. They characterized it as an enjoyable style to do lessons and asked when we are going to do something alike. GMF was a topic that activated them and agitated them, especially when arguments that advocate the use of such products were presented. On the other hand, we should point out some observations that concerned us:

1. Pupils' written contributions to the forums and "question and answer" activities lacked language wealth. They were simple sentences, with not enough arguments that supported their option, although their oral contributions were much more elaborate.
2. Most pupils entered the online environment at school, with the presence of the teacher, rather than do it at home. The reason for this, according to their sayings, was that they felt insecure about doing something wrong. It seems that the passage

from the closed conventional learning settings to a more open environment needs its time. Some pupils even didn't know what to do after completing an activity since they didn't read the instructions given. Self-paced learning has its own logic and requires activating certain skills such as reading instructions.

Conclusion

The instructional model described in this paper was designed to help pupils come to an integrated understanding of the GMF controversy. The issue had the potential to activate pupils' reflective practices and make them think about issues that relate to their health and the environment in which they are going to act as citizens. By contemplating on their beliefs, juxtaposing statements and reconstructing their dispositions, they acquired the basic skills needed for creative citizens that live in a world that changes. Making sustainable choices necessitates the adoption of certain stances towards the self and the community and this cannot be attained through didactic or lecture practices. Children have to be immersed in learning practices that urges them to search for data, cross-examine their validity, contemplate on the impacts of their choices and take action. This leads to a transformation of the classroom from a place where taken-for-granted knowledge is transmitted into a place where everything is put in question. And this cannot be achieved inside the four walls of a classroom. Dilemmatic topics such as GMF offer all the preconditions to achieve such skills. The teacher must struggle not to give answers to pupils but leave them to construct their points of view and give meaning to their choices. Scaffolding questions such as "*why do you say that?*", "*How do you feel about this?*" and "*How did you reach that conclusion?*" can trigger their critical skills and keep them focused while supportive data should be given after they have stated their prior knowledge and predispositions. It is important to make the class discuss, juxtapose and respect other opinions. This could be achieved if pupils had time to contemplate and discuss with the community and their family. Learning Management Systems and open e-learning environments can broaden the classroom's settings and give space to such perspectives. Concerning, this small case study, we were given the impression that pupils activated themselves about GMF by involving their families. For at least three months, we were bombarded with questions and comments, which were derived from discussions with their parents, concerning advertisements and journals about GMF, as well as consumption practices.

Transformative and critical constructivist learning is a shift of consciousness that involves an understanding of a) one's self in the world; b) relationships with others and the natural world; c) the relations of power; d) alternative approaches to living and e) the possibilities for social justice, peace and personal joy (Kostoulas-Makrakis, 2011). A critical constructivist perspective of learning incorporates social negotiation, which recognizes that learners learn by challenging their thoughts, beliefs, perceptions and existing knowledge, through interacting with other learners and applying reflective practices in the classroom.

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494)). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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ICT-ENABLED CLIMATE CHANGE EDUCATION AND CHILDREN'S RIGHTS

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Abstract

This paper deals with a web-based learning environment that introduces primary school learners on the issue of "Children's Rights and Climate Change Education. The methodological approach used is based on critical pedagogy and hypermedia technology. Through open source learning technologies and authentic learning activities that are enriched by open education resources and learning objects largely elicited from the Web, learners are being informed and construct knowledge related to six key areas of children's rights affected by climate change.

Key words: *children's rights, climate change education, ICT, education for sustainable development*

Introduction

There is widespread consensus among researchers that climate change is taking place bringing a number of risks and irreversible impacts on people and nature. Children and adolescents and especially girls are among the most vulnerable social groups of any community, especially in less economic developed countries who will disproportionately suffer the negative effects of climate change (Hodge, 2010). Women are particularly affected because they are the largest percentage of the poor population (it is estimated that women account for 70% of poor people) and they also face gender inequalities, which climate change tends to exacerbate, as highlighted by the 2007/2008 UNDP Human Development Report. Some of these inequalities are: lack of access to resources such as land, credit and training; limited participation in decision making processes; more dependence on natural resources, and; greater caring responsibilities (Agostino, 2010). In general, those most prone to suffer the effects of climate-related hazards are often marginalised geographically (e.g. live in hazardous places such as informal settlements or in remote locations), socially (e.g. lack social protection and health services), economically (e.g. low-income people or resource dependent populations) and politically (e.g. people not giving them a voice and thus excluded from political and decision-making processes) (Gaillard, 2010). This resulted to 54 articles and

two optional protocols of the Convention on the Rights of the Child that is the first legally binding international instrument to incorporate the full range of human rights (UNICEF, 2012). It includes: the right to survival; to develop to the fullest; to protection from harmful influences, abuse and exploitation; and to participate fully in family, cultural and social life. UNICEF-IRC (2008), Back & Cameron (2008) and Stone & Lofts (2009) focus on the articles of the Convention of Rights of Children (CRC) that are relevant to child's rights affected by climate change. These are divided by UNICEF-IRC (2008) into 4 categories: 1) child survival and child health; 2) education and equality; 3) emergencies and child protection and 4) empowering children to act. All these issues are seen as closely related to climate change. Child survival and child health are connected with article 6 of the CRC (children's right to live and governmental safeguard of survival and healthy development) and article 24 (children's right to good quality health care, to safe drinking water, nutritious food, a clean and safe environment, information to help them to maintain their health and provision for help from rich countries to poor towards the achievement of the above rights).

By agreeing to undertake the obligations of the Convention, national governments have committed themselves to protecting and ensuring children's rights. In an effort to increase the scale and effectiveness of EU action, the European Commission came forward with a cross-cutting document including internal and external policies on children's rights (Ruxton, 2005). In its Communication, it outlined seven specific objectives (E.U, 2006):

- Capitalising on existing activities while addressing urgent needs;
- Identifying priorities for future EU action;
- Mainstreaming children's rights in EU actions;
- Establishing efficient coordination and consultation mechanisms;
- Enhancing capacity and expertise on children's rights;
- Designing a communication strategy on children's rights;
- Promoting the rights of the child in external relations.

Through these short and long-term measures, the Commission hopes to promote universal children's rights worldwide, building on its tradition of legal and political commitments with regard to human rights in general and children's rights in particular.

The potential impact on children has been a critical missing element from the debate about climate change, despite the fact that there are several studies showing that the climate change impact on children is of critical importance. UNICEF (2009) identifies several reasons that make children particularly vulnerable to the impact of climate change. These include:

- the high risk of exposure to environmental hazards due to their stage of psychological and cognitive development;
- the fact that vector-borne diseases and under-nutrition (which are the main reasons of child mortality) are highly sensitive to climatic conditions;

- the fact that world's least developed countries, which have the largest proportion of child population and poor means to face extreme climatic events, will be mostly affected by climate change;
- climate change's intersection with social, economic and political strains, which result in children's "psychosocial trauma, recruitment into armed forces, displacement and forced migration, which may in turn lead to family separation and exposure to trafficking and exploitation.

UNESCO (2009) has stressed the need to review and re-orientate the present educational and teaching and learning programs in order to address the causes and consequences of climate change. Article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) calls on countries to promote and facilitate education and public awareness of climate change. The International Alliance of Leading Education Institutes (IALEI) (2009) attempted to define Climate Change Education (CCE) pointing to two different positions regarding CCE. The one regards CCE as a natural sciences issue, whereas the other sees climate change as an integral part of sustainable development, defined as: a delicate balance between the human need to improve lifestyles and feeling of well-being on one hand, and preserving natural resources and ecosystems, on which we and future generations depend (GDRC, 2009). Plantilla (2006) refers to the United Nations Development Program (UNDP) classification of groups of human rights which are most frequently encountered in sustainable human development activities (figure 1). Hence, these rights and issues could be deemed as closely related to Education for Sustainable Development (ESD) and to CCE respectively. These issues include:

1. food and health
2. land, language and culture
3. environment
4. labor and the workplace
5. children's welfare
6. education
7. women

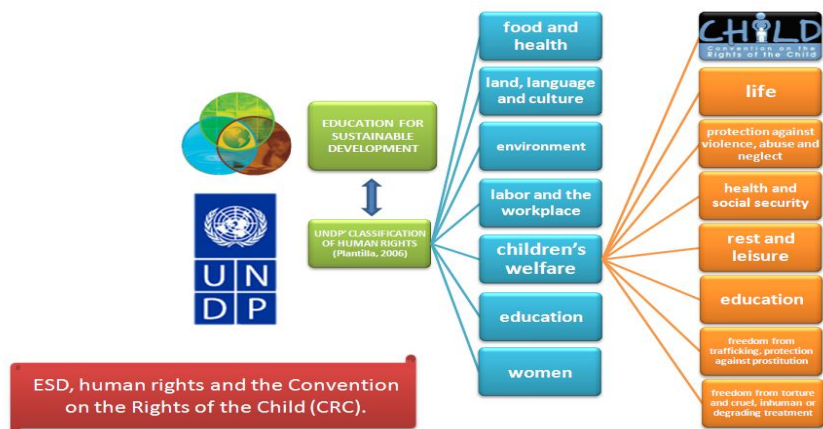


Figure 1. ESD, human rights and the Convention on the rights of the child (CRC)

Climate Change Education is also closely related to another United Nations (UN) initiative, the Millennium Development Goals (MDGs). Concerns are raised that climate change threatens the progress made toward meeting the Millennium Development Goals (MDGs). Therefore, investing in quality education to combat climate change is seen as an essential tool in achieving the MDGs. Figure 2 attempts to illustrate UNICEF's (2003) connection between MDGs and the priority areas of action of the "A World Fit for Children" agenda. Todaro & Smith (2009) argue that the MDGs allocate specific responsibilities to the rich countries in an attempt to reduce the gap between them and the developing countries. At this point it would be interesting to mention Sax's (2008) view that "basically all eight MDGs are more or less directly linked to the situation of children"(p.1).

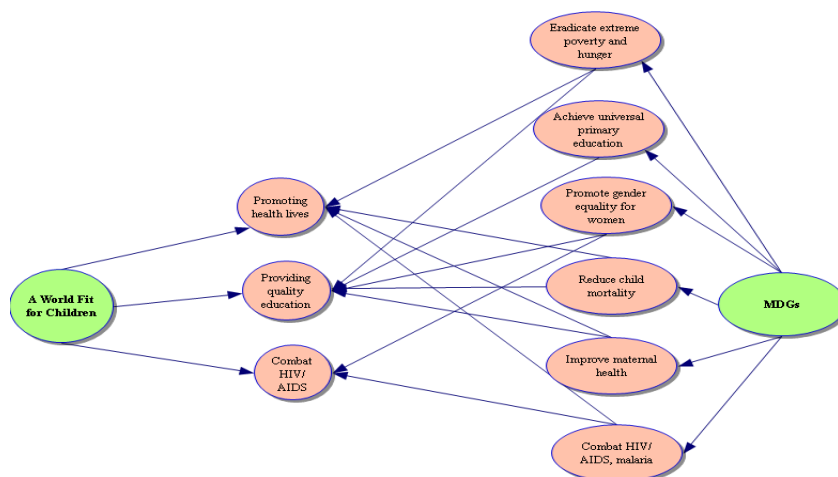


Figure 2. MDGs and “A World Fit for Children”

It can be argued that a child rights-based approach (Figure 3) to the integration of climate change into the school curriculum is of high importance. In such a context, CCE programs should not only make children aware of the present environmental situation and its effect on their rights but also actively involve them in child-centered as well as child-led activities (Arts, 2009). The implementation of such an approach could in its turn make children “potentially effective agents of change within communities to foster an appropriate approach to address climate change” (Tanner et al, 2009, p. 5). As Putnam (2009) argues climate change is not just an environmental problem, but it is more a human rights issue.

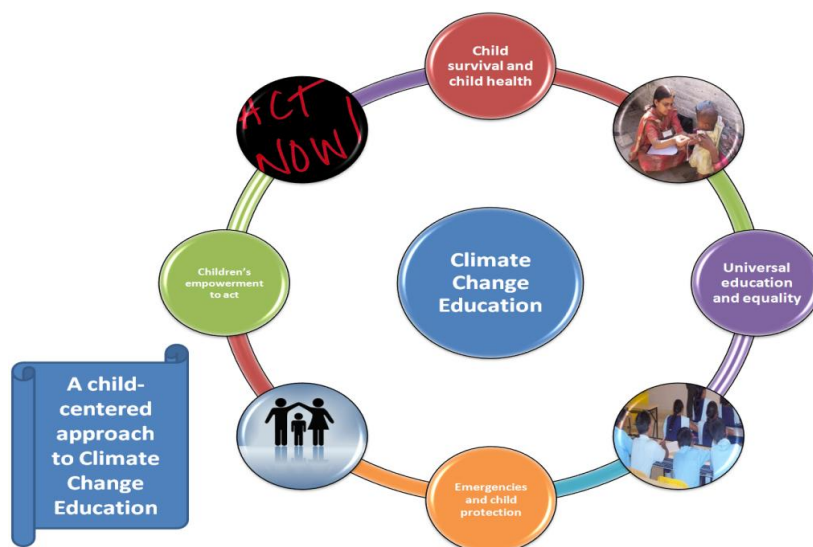


Figure 3. A child-centered approach to CCE.

ICTs as enabling tools for climate change and children's rights

The increasing diffusion of ICTs, from interactive Web portals, Web 2 applications, educational TV, social media, text messages (SMS), community radio, mobile phone-based monitoring systems, GIS, among others, are offering new mechanisms for advocacy, empowerment, and capacity building in tackling issues related to climate change. Emergent experiences, particularly from developing countries, suggest the potential of ICTs in face of the challenges posed by pervasive poverty, environmental degradation and climate change impacts (Ospina, 2012). In a review of the existing literature on ICTs, climate change and development Ospina and Heeks (2010) indicate that the potential of digital technology has not yet been integrated into a systematic understanding of adaptation and resilience, let alone from the perspective of a conceptual framework. However, for ICTs to serve their potential for learning to transform oneself and society there is need to view ICTs both as context to climate change education and the latter as context for integrating ICTs in the teaching and learning process. The recognition of ICTs has been also extended in the Rio+20 World Summit. More specifically, the role of ICTs is explicitly mentioned in regards to **five key areas of action** towards the achievement of sustainable development (Ospina, 2012):

a) ICTs and Multi-stakeholder Engagement

- Article 44 of the outcome document that recognises the role of ICTs facilitating the flow of information between governments and the public, **enabling public**

engagement in sustainable development. The document calls for governments to “work toward improved *access to ICT*, especially broad-band network and services, and bridge the digital divide, recognizing the contribution of international cooperation in this regard”.

b) ICTs, Knowledge Exchange and Capacity Building

- Article 65 of the outcome document acknowledges the potential of ICTs to promote knowledge exchange, technical cooperation and capacity building for sustainable development. The article emphasizes the role of these tools in fostering experiences and knowledge sharing in different areas of sustainable development in an “*open and transparent manner*”.

c) ICTs, Food Security and Sustainable Agriculture

- With the aim of improving agricultural productivity and sustainability, Article 114 of the outcome document calls for government action to improve access to “*information, technical knowledge and know-how, including through new ICTs that empower farmers, fishers and foresters to choose among diverse methods of achieving sustainable agricultural production*”.

d) ICTs and Energy Efficiency

- Article 128 of the outcome document recognizes the need to improve energy efficiency and the role of energy-efficient technologies in addressing sustainable development and climate change goals, including energy efficiency measures in urban planning, buildings, and transportation, and in the production of goods and services. These constitute areas in which ICTs have proven potential to reduce emissions through ‘*smart*’ applications (e.g. smart motor systems, smart logistics, smart buildings and smart grids).

e) ICTs and Youth Education

- Recognising the importance of youth education and of ensuring that education systems provide the tools to pursue sustainable development, Article 230 of the outcome document calls for a more effective use of ICTs to enhance learning outcomes.

ICTs can provide opportunities for learners to construct meaningful learning environments which can be applied to ESD such as: a) engaging and challenging learners; b) stimulating dialogue and social negotiation through new modes of social interaction; c) learning by exploring and discovering, d) doing and reflecting; e) constructing personal and collective representations of meaning; and f) supporting discourse in dealing with real-life problems

(Makrakis, 2011). More specifically, ICTs play an important role in advancing CCE and ESD in three ways: a) by increasing access to educational materials about sustainability (e.g. via distance learning, educational networks and databases); b) by helping to promote new ways of interactive learning addressing sustainable development issues and c) by opening access to information and knowledge (Makrakis, 2008; Makrakis, 2010). ICTs can help learners explore concepts, engage in problem-based and authentic learning, enhance meta-cognitive skills and present information using multiple media. All these are closely related to the goals, themes and learning objectives addressed by education for sustainability and CCE. While ICTs can provide interactive mind/cognitive tools to support learning and develop new understandings and knowledge in areas of teaching and learning for sustainability, CCE themes integrated into the school curricula could provide a worthwhile context for ICTs in education.

The back-end system of our ICT-enabled climate change education and children's rights learning environment is based on Drupal- an open source Content Management System (CMS) similar to platforms like Joomla and Moodle that offers a powerful and extensible framework for web-based teaching and learning. Some of the advantages in using a CMS as a back-end are low development time along with high reliability and a wide variety of useful tools for educators such as blog, forum, user groups, privacy options, rich user profiles and easy management. The ICT-enabled climate change education and children's rights learning environment is enriched through the elicitation of learning objects found in the Web, including texts, images, videos organized and classified in a hypertext mode, which involves the existence of nodes linked with various ways and not only linearly. The main learning content is composed of Learning Objects (LO's). The authoring tool that was used to create the LO's is Adobe Flash. Each LO is constructed from various media assets, such as text, video, animation, charts and sound narration, all gathered under a simple graphic user interface, comprising a dynamic and adaptable learning environment. It is also supported through the integration of various ICT tools, such as concept maps (Text2Mindmap), spreadsheets (Zoho Sheet), presentations (280slides), paint tools (Pixlr), word processing (Zoho Writer), venn diagrams (classtools.net). In developing this hypermedia learning environment we used both ESD-based instructional design principles and software engineering methods.

The curriculum structure of the hypermedia environment and its underpinning theory

Learning theory foundations: The ExConTra learning paradigm

The structure of our hypermedia learning environment is based on the principles of the ExConTra learning paradigm as depicted in figure 4 (Makrakis & Kostoulas-Makrakis, 2012).

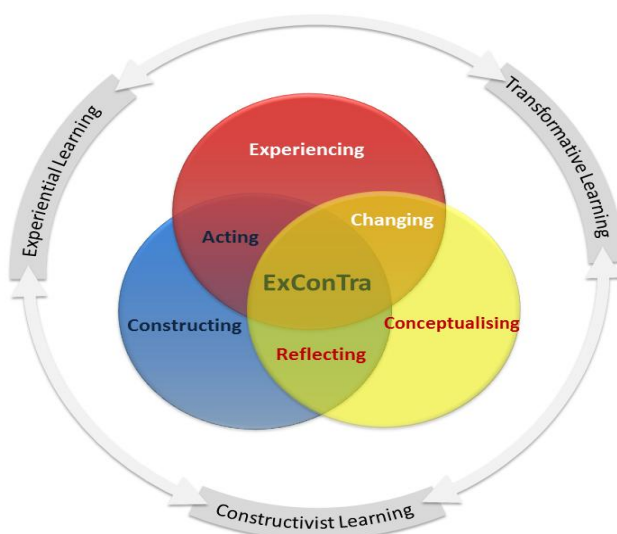


Figure 4. The ExConTra learning paradigm

Beginning with experiencing, learners identify a realistic and authentic task associated with a sustainable development issue, such as climate change and start collecting the information needed for their analyses, using various inquiry-based methods. Reducing the production of greenhouse gasses and in preparing societies for adaptability to risk and physical environmental change, climate change education needs to be experienced-based and practice-centred. Learning-centred actions for changing unsustainable practices are needed (e.g. learning to implement energy saving measures), so that learners can experience and reflexively review their values and practices in climate change solutions. Through reflecting, self and/or social, as well as through further reading and observing, learners organize and examine the collected data for the new experience from multiple perspectives in order to find meaning. For learners to make meaning, either individually and/or shared, they need to reflect on their own experiences, leading them to develop more abstract understandings of their experiences (conceptualizing). Arriving at individual and shared meaning (construct-

ing), learners need to get involved in a shared inquiry enriched through continuous reflection, re-conceptualization and active experimentation. In this sense, learning is an active and contextualized process of constructing meaningful knowledge based on ones own experiences, rather than acquiring it from someone else. Constructed knowledge and meaning is meaningful when it opens up opportunities for action. Merging knowledge and meaning with action (acting) implies a change agency and active citizenship. Acting as change agents, learners are empowered to transforming experience through critical reflection and active experimentation. When critical reflection is transformed into an action it becomes praxis that turns learners able to transform oneself and society (transforming).

Central to the climate change processes of mitigation, adaptation and transformation are new values, creative thinking and problem solving skills. These skills require learners to engage in critical analysis of causes and consequences, and construct knowledge that may lead to action. This requires teachers involved in climate change education to integrate into their teaching and learning methodologies experiential, constructivist and transformative learning principles and values. Teachers need to shift from functioning as the sole source of information to becoming co-learners and facilitators using multiple sources of information and provide support and motivation in helping learners in the process of self-directed learning. Similarly, students' roles also need to change from passive recipients of climate change information to active learners who search, collect, analyze and interpret climate change data and collectively build up knowledge through inquiry and reflection.

Curriculum structure: A theme-based approach

A horizontal approach was adopted to organise curriculum that gives meaning to the scope and integration of curricular contents of different disciplinary areas and knowledge domains in a certain level of teaching (Makrakis, 2012). The following description introduces the function of this Web-based learning platform for each stage of thematic learning (Figure 5).



Figure 5. Steps in designing a theme-based instruction

Choosing a theme– This stage involves the choice of a large theme related to a compelling real-life issue, such as climate change which has meaningful connections in the broader framework of human experience that may connect family, school, and community. In a recent study, it has found that web-based thematic learning: 1) has positive effects on learners' concept learning; 2) provides learners with a framework from which develop the related concepts, in a more stable learning mode; 3) is suitable for students with different abilities (Liu & Wang, 2010).

Planning the integrated curriculum– In this stage sub-themes, in the form of thematic areas, such as “climate change and me” are planned to integrate concepts, skills and strategies that give meaning and direction to the whole learning process of climate change. The teachers involved organize the climate change core curriculum (both process skills and content knowledge) and sub-themes in an open and flexible way to assure student involvement at a later stage. Inter/cross disciplinary approaches are adopted in planning the integrated curriculum giving more emphasis in the processes involved rather than the outcomes. In web-based settings, particular emphasis is given to a variety of interaction choices for participants: teacher-to-student, student-to-student, and student-to-resources and content. Additionally, a well-planned curriculum balances three types of activities: individual activities, small group activities, and large group activities. By ensuring multiple channels of communication, engagement, and collaboration within the design of a curriculum, providing a richly textured environment that can accommodate a full range of student needs and learning styles is of critical importance (Boettcher, 2007).

Designing learning and instruction – In a web-based learning environment the learner interacts with the content, teacher, and technology. This stage involves first the design of learning activities enabled by ICTs. Through designing learning activities suitable in web-based learning environments, and driven by the ExConTra learning, the content becomes the means to an end and not an end in itself. In designing thematic learning and instruction, one approach that is consistent with the ExConTra learning principles is that a group of teachers can brainstorm learning activities using existing curriculum materials and be drawing directly from end-users' (teachers and students) ideas, interests, and experiences during the formative evaluation process. In this process involving community experts and other members could add value to designing meaningful and engaging learning activities. Strategies that ensure the reusability, adaptability, and generalisability of teaching and learning materials should be planned.

Implementing the integrated curriculum: As pointed earlier, one of the most effective strategies for an integrated theme-based curriculum is to teach climate change in conjunction with mathematics, science, social studies, language arts, environmental studies and so on. This allows students to make connections between different areas as they explore a topic in detail and from a variety of approaches. Cross-curriculum projects allow students to see how knowledge and skills are connected in the various school subjects and how knowledge constructed and skills acquired can be transferred to other situations and real-life contexts. This step involves project-based learning as a model for implementing thematic learning activities. It is a shift away from the traditional classroom practices of short, isolated, teacher-centered lessons. Instead, it emphasizes learning activities that are long-term, interdisciplinary, student centered, and integrated with real-world issues and practices

in which students plan, implement, and evaluate projects that have real-world applications beyond the classroom. ICTs should be involved in such a curriculum in two ways. First, technology can be used to support the instructional process, and, second, it should be a significant part of the content of the curriculum. The theme should provide a context for learning with ICTs and vice versa. Various ICT tools and Venn diagrams, like concept maps and semantic webs, help show the connection between related concepts and help learners explore meaningful learning experiences. Implementing the integrated curriculum in web-based learning settings with different tools and resources for retrieving content, using the online tools and facilitate interactions among teachers and students as well as other stakeholders, requires new instructional practices, such as peer tutoring, collaborative learning.

Assessing the impact of the integrated curriculum: In this stage, the focus is to determine the extent to which the curriculum plan that was implemented has achieved its goals and objectives as planned. The information collected from evaluating a curriculum forms the basis for making judgements about how successfully has the programme achieved its intended outcomes and the worth or value of the programme. This process can be integrated into three interlinked assessment levels: 1) diagnostic; 2) formative and 3) summative. The term *diagnostic* refers to a process at the initial phase; *formative* refers to a process while developing the curriculum so that revisions to it can be made and *summative* refers to a process at the end/after the curriculum programme is implemented. A critical concept applied to these processes is authentic assessment that is driven by ExConTra learning foundations. Authentic assessment to be incorporated in assessing the impact of the integrated curriculum include an amalgamation of tools and strategies that derive from ExConTra learning but also from objectivist learning theories if such tools contribute to the ExConTra learning principles. Among the most used tools include: multiple choice tests with extended responses to help students become aware of their own thinking processes; observation; checklists; portfolios; concept mapping and Venn diagrams; scenario building; reflection and reflexivity; journalising; simulation; case-study analysis. All the three levels of assessment are interlinked and in a way they provide a holistic framework for assessment. However, we consider formative assessment as the most critical process as it provides effective feedback and gives the opportunity for learners' and other stakeholders' active participation in the design and development of the integrated curriculum. Within this process, the use of concept maps and other structural knowledge representation techniques are very effective tools (Trumpowe & Shahzad Sarwar, 2010; Ahlberg, 2004). The process of formative assessment should: 1) enable students to self-monitoring progress; give regular feedback to students; support peer learning and assessment; and design self assessment practice (Liang & Kim, 2004). As Visualization tools such as conceptual maps help students to process the abstract concepts or mental images that they depict and the more they work designing materials, the more they construct their own meaningful realities based to new knowledge (Jonassen, et al., 1998; Jonassen & Reeves, 1996).

Curriculum areas of climate change education for children's right

We also adopt a human rights education approach that is based on empowering learners to differentiate between the charity dimension and other forms of aid, although valuable, and enabling learning environments that support learners to understand the roots of the food-related issues and get involved in action to help eradicate the problem. The structure of the “Children’s Rights and Climate Change” curriculum is comprised of 6 areas (Figure 6) integrated across the school curriculum of the primary education level (Figure 7):

1. Right to food and climate change.
2. Right to water and climate change.
3. Right to education and climate change
4. Right to health and climate change
5. Gender equality and climate change
6. Right to environment and climate change

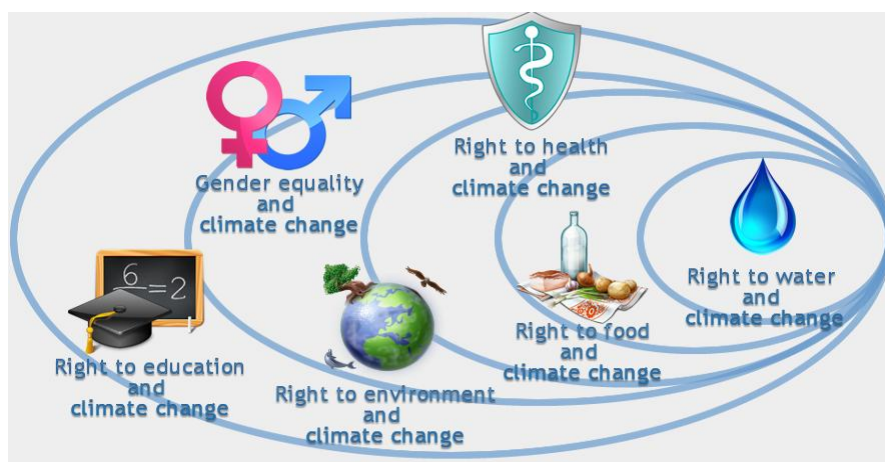


Figure 6: The content areas of the climate change education and children’s right curriculum

In this presentation we will deal with the first five, as the last one is in the process of development. These are designed to be integrated into the existing primary school curriculum from grades 4 to 6. In an integrated methodology interdisciplinary topics are arranged around overlapping concepts and emergent patterns. This process blends the disciplines by finding overlapping skills, concepts, and attitudes in a synergistic manner that makes the knowledge of one subject inseparable from that of another subject. These units together with the supportive web-based learning environment with its technologies can provide a good resource for the respective course of “ICTs, Climate Change and GIS/GEO Spatial Tools” of the M.Sc. programme within the framework of the ICT-enabled ESD project financed by the European Commission.







Curriculum areas		Integration Across School Subjects									
		Language By the Environment	Mathematics	Environmental Studies	History	Religion	Geography	Visual Arts	Health Education	Physical Education	Citizenship Education
 Right to water and climate change		✓	✓			✓	✓	✓		✓	
 Right to food and climate change	✓	✓	✓		✓	✓	✓	✓		✓	
 Right to education and climate change		✓	✓	✓		✓	✓			✓	
 Right to health and climate change		✓	✓			✓	✓	✓	✓	✓	Biology
 Gender equality and climate change		✓	✓			✓	✓			✓	Physics
 Right to environment and climate change	✓		✓			✓	✓	✓	✓	✓	

Figure 7. The cross-curriculum planning of the climate change education and children's rights curriculum

The learning environment (figure 8) consists of the introduction and four units: a) Me and my food, b) Food as a basic need, c) Food as a right and d) Right to food and climate change. Access to these units is available through the top menu of the home page of the learning environment. At the left side of each page there is direct access to the basic tools of the learners (concept mapping, word processor, paint) as well as to a modern Greek online dictionary. The engagement of learners in the web-based learning environment starts with the exploration of learners' experiences about the concept of hunger. In the first unit entitled "Me and my food" learners' experience is explored through individual and group activities, with which they are called to mention their nutritional habits and to express their views regarding the foods that are necessary for our survival and growth. After the conceptualization of the nutritional needs through the engagement of learners in various activities, they are asked to create their own meal plan by selecting themselves the kinds of food that it will contain. Then they share their constructed knowledge with their parents and encourage them to create a similar meal plan. At the end of the unit, learners working in groups are called to build a final concept map containing the foods, which they believe are necessary for their survival and growth.



Figure 8: The learning environment

Description of the curriculum areas

Right to Food and Climate Change

The right to adequate food is recognised in several international conventions. Food as a human right and basic need is the right of everyone to an adequate standard of living for himself and his family. There is little doubt that climate change will accelerate grain sterility; accelerate erosion, desertification and reducing crop and livestock yields which will detrimentally affect the right to food of millions of people worldwide.

In the web-based hypermedia application entitled “Right to Food and Climate Change”, learners experience and conceptualize their nutritional needs, while they are engaged in activities that lead to understanding food as a basic need and human right. Additionally, learners, through case studies activities, experience and conceptualize the way the denial of the right to food is related to some extreme local climate conditions, which are due to the climate change phenomenon. Students are also asked to find ways of action in order to mitigate the climate change phenomenon and the shortage of food that derives from this phenomenon.

The unit “Food as a basic need” aims to make learners understand how important nutrition is for human survival, making a connection to food as a basic need and human right, in particular with child’s rights. During the experiential phase, learners are watching embedded advertisement videos about food. Learners’ groups are reflecting upon the four groups of rights, the so called four pillars of the CRC and they are asked to decide in which group the right to food should be included. In order to understand the importance of this right, learners are called first to calculate the number of people in the world who are denied the right to food and to consider the consequences of that denial. As a case study, we se-

lected the Horn of Africa Peninsula, an area in which a great amount of the population is malnourished. In the next unit entitled “Right to water and climate change” Pakistan is examined as a case study in comparison with the previously examined case study of the Horn of Africa Peninsula. Through this comparative examination, learners’ groups are asked to explore similarities and differences between these two areas, which have a high percentage of malnourished inhabitants. Through the study of selected texts and critical reflective questions, it is attempted to motivate learners to conceptualize the relationship between the denial of the right to food and some extreme local climate conditions that have been arisen as an effect of the climate change phenomenon. Then, learners’ groups are asked to use their constructed knowledge in order to find ways of action with which they could mitigate the climate change phenomenon and the denial of the right to food that is caused by the effects of this phenomenon. At the end, learners’ groups are called to reflect upon all the previous activities and to share their knowledge by making a presentation for a healthy and environmentally responsible nutrition.

Right to Water and Climate Change

The right to water is intricately related to the preservation of a number of rights; underpinning the right to health in article and the right to food in article. As the earth gets warmer, there will be lower and more erratic rainfall, which will exacerbate the already existing problems related to water supplies and access. The “Right to water and climate change” unit aims to make learners understand that access to drinkable water is a need which they have the right to fulfill as well as to encourage them to get involved in actions for the protection of the corresponding right. Additionally, learners, through case studies activities, are experiencing how the denial of the right to water is related to some extreme local climate conditions, which are due to the climate change phenomenon. The web-based learning environment consists of the introduction and five units: a) restrictions of access to drinkable water, b) cost of access to drinkable water, c) climate change and drinkable water in the Mediterranean countries, d) over-consumption of water and e) pollution of the hydrographic network.

Through open source learning technologies and authentic learning activities that are enriched by open education learning objects elicited from the Web, learners experiencing the issues of the limited availability of drinkable water, the number of people worldwide that are denied the right to water and they conceptualize the effects that this denial could have. During conceptualization, learners are also directed to consider the cost of drinkable water consumption. Learners also experience and conceptualize the effects of climate change phenomenon in the availability of drinkable water in the Mediterranean countries. Finally, we attempt to empower learners to take action regarding the protection of their right to drinkable water. This is accomplished through activities that involve not only climate change, but also the two other main causes for the limitation of the availability of drinkable water: over-consumption of water and the underground water pollution. In the unit entitled “Restrictions of access to drinkable water” learners’ experiential learning starts with the number of people worldwide that are denied of this right and then they conceptual-

ize the effects that this denial could have. In the last two units learners conceptualize two other factors that influence the availability of drinkable water: its over-consumption and water pollution. In the last unit they reflect upon Asopos' river pollution as a case study.

Right to Education and Climate Change

Education is a human right for everyone. The thematic area of education as a human need and right is explored in the “Right to education and climate change” unit. Learners are experiencing how the denial of the right to education is related to some extreme local climate conditions, which are due to the climate change phenomenon. It consists of the introduction and four units: a) education as a basic need, b) education as a right, c) right to education and climate change and d) right to education and local action. In particular, learners are encouraged to get involved and act locally in an attempt to overcome the obstacles that limit the provision of education to children locally as well as globally, with a particular focus on those obstacles related to the effects of the climate change phenomenon.

The engagement of learners in the web-based learning environment starts with putting them to experience a hypothetical situation, in which they would have to live in a deserted place where it would be no school. Thus, learners are engaged in the unit titled “Education as a basic need” and are asked to conceptualize the impact that this lack of school would have in their life. Then, they experience and conceptualize the ways in which school is beneficial for our life as well as the extent to which education is denied to people globally, by solving simple mathematical problems. Learners then study the case of Igoal campaign that was organized by the International Federation of Association Football (FIFA), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and ActionAid. They are watching an advertisement of this campaign which helps them to transform their learning and see education not only as a need but as a right. Thus, learners are engaged in the unit entitled “Education as a right” Learners' groups are reflecting upon the provisions of the CRC and are called to conceptualize the relation of some articles of the Convention with education. They are provided with online text and multimedia material. Then, learners are experiencing the extent to which the right to education is fulfilled globally (focusing on Nigeria as a case study) and locally. In their local study they are also called to reflect upon the provision of education in Greece now and in the past. Learners' parents and grandparents are engaged in this comparative reflection. Learners also conceptualize the factors that are affecting the right to education and the experiences about the relation of education and climate change. Tanzania and Poland are explored as case studies of climate change impacts on education. Through these case studies learners divided into groups are asked to use their constructed knowledge and find ways of action with which they could mitigate the climate change phenomenon and the denial of the right to education that is caused by the effects of this phenomenon.

Participation in the campaign “Schools as Protectors of Children”, organized by United Nations Children's Fund (UNICEF) Greece is suggested as a possible way of action that engages learners in the concluding unit of our intervention entitled “Right to education and local action”, in which learners are conceptualizing the main factors that restrict the right to

education in Greece, with child labor being one of the most severe ones, and then they are asked to apply their constructed knowledge in order to find ways of further personal involvement and action with the aim to protect the right to education for all the children locally as well as globally.

Right to Health and Climate Change

Climate change poses significant risks to the right to health for millions of people worldwide through the spread of a wide range of diseases. In the unit entitled “Right to Health and Climate Change” learners experience and conceptualize their health needs, while they are engaged in activities that lead to understanding health as a basic need and human right. Additionally, learners, through case studies activities, experience and conceptualize the way that some diseases are related to some extreme local climate conditions, which are due to the climate change phenomenon. They are finally asked to find ways of action in order to intervene in this relation. The learning environment consists of three units: a) Health as a basic need b) Health as a right, c) Right to health and climate change.

The engagement of learners in the web-based learning environment starts with the exploration of learners’ experiences about the concept of health. In the first unit entitled “Health as a basic need” learners’ experience is explored through individual and group activities, with which they are called to express their views regarding health self-protection and they experience in which ways health care is provided by the state. Through reflective activities it is attempted learners to identify which are the main factors influencing our health. Learners then study the Declaration from the International Conference on Primary Health Care, in Alma-Ata, September 1978, which expressed the need for urgent action to protect and promote the health of all, believing that it is a fundamental human right. Thus, learners are engaged in the unit entitled “Health as a right” Learners’ groups are reflecting upon the provisions of the CRC and are called to conceptualize the relation of some articles of the Convention with health. Moreover, they are given material to study, which helps them to construct knowledge regarding the relation of the right to health with the rights to food, water and education, which were examined in the previous units. Malaria is explored as a case study of the climate change impacts with this vector-borne disease. Through these case studies learners divided into groups are asked to use their constructed knowledge and find ways of action with which they could mitigate the climate change phenomenon and the denial of the right to education that is caused by the effects of this phenomenon.

Gender Equality and Climate Change

Climate and gender issues are inter-related for several reasons. Women and men affect the climate in different ways. The European Institute for Gender Equality (EIGE) (2012) has published a report on gender equality and climate change which covers all the European Union Member States and provides comparable data on the European Union level. The findings demonstrate that women’s involvement in climate change decision-making at national, European and international levels is still low.

The unit entitled “Gender equality and climate change” aims to turn learners able to understand that certain inequalities exist between men and women and that these inequalities are intensified by the effects of the climate change phenomenon. It also attempts to make learners understand that they have the right to be treated equally, irrespective of their gender as well as to make connections between gender equality and the child right’s which are reviewed in the other units of the learning environment. The web-based learning environment consists of the introduction and five units: a) Women in society b) Gender equality as a right, c) Gender equality and climate change, d) Gender equality and child’s rights. When learners enter the web-based learning environment they first experience the problem of illiteracy around the world and the fact that it mostly involves women. In the first unit entitled “Women in society” learners experience women’s position at work and in social and political life and they conceptualize existing inequalities between women and men.

The unit gender equality as a right aims to make learners understand that all people should be treated equally irrespective of their gender. Learners experience the situation of women in several places around the world. In the next unit entitled “Gender equality and climate change” Senegal is examined as a case study. Through the study of selected texts and critical reflective questions, it is attempted to motivate learners to conceptualize the relationship between gender equality and some extreme local climate conditions that have been arisen as an effect of the climate change phenomenon. In the last unit entitled “Gender equality and climate change”, learners’ groups are asked to use their constructed knowledge in order to make connections between gender equality and other child’s rights. The aim is to make learners understand the extent to which the protection of other child’s rights is related with gender equality and thus to motivate them to actively participate in actions for their protection of their rights irrespective of gender.

Concluding Remarks

Many poor people already live in fragile climates, where food, health, education and clean water are scarce – climate change will exacerbate this fragility. Our children, especially the poor are already facing a dismal future which appears to be even more detrimental. The potential impact on children has been a critical missing element from the debate about climate change. Increasing awareness, constructing new knowledge and generating action should be a priority that education should cope with. The web-based hypermedia environment on the issue of “Children’s Rights and Climate Change Education” presented in the previous sections can be used for enriching the primary school curriculum by integrating an education for a sustainable development perspective. Our learning environment adopts a child rights-based approach to the integration of climate change into the primary school curriculum. The structure of our hypermedia learning environment is based on the principles of the ExConTra learning paradigm (experiencing, constructing, transforming), which empowers learners for active citizenship. Five of the six units were presented: right to food, water, education, health and climate change, as well as gender equality and climate change, as the last one is in the process of development. The activities integrated within this application are directly connected to the Hellenic primary school curriculum and in particular to

the subjects of Civic Education, Geography, Mathematics, Language and Religion, as we adopt a cross thematic and interdisciplinary curricular approach. A number of learning objects and ICT tools, largely elicited from the Web, have been used as scaffolds to advance the issues of food, water, education, health and gender equality as basic needs and human rights in connection to climate change education for sustainable development.

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494)). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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ACTION RESEARCH FOR CREATING KNOWLEDGE IN AN E-LEARNING ENVIRONMENT

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Abstract

The paper describes an action research during the implementation of an e-learning course on commercial studies in a bachelor's programme. The action research study aims to: (1) determine the effectiveness of action research in a technologically-based learning environment, and (2) establish how group work in e-learning environment affects students' interest in, and need for, communication and discourse. Qualitative and statistical methods of data analysis were used in this mixed-methods study. The present paper analyses the experience of students working in three action phases to design their personal frames of reference for evaluation of the content and metacontent of business fundamentals. The study identified several possibilities for improving e-learning environment with techniques that make this form of learning more sustainable.

Key words: *educational action research, e-learning, learning environment, group work, lived experience, living theory*

Action research is one of the contemporary approaches to educational research and creation of new knowledge (Dick, 2009; Herrington & Weaven, 2008; Keiny, 2008; Salīte, Mičule, Kravale, Iliško, & Stakle, 2007; Salīte, 2008; Salīte, Gedžūne, & Gedžūne, 2009; Whitehead, 2009). Action research is suitable for identifying problems of social development and seeking their solution. This approach is particularly appropriate at a time when nations and communities face dramatic changes caused by the introduction of new technologies (Stringer, 2008). To satisfy the newly arisen needs, approaches are sought for more extensive use of e-learning in education.

The present paper aims to identify new opportunities for the use of ICT in fostering students' creation of personal knowledge and skills while mastering a course on the fundamentals of business in a technology-based environment. The study was conducted with a *broader educational research aim* – to identify the opportunities of using action research to foster acquisition of e-learning study courses and to evaluate the influence of e-learning

techniques on the extension of cooperation and discourse in an e-learning environment. The above-mentioned educational aim is viewed in this study in a contemporary context that emphasises e-learning methods and the use of technologies requisite for their implementation. It is one of the most prominent features in knowledge society. Technological possibilities and the new societal needs on the way towards knowledge society enhance the rapid development of e-learning.

Theoretical framework

Knowledge society requires new approaches to education. The ever increasing usage of various technical means to create e-learning environment for knowledge acquisition warrants a scrutiny of the pedagogical implications of these technological advances. A critical examination of their educational outcomes is of crucial importance. The rapid development of information and communication technologies (ICT) over the last decades has created great instruments for the formation of knowledge society. Yet, many e-learning projects that are based on the experience of industrial society have also created “bubbles” (e.g. the internet bubble) that tend to burst, but are able to give new experience. Up to now in the global practice, the implementation of ICT solutions has been largely unsuccessful because the content of development projects is generally determined by technological opportunities whereas research into the users’ behaviour and flow of knowledge is neglected (Kapenieks, 2009).

The chief goal for cooperation between pedagogical researchers and ICT scientists is to identify the aims to be reached and adapt the developed ICT instruments to the educational needs of knowledge society. One of such opportunities is a combination of individual and group autonomous learning in e-learning environment where meaningful knowledge of learners is created in cooperation and discourse is an indispensable component of the knowledge making process. In this respect, it is important *to evaluate the opportunities and limitations of technologies and programmes* (Loveless, 2007) which take the form of e-learning as well as to seek solutions for a more successful usage thereof or find ways to compensate for the said limitations by improving the design of e-learning or perhaps identifying other effective pedagogical solutions.

Although e-learning is relatively new in education, its application has already resulted in the elaboration of several approaches and guidelines for creation and further development of e-learning design (Clark & Mayer, 2007). These suggestions are grounded in the science of instruction and aim to help consumers and designers of multimedia learning reach the bipartite aim of e-learning: *inform and perform* (Clark & Mayer, 2007). This double goal permeates the instructional methods and suggestions that are meant to help learners effectively process and assimilate new knowledge and skills.

E-learning is dominated by two learning approaches – instructional methods and cooperative methods in e-learning environment. An evaluation of the contribution of digital technologies to learning allows for viewing technological opportunities in terms of clusters of purposeful activities: creation of knowledge, distributed cognition, community and communication, involvement (Fisher, 2006). Instructional knowledge acquisition is charac-

terised by delivery of knowledge (Clark & Mayer, 2007). Cooperative methods feature acquisition and creation of knowledge in cooperation. They can be subdivided into cooperative and collaborative methods. In cooperative e-learning several learners each create a part of a joint project, and the discrete parts are ultimately assembled in an end-product. In collaborative learning learners work together to complement each other's ideas that result in a shared project (Salmon, 2004).

Clark and Mayer believe that the main task in this case is designing an e-learning environment which would support the learner's cognitive abilities. They also define six basic principles for instructional e-learning (1) maximum use of pictures, (2) close proximity of words and pictures, (3) maximum use of the spoken text, (4) avoiding duplication of information in the written and graphic form, (5) avoiding superfluous and attractive information and (6) maximum use of personalization by creating the material in the form of a personalised conversation. These principles are grounded in research into the cognitive processes of knowledge acquisition and should be considered when designing an e-learning environment for knowledge creation. In this case, however, it is more important to create a design that would motivate creative activity, generation of new ideas and their exchange with peers. Acquisition of business regularities is often taken as a medium to research the expediency of using e-learning to motivate learners for knowledge acquisition (Mayer, 2001). Additionally, business-oriented study courses are frequently used to research tutor's (consultant's) activities. Salmon (2004) has studied the role of an e-learning consultant and the principles of e-learning model design to increase student motivation, enhance socialization, information exchange and knowledge creation. She proposes a five-stage teaching and learning model (Salmon, 2002). The **first** stage should ensure access to the learning environment, the **second** permit students to create online identities. Cooperation in the **third** stage is possible because each participant supports the aims of others. In the **fourth** stage, with the development of discourse, cooperation becomes more intensive and purposeful. In the **fifth** stage, participants find new gains which help them realise personal aims that reflect the learning process. The level of interactivity differs across stages, but it is crucial in information exchange and knowledge construction.

In all cases, complex systems of educational solutions are considered effective owing to the crucial role of interaction between technologies and humans within them (Tilbury, 2007). Purg and Zakrajšek (2009) argue that systems that unite the human and technological factors can be implemented by creating complex models where the possibilities of information and communication technologies are used for both knowledge delivery and evaluation while sustainability is ensured by cooperation networks (Purg & Zakrajšek).

This paper will refer to several specific issues selected from a broader study which explored the opportunities to improve the quality of e-learning. The selected range of issues pertaining to e-learning will be discussed in the context of complementary usage of particular processes from both personalised autonomous and cooperative learning. Bridging these two types of learning, especially the dynamic interplay between the both in the educational process, is an issue of significance in the context of the quality of learning outcomes. Our previous studies were focused on evaluation of these two types of learning in the context of the quality of e-learning environment which was created in educational action research.

Contemporary pedagogical and sustainability perspective underscores the importance of viewing the relationship between humans and technology in light of learners' *lived experiences* and extension of the latter with the outcomes of complementarily applied autonomous personalised and cooperative learning forms. This interplay of old and new experiences and the learners' seeking a meaningful purpose for their learning creates conditions for learners to use their *lived experiences* to create personally meaningful *living theories* that expand and deepen their assumptions about the essence of sustainable development and, on a more general scale, sustainability, arrived at via individual studies and group work.

The present paper presents an account of our experience and some findings from the application of such a perspective on pedagogy and sustainable education to implement educational action research embedded in the process of study course acquisition.

Action research as a learning environment for the creation of 'living theory'

The use of action research analysed in the present paper is grounded in the philosophy created by John Dewey at the end of the 19th century (Dewey, 1916). It is likewise the basis for the e-learning method which has been applied in various projects; the method is rooted in the holistic approach that permits to activate students' creative potential. This philosophy is a prerequisite for the tendencies that dominate contemporary education – personalization and student-centeredness of knowledge acquisition. On the grounds of Dewey's philosophy, Kurt Lewin (1946) created the fundamentals of action research theory. Kemmis and McTaggart (2000) highlight the importance of participation in action research and suggest answers to significant questions: comparison of action research and 'scientific' research, the importance of participation and its influence on social processes. Dick (2009) provides a broader analysis of the evolution of action research theory until 2007 and proposes useful materials for teachers willing to do action research ([http:// www.aral.com.au/ resources/](http://www.aral.com.au/resources/)).

Recently, many studies have demonstrated that action research approach is effective for motivating students and enhancing their participation (Herrington & Weaven, 2008) as well as for fostering self-education (Keiny, 2008). Experience indicates that people perceive information much easier if they are solving real life situations (Kapenieks & Jirgensons, 2008). Attributes which are integral aspects of autonomous learning: the ability to motivate oneself; the ability to work autonomously; the general management of one's own work to time limits; a flexible and adaptive mind able to face new situations, the ability to think creatively, self-critically and independently (*Subject Benchmark Statement: Philosophy 2007*, The Quality Assurance Agency for Higher Education, p. 5.)

Several authors suggest incorporating grounded theory in action research. A significant step in theory development was the introduction of the concept of grounded theory by Glaser and Strauss (1967). When people act, they usually predict the result of their action, namely – it is their theory. Such theories are usually informal and relate action to its results. Grounded theory is a systemic and qualitative research method where theory is generated through data instead of hypothesis, which might seemingly contradict more 'scientific' methods. Practical theories differ from scientific ones by at least three parameters. Firstly,

they are viewed as instruments or tools. Secondly, practical theories are openly heuristic because they use concepts and instruments that permit various interpretations of one and the same situation. Thirdly, practical theories envisage actions that lead to the improvement of the current situation (Barge & Fairhurst, 2008). Introduction of the notion of grounded theory was the turning point in social sciences since it added new significance to qualitative research (Charmaz, 2000). Whitehead (2009) developed the *method of grounded theory* into *the living theory approach* to educational practice. It is grounded in human ability to create personal and unique explanations to the educating influences encountered in the learning process.

These theories are sensitive towards the situation of their creators. Yet, they can go beyond it and reveal heretofore unpredicted causal dimensions in the relationship between the participants and their environment. It helps co-create theoretical knowledge about the causal conditions of the social world (Friedman & Rogers, 2009). Creation of a meaningful theory in action research is the basis for creation of a shared local understanding among community members, which frequently enables them to take a critical stance to the dominant discourses (Genat, 2009). Acquisition of situational knowledge is facilitated by reflection and conceptualisation of action in cooperative groups. Joint researches and their evaluation develop self-assurance and decrease unwavering faith in authoritarian knowledge (Koutselini, 2008).

Explanation principles are the embodiment of the flow of energy and its manifestation in action. Their opposites are propositional theories where action explanations and individuals' learning are detached from the conceptual abstractions of the interrelations among propositions. Living theories are generated by action researchers in the practice of knowledge creation. Living theories integrate insights from both kinds of theories without lessening their abstract and conceptual understanding (Whitehead, 2009).

Research Method

The present paper describes an experience gained during the implementation of a mandatory study course on the fundamentals of business in a bachelor study programme at the Faculty of Electronics and Telecommunication of Riga Technical University.

Research participants:

(1) Student participants. 199 first-year students (32 females and 167 males) participated in the study. They all have adequate computer knowledge and skills. Some of the participants consider knowledge about business fundamentals especially important in view of their intended going into business.

(2) Researcher/e-learning consultant. In the process of action research the researcher/consultant cooperated with course tutor and students. Close partnership developed with the tutor with regards to choosing course content and meta-content, analysing its process and outcomes. Students and the consultant meet regularly during classes every two weeks. When students performed the tasks of each action research phase, the consultant supervised their activity in the e-learning environment. Should the occasion arise, the consultant became directly involved – commented on the students' performance, motivated

them via e-mail or messages in the e-learning environment. Upon completion of each cycle of knowledge acquisition, the consultant evaluated the students' performance.

For the purpose of this action research study, knowledge creation was divided into acquisition cycles. Figure 1 depicts a knowledge acquisition spiral that illustrates the strategy of acquisition. It is grounded in the systemic constructionist approach which posits that research should address three important discursive practices: (1) construction of meaning, (2) positioning and (3) performance. Each acquisition cycle begins with the identification of the problem to be solved. In each cycle, on the grounds of autonomous learning and communication within the group (network), a *lived experience* is actualized and some generalizations located as a resource for the building of *living theory* which is further developed in each consecutive cycle.

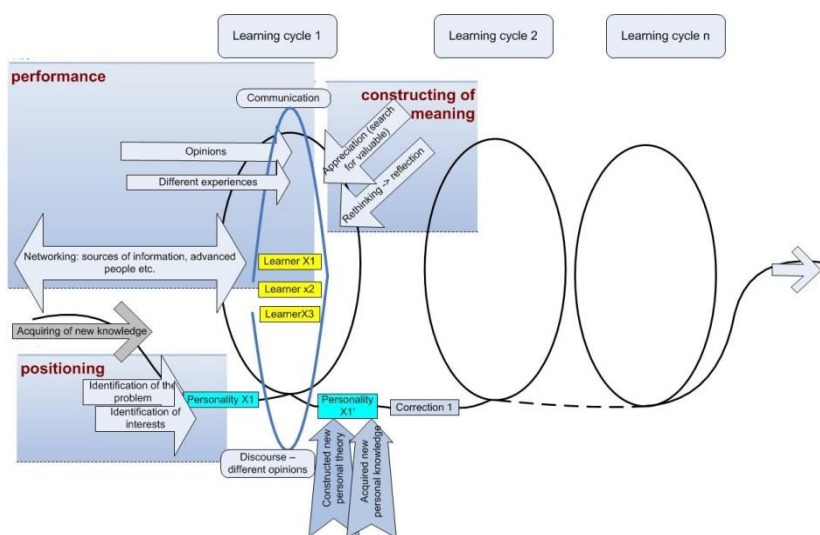


Figure 1. Continuity of project-based learning via action research in the course *Business Planning for the Open Market* (Kapenieks, 2010)

Creation of living theory is based on contemplation and evaluation, which are grounded in personal beliefs, experience and interests. Contemplation and searching for the valuable result in reflection. Predictably, the process of theory generation changes learners' interests and beliefs, which are recorded at the beginning and end of each cycle. Communication with co-participants introduces various experiences in the process of generating theory, which results in discourse. At the end of each acquisition cycle, the living theory is analysed and some corrections are introduced if necessary. At this point, the tutor and the e-learning consultant both play the crucial role – that of observing and investigating individual or autonomous learning and group learning' as well as using these types of learning to become involved in problem identification and solution in all three action research phases. The problem to be solved during educational action research is planning a successful financial flow for students' business ideas – enterprises. The learning process is organised by

using a project-based approach – planning the income/expense, balance and tax policy of one's enterprise.

Students work in groups of four to six and participate in three action research phases (cycles). During the introduction class of the first cycle, they become familiar with the chief regularities and concepts. Students find success stories in business and learn more about them. Each proposes their business idea (an enterprise) and designs a business plan. Prior to action research, students attend a class where they are introduced to the course and its aim, and where output data are defined. The problems and issues to be addressed in the first cycle are also defined. At the beginning of the acquisition cycle, students' interests are determined as well as their motivation for mastering the study course, related experience and beliefs.

The first phase begins with each student answering the questions asked in a *Google docs* environment about the income/expense planning for their enterprise. Then group mates add to each other's ideas, and each student summarises the discursive opinions in a living theory. Each student's ideas are complemented by two peers. E-learning consultant evaluates each student's input and adds some correction if necessary. He also monitors the process and motivates students during the classes and via e-mail. The second and third phases of action research are characterised by a similar process. Each student creates their living theory about the balance and tax policy of their enterprise, which would ensure the most effectiveness in business. As a result, each student develops a personal frame of reference for evaluation of the content and meta-content of the study course on the fundamentals of business, thus creating personal knowledge and approaches, and expanding own interests and beliefs.

Each member of the learning community is a source of experience for others. The blue lines in Figure 2 indicate how beliefs are constructed and developed in each acquisition cycle.

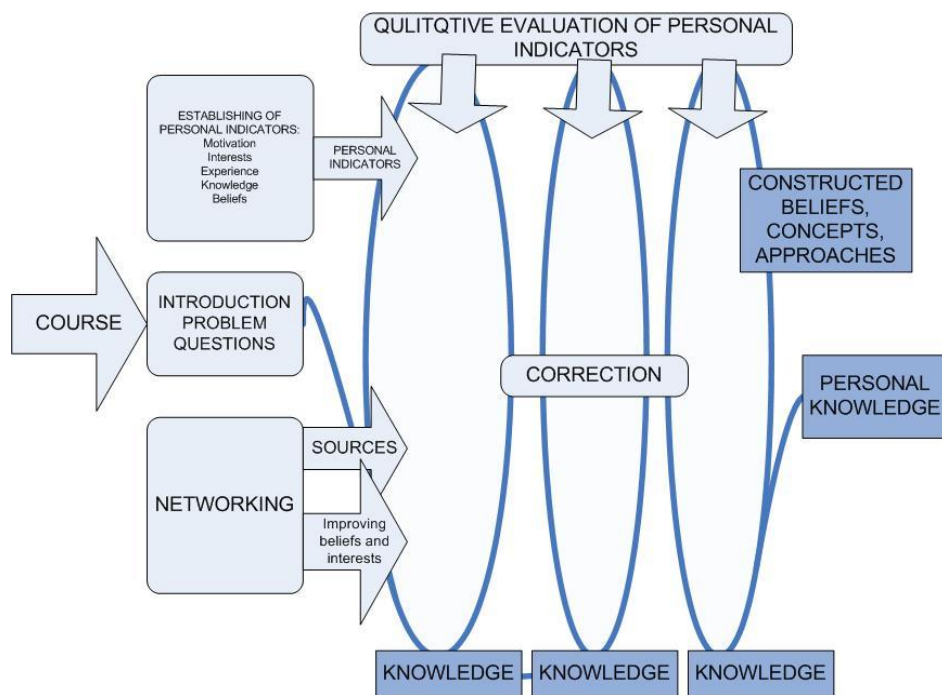


Figure 2. Development of personal knowledge during course acquisition in action research

By gaining new knowledge, students enter each consecutive cycle with complemented beliefs. While creating the living theories, students acquire personal knowledge which includes new beliefs, conceptual knowledge and approaches. The system of content knowledge is grounded in inductive and deductive analyses.

Design of the e-learning environment

The opportunities provided by the e-learning portal 'ORTUS' of Riga Technical University were used to coordinate action research. The portal is designed by using open code software MOODLE. In this environment, students receive directions about the tasks to be completed, are able to download learning materials and task templates as well as upload the tasks after completing them. Action research was conducted in *Google docs* environment. Here students answer questions and their answers are summarised in a MS Excel table. The e-learning consultant groups the students and ensures each student's access to their group table in the editing or viewing mode. In the group table, the students add to each other's opinions, summarise them in a living theory and can view the tutor's corrections and evaluation. This environment affords a possibility for several students to work in one and the same table as well as provides a convenient way of communication via e-mail between group members and the tutor. The latter opportunity is used for motivating students.

The first questions in *Google docs* environment help determine students' interests and beliefs in which the first acquisition cycle is subsequently grounded.

During the first acquisition cycle, students need to answer some questions in *Google docs* environment. These questions encourage students to seek regularities in the functioning of their enterprise. Some of the questions to be answered in the first cycle are the following:

- What kinds of income do you expect to receive in your enterprise?
- What criteria will you apply for choosing your target clientele and who will they be?
- Please characterise the geographic, demographic, professional and social segmentation of the market.
- Please characterise the aims for setting the prices.

After completing the questionnaire, all group members can view the answers and comment them in a MS Excel table. In this table, the students summarise their own and their peers' opinions in a living theory by participating in a communicatively created discourse. The tutor also uses the tables to add his comments, corrections and evaluation. In the second and third acquisition cycles, the e-learning environment is designed in a similar way.

Action Research Results

177 students out of 199 completed two cycles of creating living theory whereas 148 went through all three cycles. In each cycle, students were divided into groups of four to six in the order of filling in the questionnaire form. Each group worked in one document; each student created their own living theory in cooperation with two group mates. Participation in the educational action research gave students a possibility to upgrade their final assessment.

100 students participated in a voluntary survey about the course upon its completion. Generally, the target group was responsive and asked questions both during the classes and via e-mail. During the cycles, e-learning consultant sent reminder e-mails about the work to be done, which invariably caused an increase of activity. The increase of activity was also observed shortly before the end of the course.

The effectiveness of the creation of living theory was evaluated in two ways: (1) by analysing the results of course acquisition, (2) by conducting a qualitative study – an in-depth interview with the course tutor.

The study yielded an extensive amount of data, which will be presented selectively in this paper in order to (1) give a general illustration of the study and (2) underscore the core finding of qualitative analysis – identification of prototype ideas which can be used to create living theory.

Pierson's correlation confirmed the intuitively perceived relation between the final evaluation of creating the living theory at the end of each knowledge cycle and the total

evaluation of the acquisition of the respective portion of the course. Pierson's correlation coefficients are, respectively:

- 0.167 (0.05 is significant) in the first cycle (income/expense)
- 0.217 (0.01 is significant) in the second cycle (balance)
- 0.179 (0.05 is significant) in the third cycle (taxes)

In the survey, the students answered the question if creation of living theory helped to prepare the project – financial flow table. 80% (80) of students agreed. 23 of them used their own ideas in the living theory whereas 18% (18) reported that they had also taken into consideration their peers' ideas. The rest admitted that the creation of living theory was mainly helpful in mastering the new concepts.

The course tutor evaluated the students' activity, motivation and acquisition quality by comparing it to the results of the previous years. He appreciated the students' interest and an increase in activity during course acquisition this year as compared to the previous years. The quality of knowledge acquisition among students was considerably higher than before. The majority of students agreed that the applied method of knowledge creation was interesting. The students assessed their personal gains from using the method. Their evaluation is depicted in Figure 3.

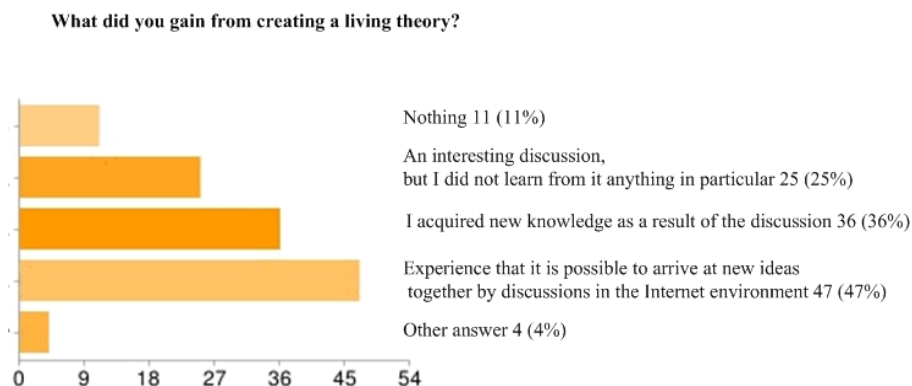


Figure 3. Students' evaluation of their gains from using the living theory method (100 respondents)

The method might first have appeared complicated since students had to repeatedly and independently complete tasks in an Internet environment and cooperate in the process. That is why it was important to establish if students found it difficult to understand the tasks to be performed. 23% (23) of the students who participated in the survey understood everything at once, 55% (55) reported that it was difficult to start with but they quickly understood the tasks to be done. 13% (13) of students only understood what needed to be done at the very end.

Key to group work in e-learning environment is each student's access to computer and the Internet as well as appropriate computer skills. 64% (64) of students had constant access to the above whereas 11% (11) found they did not manage to complete the tasks successfully because of access problems to ICT. The *Google Docs* environment which had been used for group work was considered ideal for the task by 24% (24) of students, but the majority awarded it between 4 to 5 points (41%).

Since group mates participated in creation of living theory with their opinions, it was expected that this participation would have had some contribution to the acquired knowledge. Students' evaluation of this issue is depicted in Figure 4.

Assess the contribution of your group mates to your knowledge.

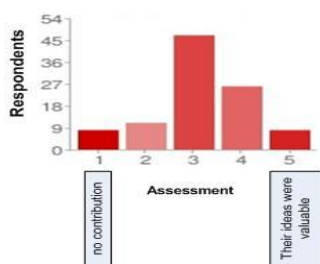


Figure 4. Students' evaluation of their contribution to their peers' theories

Group work also affected the students' activity and motivation. 62% (62) of the students confirm it by stating that they liked their peers' contribution to their ideas. 36% (36) enjoyed evaluating their peers' performance whereas 24% (24) of students liked summarising their own and their group mates' ideas in a living theory.

As a result of communication, during the creation of living theory, e-learning environment acquired some features of a social network. Since students from various academic groups worked together, they were often unacquainted. 28% (28) of students met their group mates in person and discussed the tasks to be performed.

Group work also caused some problems. 23% (23) of students struggled to understand what their peers had meant in their theories whereas 34% (34) found it difficult to complement their colleagues' ideas. Psychological factors are also important. 30% (30) admit that they were afraid to harm their peers with their ideas and were concerned it would affect their group mates' final mark (although it had been stated before that this would not happen).

Analysis of the creation of living theory across the seven groups of the first cycle reveals that no explicit leaders appeared within the groups who would assume the leadership of the group as it usually happens during class work. Nevertheless, mutual influence is highly pronounced in e-learning environment: if someone from the group does the task on a high level, others will presumably try to follow the lead and be like him/her. The situation is similar with discursive opinions – if a group member expresses many discursive opinions, an extended discourse develops within the group. Thus in three out of seven groups at

least 80% (4) of students performed more than 90% (11) of the procedures (the latter include filling in the form, commenting a group mate's opinion on one issue, summarising the opinions in a living theory; the maximum number of procedures in the first cycle is 12). The quality of acquisition in such groups was considerably higher than in others.

Similar mutual influence was observed in some of the groups with poorer performance, yet it was not as pronounced as in those described above. In group work, students depend on each other's performance. Thus, a student we shall call Liene writes: "It would be nice if the tempo of my work were not so much dependant on the diligence of other people; I mean, I had to wait until others evaluated my work".

Since students had to perform several procedures in each knowledge acquisition cycle (up to 12 in the first cycle) and repeatedly access the shared group document (at least four times during each cycle), students' activity plays the crucial role in knowledge acquisition. One of the motivating factors is communication with the tutor. It comprises a 30-minute introduction during a class lecture before each cycle, motivational letters in cases when activity plummets, the tutor's commentaries in the shared document about the mid-cycle performance and corrections to the living theory at the end of each cycle, as well as evaluation of the students' performance. Figure 5 illustrates how motivational letters affected the students' activity in the first acquisition cycle.

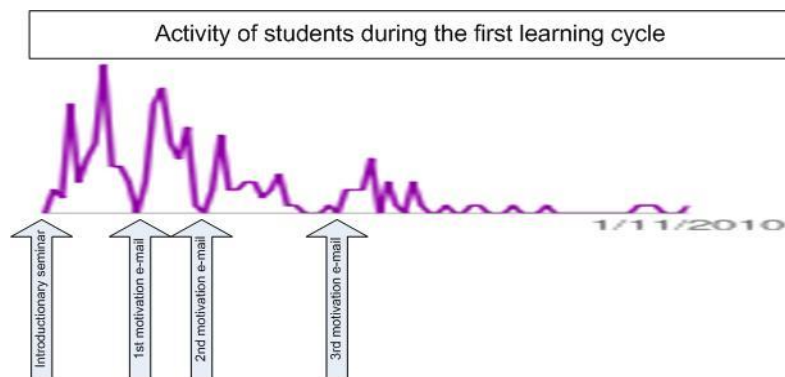


Figure 5. Influence of motivational letters on students' activity in the first acquisition cycle

The students also used the chance to ask questions via e-mail, which were answered as soon as possible.

In the final questionnaire, the students evaluated their communication with the tutor, and 25% (25) estimated it as very good (the maximum score on a five-point scale). 52% (52) of students awarded it four points, 19% (19) – three points whereas 4% (4) only gave two points. None of the students regarded communication as insufficient. Figure 6 depicts the students' opinions on what they gained from communication with the tutor.

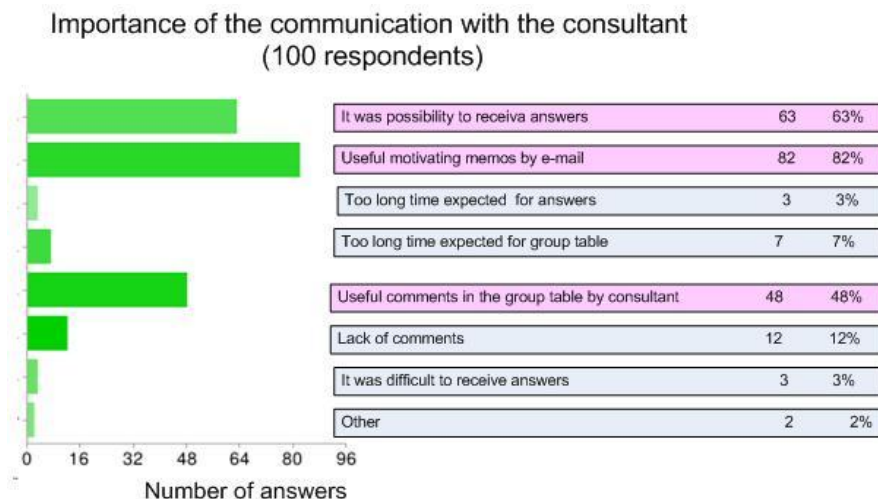


Figure 6. Students' opinion about the importance of communication with their tutor

Following the termination of the course, the students were given an opportunity to comment on their impressions from the method of educational action research as well as propose suggestions for improving it. The majority enjoyed creating knowledge with this innovative method. Anna writes: "I find this method very progressive; it should be popularised and widely used because it permits to find out other people's opinions, which is very important since, by learning more about people's views, we can objectively judge our own ideas and quickly make a summary. I generally did well; my group mates' opinions helped a lot." 93% (93) of the students believe the method should be used in other study courses.

A turning point in the qualitative analysis of data was the identified need to introduce the concept of *prototype*. The student-generated comments suggested the presence of some prototypes with distinct inherent features in the students' *lived experiences*. In Google Docs texts where the students complemented their peers' ideas on conditions for successful running of their businesses it was perceived that the students' living theories were constructed around prototypes with specific innate features. Some students' writings were analysed in the first knowledge acquisition cycle where they evaluated each others' business ideas in terms of expected income and expense, target group of buyers, market segmentation, price planning policy and expected financial flow.

Here are some examples. For instance, student Eve adds to student Armand's idea about the formation of expense. She believes that Armand will need to make several purchases which will significantly increase the price of the end product. Armand includes this idea in his living theory as a feature of the prototype of target buyer "buyer's solvency" which, in its turn, leads to an identification of a target buyer – prototype "middle class" (Table 1).

The business idea of another student, Christine, is selling multimedia navigation blocks for cars. Her living theory includes prototypes whose features were derived from complementary discourse generated by her fellow students Peter and Mark. Mark believes that older people will not be among target customers due to their being more conservative and likely to select car accessories that are easier to use. Christine transforms this discourse into a prototype feature “attitude towards new technologies” and, consequently, in her living theory she does not include senior customers who are not supportive of new technologies in her target group of buyers.

Student Eugene complements group discourse with his suggestion: it is important that a new business idea is not only profitable, but also does some good to the world. Accordingly, student Christine identifies reputation as a prototype feature of a business’s sustainability and includes the prototype “securing the company reputation” into her living theory. Not all students’ contributions to discourse eventually transform into prototypes. Thus, student Inga’s business idea about selling a high-quality detailed interactive map does not result in a prototype about extra expense incurred from purchasing or designing the map – a piece of discourse contributed by Paul.

Table 2 contains some other examples of prototype formation which occurred on the grounds of discourse generated from lived experience.

Table 2. Transformation of the discourse generated from students’ lived experiences into prototype features and corresponding prototypes in EAR

Discourse	Prototype feature	Prototype in the living theory
Great expense from different purchases	Buyer’s solvency	Target buyer – middle class
Older people will not be among target customers due to their being more conservative and likely to select car accessories that are easier to use	Attitude towards new technologies	Target group does not include senior customers not supportive of new technologies
The suggested price must be higher than the loss-threshold	Mean price	Finding mean price to be increased or reduced accordingly
The business idea will be implemented and will benefit the world; one cannot always focus business exclusively on profit	Reputation	Securing company reputation
You will need to attract customers and surpass all leading business in your sphere. Good luck to you :)	Advertising	Focus on advertising the product

An analysis of students’ discussion and living theories suggests that in many cases they transform discourse into prototype features and prototypes. These prototypes, in their turn, become the grounds for living theories about the specific problems related to their business ideas.

Discussion and implications for further studies

The present study explores a way of organising discussion in a technologically grounded learning environment and thus sustaining conditions for reflexive creation of personally meaningful living theory. The making of living theory is a creative process compatible with endeavours to develop a knowledge society by integrating ICT in the learning process, personalizing knowledge, fostering creativity and facilitating research skills.

The study confirms the importance of learning environment in the educational process and ascertains the correspondence of the e-learning environment used in educational action research to Dewey's (1916) perception of a sound learning environment. It enables tracing students' cooperation and reflection without assuming excessive control of their work. E-learning consultant's presence emerges as a motivating factor in the study. The consultant follows reflection as it unfolds in the e-learning environment and affects the students through this environment. This relationship derives specific implications for the personalisation of environment. Environment stimulates meaningful growth which, in the present context, entails an improved understanding of business processes in different situations. In this study, the environment was shaped according to Dewey's criteria. Growth was the result of reflection as students became engaged in discussion and interactively pursued their personal educational aims.

Such developments correspond to education for sustainable development. Demand for a high skilled workforce will increase (it has been estimated that from 2006 to 2015 the demand for high skilled specialists will rise by 2.4 % (12.5 million jobs from 2008) while the demand for medium skilled specialists will increase by 1.0 % whereas a decrease in demand by 1.9% is expected with regards to low skilled workforce) (Cedefop, 2008). The qualification level of high skilled specialists corresponds to ISCED (International Standard Classification of Education) level 5 and ISCED level 6. These levels require profound theoretical knowledge and research skills based on innovative and creative thinking and theoretical and practical know-how.

Educational action research sets high demands for e-learning environment and demands its improvement. The *Google Docs* infrastructure used in the present study ensures the functionality that is necessary for educational action research. At the same time, it has a number of shortcomings in interface design, such as insufficient personalisation and an uncomfortable layout in a *Google Docs* spreadsheet. Upgrading user-friendliness and personalisation are two key directions for future studies of interface design.

Educational action research highlighted several novel considerations which can be developed in educational philosophy and pedagogy and become the grounds for development of e-learning theory. One of such issues which can contribute to advances in both theory and practice is using the potential of action research as an e-learning environment for autonomous learning in terms of both individual work and group work. In a knowledge society such learning environment can serve to develop valuable habits of mind.

The study uncovered the compatibility of living theory and prototype theory. Careful scrutiny of the opportunities afforded by both these theories can result in a set of suggestions to be qualitatively analysed by action researchers. For researcher can find the transformation process from lived experience to prototypes to living theory challenging as it is

not easy to separate these phenomena. A blurring of boundaries and an overlapping of features in this transformation is a complex, adaptive and evolutionary process on the one hand and a development of a virtuous habit of mind on the other hand, greatly affected by the quality of e-learning environment.

Action research permitted to identify new research directions for a broader use of the proposed innovative method:

- Integration of action research approach in various study courses, including science, social sciences and the humanities.
- Behavioural studies of students in e-learning environment with an aim to render this kind of work more effective.
- Dynamics of students' interest while acquiring personal knowledge through creation of living theory in a group in e-learning environment.
- Possibilities for diagnosing and developing cognitive and metacognitive skills by integrating action research approach with e-learning methods.
- Improving the design of e-learning environment so that learners feel comfortable and teachers can fully contribute their intellectual resources to communication about the studied topic instead of organising the groups and addressing the technological issues.

Conclusions

So far, no attempts have been described to use action research by integrating the living theory method for creation of personal knowledge in groups within e-learning study courses. Project-based knowledge creation and acquisition can be organised in a group by using the methodology of action research in e-learning environment. Since the method is oriented towards cooperation, such software opportunities should be used that permit to access other opinions and complement them with one's personal experience, thus creating discourse and comparing experiences. *Google Docs* environment is appropriate for group work and formulation of living theory. This way, it is possible to create personally significant knowledge.

Action research demonstrates that this method considerably improves students' motivation, interest and activity in acquisition of the study course. The quality of the acquired knowledge increases noticeably as many students master the skill of expressing and substantiating discursive opinions as well as the courage to do so. Nevertheless, the students' activity tends to decrease with each consecutive cycle.

The study highlights the crucial role of communication in motivating students and sustaining their activity throughout the entire period of knowledge creation. Within this method, communication in group exhibits some features of a social network. While working in groups, students affect the quality of each other's work, yet no leaders appear. Tutor's interest is significant for enhancing students' motivation. Corrections to students' ideas should only be added at the end of each acquisition cycle.

This method can be used for acquisition of various study courses. Yet, it requires additional research and perfection of technological solutions.

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TEACHER EDUCATION FOR SUSTAINABILITY IN NETWORK SOCIETY: COMBINING DIGITAL AND SUSTAINABILITY LITERACIES

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Abstract

How should teacher education for sustainability (TEfS) respond to new information and communication technologies that can enable new forms of social and environmental relations and new forms of pedagogy? To answer that question, this article will consider the potential of Web 2.0 technologies or social media to enrich the content and pedagogy of education for sustainable development (ESD) in both university and school classrooms. It will suggest that teachers should be introduced to critical social theory that seeks to explain the role of these new technologies in the recent wave of capitalist development that precipitated economic and ecological crisis, and their potential to bring about more sustainable alternatives. Such alternatives will be based on more radical and deliberative forms of democracy and citizenship enabled by the new technologies, and TEfS should equip teachers to explore these through appropriate forms of citizenship education and model them in their classrooms via new forms of critical pedagogy. Such ideas as those of Erik Olin Wright on real utopias and Manuel Castells on network society provide such TEfS with appropriate theory, while consideration of how You Tube videos might be used to develop critical digital and sustainability literacies in the classroom, illustrates how such theory might be related to practice.

Key words: *teacher education for sustainability, education for sustainable development, network society*

New technologies, neoliberal capitalism and unsustainable development

All teachers who claim to educate for sustainability should have a critical grasp of the structures and processes shaping the development and underdevelopment of the societies in which they teach. TEfS should help them to understand that information and communication technologies linked to the internet enabled, but did not cause, the neoliberal regime of capital accumulation that began in the late 1970s and ended with the financial crisis of 2007/8. This neo-liberal era was characterised by deregulation; privatisation; the privileg-

ing of corporate power; ultra-mobile capital; globalisation; outsourcing; imperialist militarism in Iraq and Afghanistan; growing social inequality and unrest; and increased environmental degradation. Designed to restore the rates of return on capital and further shift power to economic and political elites, it used new technologies to speed up the circulation of capital (for example just in time delivery); introduce new consumer and financial products and services (personal computers, spread betting); intensify globalisation (global logistics networks); wage war (pilotless aircraft); control social unrest (video surveillance); maintain ideological control (new forms of popular entertainment and media); improve environmental management (remote sensing); and introduce new priorities to schooling (computer literacy). New technologies also provided new ways of engineering nature (biotechnology) and increasing the efficiency of resource use (waste free production) that are often represented as sustainable development.

That neo-liberalism failed to revive capital's fortunes and proved unsustainable is due to three factors: its inherent instability; the increasing cost of reproducing the conditions of production; and the falling demand for capital investment and workers due to technological change. Capitalism has an inbuilt tendency to grow to a state in which it cannot sell all it produces and capital must be scrapped before a new wave of accumulation can begin. In the recent neoliberal era in the West, capital accumulated as credit and property bubbles as bankers borrowed to speculate on increasingly complex financial products and households borrowed against rising property prices to maintain consumer lifestyles rendered less accessible by falling real wages. Capital was re-invested in property and financial bubbles to maintain economic growth but eventually sub-prime mortgages and complex financial products proved impossible to sell at their inflated values and the whole debt dependent regime collapsed (Harvey, 2010; De Santos et al, 2009). In Europe a one size fits all monetary policy reinforced mounting instability. Countries on the periphery had higher costs and lower productivity than those in the core, but a common interest rate allowed them to disguise their weaknesses by borrowing on the strength of inflated asset-prices and credit ratings. In the absence of controls on capital movement, trade surpluses generated in the core were recycled into Mediterranean property speculation: a situation echoed in the global imbalances between China and the West. When property and financial bubbles burst governments stood behind their banks, bailing them out at huge public cost. The result is a collapse in public investment, growing austerity, mounting social problems, and rising unemployment particularly amongst the young.

Europe's debt crisis is compounded by ecological debt as an accelerating treadmill of production and consumption has damaged or destroyed ecological resources and services often in other parts of the world. Capital finds it harder and more costly to reproduce the conditions of production (fertile soil, clean air and water, waste treatment, space free from pollution and congestion, healthy and suitably educated workers) and this is a further reason why recent growth has proved unsustainable (O'Connor, 1991). Capital is now seeking to shed the costs associated with reproducing the conditions of production by requiring citizens to pay for health care and education; by lobbying for further deregulation of the environment and land-use planning; and by further outsourcing production to countries with cheap resources and/or low environmental and welfare standards (Harvey, 2011). Teachers will recognise that the continuing restructuring of education is part of these developments

and is associated with the loss of professionalism and worsening conditions of service in many European states.

Technological change is the third factor contributing to neo-liberalism's failure to revive capital's fortunes. While capitalism currently requires 3% growth to absorb the constant supply of new capital created, there is a falling demand for capital investment and workers as less capital and labour are now needed to produce each unit of output (Schutt, 2010). As markets for some manufactured goods become saturated, consumer demand shifts to services that are less capital intensive. Web technologies deliver communication and media services at reducing cost to consumers and conventional suppliers of music, films, newspapers and postal services, find it increasingly difficult to make a profit. There is growing resistance to intellectual property rights, a growth of open-source products such as Linux and Wikipedia, and a readiness to use services such as eBay to buy used rather than new goods. While some take a positive view of Web 2.0's potential for business (Tapscott & Williams, 2008, 2010), the dot com boom and bust of 1995 – 2000 illustrates the uncertainty that ICT brings to financial markets and the associated threat to investor confidence. Economic instability is compounded by high levels of unemployment that increase the costs of welfare, further reduce demand, and pose issues for teachers seeking to motivate older school students.

Network society, the network state and networked individuals

Manuel Castells (2008) offers teachers a new way of understanding the societies created by neo-liberal capitalism and enabled by new technologies. He maintains that we live in a world marked by globalisation: the process that constitutes a social system with the capacity to work as a single unit on a planetary scale in real or chosen time. ICT, including rapid transportation and computer networks, gives the system the technological capacity to selectively connect anyone and anything to global networks that structure the planet and through which flow people, energy, materials, and information. All the world's core economic, communicative and cultural activities have become dependent on strategic nodes in these networks that include global financial markets; global production and distribution of goods and services; international trade; global networks of science and technology; global media; and global interactive networks of communication.

Critical issues facing people and governments around the world, such as the need for more sustainable forms of development, are largely produced and shaped by interdependent global processes that move beyond the realm of supposedly sovereign states. The power of the state is challenged by that of transnational corporations and undermined by agents within global civil society that seek alternative forms of global governance. As politics shifts to the global arena, the nation state is the source of four distinct but interrelated political crises:

- **Crisis of efficiency.** Problems such as climate change or regulation of financial markets cannot be adequately managed.

- **Crisis of legitimacy.** Governments that are less efficient lose their legitimacy and support from citizens. In network society the media become the essential space of politics and its resulting simplification to images, personalities, sound bites, scandal and spin, has deepened the crisis of legitimacy. Many see politicians as self-interested, corrupt, and irrelevant to their lives.
- **Crisis of identity.** As people lose faith in their political identity as citizens, they seek autonomy in forms of resistance identity and cultural identity politics.
- **Crisis of equity.** Neo-liberalism and globalisation increase inequality within and between countries and social groups. Welfare states are undermined in the absence of a global regulatory environment.

The increasing inability of nation states to confront and manage such issues as the need for sustainable development leads to ad-hoc forms of global governance and ultimately to a new form of state. Nation states (comprising governments, parliaments, political party system, judiciary, and state bureaucracy) transform themselves by three main mechanisms:

- States associate with each other forming networks of states. For example the European Union, NAFTA.
- States build an increasingly dense network of international institutions and supra-national organisations to deal with global issues. For example the UN, IMF, NATO, UNEP.
- States decentralise power and resources in an effort to increase legitimacy and/or to tap into other forms of cultural or political allegiance. For example the Welsh Assembly in the UK.

From this three pronged process emerges a new form of state, **the network state**. As it practices global governance through ad-hoc networks it confronts major problems arising from the contradiction between the historically constructed nature of the institutions that come into the network and the new functions and mechanisms they have to assume to perform in the network while still relating to their nation bound societies. Co-ordination, ideological and geopolitical problems arise because the network state finds it difficult to co-ordinate decision-making and policy across many issues and agencies at many scales; to find common language, principles and values to underpin governance in such policy areas as sustainable development; and to abandon the old geopolitics based on the interests of nation states for a new culture of global co-operation. These contradictions can only be overcome if the world's geopolitical actors allow the evolution of the network state into a system of constitutionally accepted networked global governance or cosmopolitan democracy with associated forms of citizenship (Held, 1995, Ferry, 2011).

A key component of network society is the global/local media system made up of oligopolistic multimedia businesses controlling the mass media and an increasingly inclusive hypertext; a multitude of horizontal networks of autonomous local/global communication; and the interactions between the two systems that form a complex pattern of connections

and disconnections. Web 2.0 technology now allows mass self-communication or networks that join many-to-many in the sending and receiving of messages that bypass the mass media and generally escape government control. The logic embedded in such networks supports a major change in sociability as **networked individuals** build identities, contacts, and outlooks from the resources on offer according to their needs and moods. Since the scope of network society is both global and local ('glocal') such individuals are no longer tied to particular times and places. ICT enables the coordinates of our everyday lives to be transcended so that we can enter virtual times and places (computer games) and simultaneously perceive, think and act in both local and global terms (we buy fair traded goods locally to support banana growers who we have learnt about on the internet). Networked individuals may simply escape into the social networks and virtual worlds that ICT offers, or they may become 'netizens' seeking more comprehensive and effective forms of global governance. Clearly developments in the theory and practice of ESD and TEfS are needed to acknowledge the rise of network society, the nature of students as networked individuals, and the changing form of cultural power.

Power in network society

Castells (2011a) argues that power in network society is exercised through the construction of meaning and the hold of communications and media networks over the minds of people. Changes in social communication and sociability enabled by ICT allow a greater diversity of messages and meanings to reach wider audiences, but the communication and construction of meaning is still shaped by four different kinds of power:

- *Networking power: the power of actors and organisations who control networks to include/exclude individuals and groups (the power of editors at BBC News to decide who is interviewed about an issue relating to sustainable development);*
- Network power: the power that results from the standards or rules or inclusion built into the network that guide and co-ordinate social interaction. (the stated and hidden rules that need to be followed to work in or with the World Trade Organisation);
- Networked power: the power of actors over other actors in the network (the power of a moderator to edit or censor a contribution to a web based discussion such as the Great Northern Debate);
- Network-making power: the power to programme specific networks according to the interests and values of the programmers, and the power to link/delink different networks following alliances/falling out between the dominant actors of those networks (the power to decide what links appear on ESD websites).

While all these forms of power shape people's understanding of the world, Castells considers network-making power to be the ultimate form of power. Recent events surrounding News International and its links with politicians and the police in the UK (the phone-hacking scandal) or the revelations concerning the privileged access given to the Interna-

tional Institute of Finance (a lobby group for 450 of the biggest banks in the world) to EU talks on Greece's future, illustrate the close links between networks of financial, corporate and political power and the media networks that represent their interests. Meanwhile the web as a source of individual empowerment is under threat from corporations seeking to corral users into marketable segments (the 'walled gardens' created by Facebook and Apple) and from state power seeking control and censorship (China's great firewall). Laws are needed to protect our privacy and rights to speak and assemble in cyberspace and Iceland's Modern Media Initiative provides a model of what is possible. Morozov (2011) and Mason (2012) adopt pessimistic and optimistic views on whether the internet will spread democracy around the world and it is to the role of new technologies in enabling democratization that we now turn.

New technologies, green socialism and sustainable development

It is now several decades since the writings of Ivan Illich and Andre Gorz warned us of the dangers of 'technofacism' in modern societies and argued the case for appropriate technology that liberates rather than enslaves citizens. Gorz (1980) saw ecology not as an end in itself but as an essential part of the larger struggle against capitalism that is able to adapt to ecological constraints. The main goal should be an economic, social and cultural revolution that abolishes capitalism and establishes new sustainable relationships between the individual and society, and between people and nature. For Gorz the key to such a society lay in the potential of ICT to free people from work (through automation) so that they have time to manage their own affairs and develop civil society to such an extent that the state's role is simply that of spreading knowledge, equipping citizens for self management, and coordinating self-managing local communities from above. In 1980 he sketched a future France, with a 20 hour working week, a lively odd-job sector, a basic citizens' income paid at a flat rate to all irrespective of their employment status or income, environmentally sound forms of production and consumption, and a cultural life that encouraged the development of rich, all-round personalities.

Gorz's ideas were taken up and developed by post-industrial and green socialists (Pepper, 1993, Little, 1998, Foster et al, 2010) who realized that the key to sustainability is the social control of capital to direct it into socially useful production and the social control of technology to ensure it is used in socially responsible ways. While these writers and others envisioned future utopias, green socialism has lacked a theory of transition or ways in which its utopias might be realised. Wright (2010) fills this gap by suggesting that socialists should adopt a 'flexible strategic pluralism' in the ways they approach the transition. This should be guided by a greater realism regarding economic systems; the multiple pathways they offer for increasing social power; and the advantages and disadvantages of three logics of transformation.

Wright begins from the premise that socialism (democratic power over the allocation and use of productive resources) requires the radical democratization of all arenas of power (the state, economy, civil society) with power rooted in civil society (social power) controlling both state and economic power. Since all economic systems (national economies,

firms, etc) are complex configurations of capitalist, statist and socialist elements, transformation should not be envisioned as a binary shift from one form of power to another, but a shift in the configuration of power relations that constitute economic hybrids. There are multiple institutional forms through which social power can be increased and Wright identifies a pluralist model of socialism that offers seven different kinds of pathway for democratising power (statist socialism; social democratic economic regulation; associational democracy; social capitalism; social economy; cooperative market economy; and participatory socialism). These pathways allow different specific real utopian innovations with regard to democratising the state (he explores, for example, municipal participatory budgeting, egalitarian public financing of electoral campaigns, random selection citizen's assemblies) and economy (Wikipedia, the Quebec social economy for childcare and eldercare; unconditional basic income, solidarity funds, share-levy wage-earner funds, the Mondragon co-op, and participatory economics). There are multiple strategic logics through which such innovative institutions can be constructed and advanced: ruptural (creating new institutions of empowerment through a sharp break with existing institutions and social structures); interstitial (building new forms of social empowerment in the niches and margins of capitalist society); and symbiotic (extending and deepening the institutional forms of popular social empowerment while at the same time helping solve certain problems faced by dominant classes and elites). Occupy Athens is an example of ruptural logic; the barter system in Volos, using local currency, is an example of interstitial logic, while the green left's advocacy of a green new deal for Europe might be considered an example of symbiotic logic.

Like Harvey's theory of co-revolutionary change (Harvey, 2010) Wright's theory of transformation requires that we abandon Marx's strong theory of the inevitable demise of capitalism. Both require us to recognise multiple pathways, agents, and logics, to accept strategic indeterminacy, and to continually test and retest the limits of possibility as we act and learn our way to sustainability. Wright provides a summary of the likely changes, most if not all of them enabled by new technologies:

Unconditional basic income frees up time for social economy participation. Share-levy wage-earner funds and solidarity funds enhance the capacity of unions and other associations to control firms and investments. Worker-owned cooperatives are revitalized by new information technologies which make cooperation among cooperatives easier, and new cooperative market infrastructures are developed which buffer producer cooperatives from destructive market pressures. Direct state involvement in the economy is combined with new forms of associational participation which improve the efficiency and accountability of state enterprises. Participatory budgeting diffuses across a wide range of cities and extends to new domains of government spending. And entirely new institutions as yet unforeseen are invented to push forward social empowerment in new ways. (Wright, 2010, p. 373).

If social empowerment is the key to green socialism and sustainability, then it is vital that the web remains a source of empowerment so that groups within civil society are able to use social media to debate and promote radical social alternatives. Such tools enable online

activism (Hill, 2010) and deliberative democracy (Chadwick, 2009, Baber & Bartlett, 2005, Williamson, 2011) that can balance the interests of nature and future generations alongside current human interests and allows citizens to develop the kind of outlook that underpins ecological, cosmopolitan and global citizenship (Huckle, 2008). Such democracy is based on a set of core propositions: political equality of participants; interpersonal reasoning as the guiding political procedure; and the public giving, weighing, acceptance, or rejection of reasons. These also underpin the critical social theory of Habermas (Horster, 1992) that explains why deliberative democracy is needed to prevent science and technology serving minority interests and how the views of citizens might be moved toward a reasoned consensus on their application based on sound argument and reliable evidence. Since science and technology can only know nature in instrumental terms, they should be constantly weighed against other knowledge when applied to sustainable development. Such knowledge includes critical political ecology that is alert to the social construction of all knowledge, supposedly neutral explanations of ecological reality, and multiple discourses of sustainable development. Citizens can arrive at ecologically rational decisions provided they consider a wide range of knowledge and values covering what is technically possible, culturally appropriate, and morally and politically just. This assumption underpins critical pedagogy (eco-pedagogy) in ESD (Huckle, 1996; Kahn, 2008) and TEfS should introduce such pedagogy and demonstrate how it can be enriched by such ideas as those of Castells, Wright, Gorz, Harvey and others.

Network society, global civil society and green socialism

In network society the public sphere or space for debate on public affairs, shifts from the local to the global and is increasingly constructed around global communication networks. This space is occupied by a global civil society that has arisen due to the decreased ability of nationally based political systems to manage the world's problems. It structures and channels citizen debates over such issues as sustainable development towards the networked state and consists of a variety of social interests including transnational business; world religions; public intellectuals; and individuals and organisations promoting diverse models and discourses of sustainable development and global democracy. Castells (2008) recognises four different kinds of organisation within global civil society which overlap in their efforts as they engage with the pathways and logics that Wright outlines, innovate with institutions, and shape debate and policy on sustainable development:

- **Local civil society actors defending local interests.** For example labour unions defending local jobs against outsourcing or local fishermen protesting against foreign owned factory ships.
- **Nongovernmental organisations with a global frame of reference.** For example Greenpeace, Oxfam or the Business Council for Sustainable Development.

- **Social movements that aim to control the process of globalisation.** For example the Zapatistas defending Mexicans against NAFTA; the anti-globalisation movement;
- **Movements seeking to shift public opinion that use the media system and horizontal, autonomous networks of communication.** For example UK Uncut protest against tax avoidance; Occupy Wall Street; Adbusters.

Castells addressed Occupy London (Castells, 2011b) and analysed it in a subsequent lecture in Cambridge (Castells, 2011c). He regards its use of ICT and media to win wide support and introduce alternative ideas to a wider public as being critical elements in its success. While the mainstream media depicted it as marginal, unlawful, and over, it experimented with participatory planning and deliberative democracy and was inspired by utopias including those associated with green socialism. Determined to make the case that bankers should pay for the crisis they had caused, and that politicians no longer represented citizens, the worldwide Occupy movement demonstrated that social change begins in people's minds and develops as they build networks and challenge network making power. (Gessen et al, 2012).

Sustainability, critical and digital literacies

Having outlined how TEfS might explore the role of ICT in enabling an unsustainable neo-liberal capitalism and its potential role in the transition to a more sustainable green socialism, I now intend to link ESD and TEfS to critical and digital literacies. Luke and Woods (2009) review approaches to critical literacy that might be introduced within TEfS and suggest that it involves engagement with the major texts, discourses and modes of information in a culture. Critical literacy attempts to attend to the ideological and hegemonic function of texts and critical pedagogy is one means by which these are revealed. While critical literacy and pedagogy are underpinned by a variety of philosophical assumptions and pedagogical emphases that Luke and Woods survey (including those based on Habermas' critical theories) they share a commitment to the use of literacy for purposes of equity, social justice, and sustainability. "They aim for nothing less than readers, writers, listeners and viewers who have a cogent, articulated and relevant understanding of texts, their techniques, their investments and their consequences, and who are able to use these understandings and capacities to act mindfully and justly to change their worlds" (Luke & Woods, p. 9).

Lankshear and Knobel (2008) review the different meanings of digital literacy that have accumulated over recent years and distinguish between technical or instrumental forms that list specific skills and technique (computer literacy) and critical forms that emphasize mastery of ideas and insist on careful evaluation of information and intelligent analysis and synthesis (media literacy). Critical approaches focus on the cognitive and socio-emotional aspects of working in digital environments where information is multimediated and the networked individual has to be skilled at deciphering complex images and sounds as well as the syntactical subtleties of words. They encompass the ability to understand and use information in multiple forms from a variety of sources when it is presented

via digital codification: blogs, video games, text messages, online social network pages, discussion forums, internet memes, FAQs, online search results, and so on.

Unfortunately a 'digital divide' is opening up between home and school:

... we are witnessing a widening gap between the culture of the school and the culture of children's lives outside school. In their leisure time, children are encouraged to see themselves as active participants, navigating their way independently through complex multimedia environments. Yet in school they are expected to submit to a pedagogic regime that is fundamentally premised on the testing of decontextualized skills and knowledge. By and large the use of information and communication technology in school signally fails to engage with the ways in which young people are now relating to information, and with the ways they choose to communicate (Buckingham, 2007, p. 178).

Digital technologies suggest a radical new way of learning (connective learning, Siemens, 2004) and the need to change curriculum and pedagogy (Collins & Halverson, 2009, Joun-eau-Sion & Sanchez, 2011). Pass and Creech (2008), Tella and Adu (2009) and Blewitt (2006) have reviewed the opportunities and challenges that ICT provides for ESD more generally, while Cifuentes et al (2011) have examined the role of Web 2.0 technologies in the related field of global citizenship education. It is my intention to maintain a focus on critical literacy and pedagogy, and following Lambert and Morgan's argument regarding ICT and geography teaching (Lambert & Morgan, 2010, p. 160), what is needed is not merely a 'tech-savvy' approach that capitalizes on the interactivity of Web 2.0 to enliven ESD (You Tube rather than PowerPoint presentations, blogs rather than essays, teachers and students contributing to wikis), but an approach that sees all knowledge relating to sustainable development as being socially constructed and provides students with opportunities to reflect and act the kind of ideas outlined in the earlier sections of this paper as mediated by digital technology. Such learning would develop sustainability literacy (their ability to read the symptoms and causes of unsustainable development and write more sustainable futures) whilst also contributing to political literacy and the development of identity. Clearly this has wide implications for TEfS requiring course of initial and continuing professional development to apply relevant theory to the development of critical pedagogy that seeks both digital and sustainability literacy.

In such merging of critical sustainability and digital literacies TEfS should follow Buckingham (2009, 2012) by approaching media not as technologies but as cultural forms that represent the world and communicate ideas. It should acknowledge that bias in unavoidable, that information relating to sustainable development is inevitably shaped by discourse and ideology, and that in network society media texts play a key role in the politics of sustainable development and are shaped by, and in turn shape, the kind of network power that Castells outlines. Buckingham (2008) suggests how four key concepts central to media education (representation, language, production, and audience) can be applied to the analysis of websites and the key questions he uses are equally relevant to other texts communicated via social media. He argues that media production should accompany media analysis

as a means of developing media/digital literacy and this may involve blogging, social networking, game making, or small-scale video production. The aim is for teachers and students to understand how the media work, how meaning is created, who has the power, and how that power can be challenged.

Mocigemba (2008) presents three theses and anti-theses relating to podcasting and sustainable development that can be applied to social media more generally (Figure 1). TEfS and ESD linked to digital literacy should encourage teachers and students to evaluate these as they encounter and produce a variety of texts. Figure 1 also provide a starting point for us to consider whether the above ideas already outlined can be put into practice.

From theory to practice, You Tube in the ESD classroom

After outlining the role of social media in providing a new space for civic engagement and linking this to Habermas' notion of communicative rationality, Kellner and Gooyang (Kellner & Gooyang, 2009; Gooyang, 2009) consider the potential and limitations of You Tube to empower young citizens. While You Tube is embedded in capitalist social relations (owned by Google) and can be considered 'another play-pen in the capitalist fun house' or a medium dominated by self-expression, narcissism, silliness and entertainment, mainly used by relatively rich, white male English speakers, Kellner and Gooyang suggest that linked to a critical media pedagogy it offers some potential as a 'reservoir of true enlightenment'. You Tube allows individuals to 'organise and deploy novel strategies of self-education and social transformation'; can be seen as a 'dialogical learning community'; and by allowing users to post videos and opinions it provides opportunities for them to exhibit personal autonomy and active and critical citizenship. In this way it extends and democratises civil society.

The hopes and fears raised by Mocigemba, and Kellner and Gooyang, can be tested as part of TEfS, by examining the potential of You Tube to stimulate learning and communication around the central ideas outlined in this article. Do You Tube videos address alternative development paths for Europe including more sustainable paths linked to socialism and the radical democratisation of European society? Do they address Wright's ideas on the multiple pathways and logics shaping the prospects for change and Castells' ideas about network society? Are they likely to appeal to students in classrooms, provide an extended forum for debate and discussion, and a rich medium for critical media pedagogy?

To begin to answer these questions I searched for relevant videos on You Tube, selected nine that are listed in the table below (Figure 2), and noted related statistics on how many times they had been viewed and how many comments and expressions of like/dislike they had attracted.

With reference to Mocigemba's three theses/anti-theses, we can note that while there is relevant content on You Tube it is not attracting large audiences and there is a lack of related comment and debate. The video statistics facility shows the location and gender of an audience that is generally located in Europe and male. Developing any sort of unified narrative on sustainable development from the vast array of videos on offer requires prior knowledge of sustainability politics and skilled use of search terms. The ratio of likes to

dislikes suggests that the videos are viewed by those already sympathetic to the arguments presented and by following links to organisations that uploaded the videos, the viewer may gain access to networks that aid their ongoing search for political and personal identity.

Turning to Wright's and Castells' ideas, there is clearly a need for teachers to approach YouTube with these in mind as they provide relevant search terms and criteria for evaluating videos for classroom use. There is sufficient on YouTube to illustrate their ideas but also evidence that this is as yet not a key medium for learning about and debating radical social change. Once selected by the teacher or the students, YouTube videos can aid the development of political literacy and sustainability citizenship, but this will require a fair amount of conventional teaching and learning if the videos are to be interpreted in ways associated with critical media literacy..

Searching YouTube suggests that few schools are uploading videos on sustainability topics and that those that are uploaded mainly focus on sustainable schooling. Teachers' concerns about e-safety may explain this lack of engagement as may the relatively high level of sustainability literacy needed to comprehend much of the material uploaded to YouTube. The medium has potential but as yet its significance for ESD in the lives of school students pails into insignificance compared with its use for entertainment and distraction from real world issues.

And the present challenge?

As I write in late April 2012 it is clear that Europe's networked state is not working. An austerity programme that diminishes sovereignty, consigns youth to high levels of unemployment, and steers Europe towards a decade of stagnation, is destroying the social solidarity on which the European Union depends. Some citizens continue to demand the radical democratisation of Europe that would sweep away the existing neoliberal treaties of the EU, establish a new framework for economic integration and political union, redistribute wealth, and employ ecological planning to recover from capitalist crisis. This paper has argued that their arguments should feature in TEfS and ESD along with those that are more reformist and conservative. The critical understanding and use of social media should become a key element of TEfS but teacher educators will need to be realistic about what such media currently offer.

<p>Web 2.0 media can open up debate on SD by:</p> <ul style="list-style-type: none"> Turning lecture into debate Lowering entry barriers to discourse Turning passive governance into a deliberative process Increasing civic engagement and political participation particularly amongst the young Tailoring messages to specific audiences who can receive them free of space/time/cost constraints Expressing minority views and placing new issues on the agenda Encouraging active searching, selecting, and responding (learning) 	<p>Opening the debate on SD via Web 2.0 media is only a theoretical possibility because:</p> <ul style="list-style-type: none"> Audiences may be small or non-existent (but any audience worthwhile) Communication may not stimulate genuine dialogue (need for online leadership/moderators) Online participation in debates on SD topics appeals mainly to those already familiar with the blogosphere Talk does not necessarily lead to action Attention slips from the public to the private sphere as with mobile phones People enjoy their passivity and retreat into pri-
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vacy	
<p>Web 2.0 media can enforce a culture and lifestyle of SD by:</p> <p>Overcoming the immunization, ignorance and rejection prompted by threatening, moralizing and patronizing environmental communication</p> <p>Emphasising solutions, inducing positive emotions, and mentioning additional immaterial benefits</p> <p>Associating SD with popular media brands like You Tube ('The medium is the message')</p> <p>Using user generated content to increase identification with sustainability values and overcome suspicion of manipulation/propaganda</p> <p>Providing unifying narratives for groups sympathetic to SD, labelled cultural creatives or post materialists</p>	<p>Web 2.0 media will have little effect outside cyberspace because:</p> <p>Audience is low and messages have little social and cultural impact (no mass self communication a reality)</p> <p>Cultural creatives may be further divided by digital creatives and their diverse messages</p> <p>They will reinforce the digital divide, many have no access or lack media literacy</p>
<p>Web 2.0 is a useful tool for the existing SD community because:</p> <p>It is a way to create synergy and use network power to attract public attention</p> <p>It can reduce dependence on established media and journalists by bypassing, critiquing and correcting them (citizen journalists)</p> <p>Its use raises the reputation of the SD community</p>	<p>Web 2.0 is dangerous for the established SD community because:</p> <p>Citizen journalists may understand SD less well than traditional journalists</p> <p>Consideration of SD becomes dependent on media literacy and an affinity with ICT</p> <p>Copyright hinders translation of traditional media materials dealing with SD</p> <p>Its use threatens the reputation of the SD community</p>

Figure 1. Web 2.0 (social media) and sustainable development (SD): Based on Mocigemba (2008)

Title	Date uploaded	Uploaded by	Viewed by	Comments	Likes / dislikes
European Green Party spokesperson Phillippe Lamberts MEP on the Spanish Protests	30/05/2011	European Green Party	58	0	2/0
Susan George – Green New Deal	06/09/2011	attactv	2673	1	18/1
Participatory budgeting comes to Kensington	24/10/2011	Dorablount	308	0	0/0
The story of We the Citizens (Citizens Assembly, Ireland)	09.12.2011	wethecitizenVideo	79	0	1/0
Greek Town develops bartering system without Euros	04/12/2012	LeakSource2012	15248	28	162/0
Coops can work – Mondragon Coop 1	01/11/2011	FreeTheWorker	278	0	1/0
Occupy Athens	06/10/2011	Redandblack540	691	3	7/1
Manuel Castells at Occupy London	26/11/2011	VoicingTheCity	958	0	4/0
The Icelandic Modern Media Initiative	20/05/11	corbettreport	2326	6	62/1

Figure 2. Nine You Tube Videos relevant to debate on sustainable development in Europe (Viewed and statistics recorded on 25/04/12)

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494)). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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PEDAGOGY, PLACES AND PEOPLE

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Abstract

The paper will explore the potential of new technologies in helping educators to play an active role in creating and promoting the learning that is needed for local and global communities to live sustainably. In particular it will examine the potential of the virtual world to develop local and global communities for transformative learning for sustainable development. It is organised into three sections:

- 1. The need for new ways of knowing, learning and understanding*
- 2. The challenges and opportunities of the virtual world*
- 3. The role of virtual learning communities in ESD*
- 4. RCEs as a mobilising mechanism*

Faced with the major challenges of climate change, environmental degradation, poverty and social inequality it is clear that learning to live sustainably has never been more urgent. The credit crunch has thrown these into sharp relief and provided an opportunity to take stock of our current ways of organising the world economy which have led us to this unsustainable impasse. We are faced with a critical moment in world history which offers the chance to make the changes needed to set human beings on a path to a more sustainable future. In order to address these immense challenges, new forms of learning are needed and the paper will argue that all educators, as responsible members of local and global communities, need to play key roles as agents for change. Globalisation and new technologies have changed the way we think about the world and about what constitutes the global and the local. It is clear that both local and global solutions must be found to address the serious dilemmas of the 21st century. This paper will seek to examine the opportunities and challenges of the virtual world in enabling and supporting the development of effective ESD communities of practice.

Key words: *ESD, RCEs, communities of practice, virtual learning communities*

The need for new ways of knowing, learning and understanding

One of the obstacles to change has been a reluctance or an inability to integrate social and environmental concerns into policy making and practice. This in itself is in part a reflection of the divisions between the two agendas of environment and development (Wade and Parker 2008: 9) and the obstacles of language and understanding faced by the social sciences in working more closely with the natural sciences and vice versa. The three pillars of sustainable development are considered to be environment, economy, society (UNESCO) yet in much policy making the economic pillar is still privileged over the other two.

According to UNESCO (2012) ‘Investing in education is crucial for achieving sustainable development, poverty eradication, equity and inclusiveness. Education holds the key to productivity and sustainable growth, improves health and nutrition, income and livelihoods, creating a condition for achieving all of the MDGs and the EFA goals.’ As economic models are still so central to our world view, and as all people on earth need a livelihood in order to survive then we cannot afford to ignore some central questions:

What do we mean by sustainable growth? What kind of society do we need to build in order to achieve sustainable living? How can ESD help to deliver this? In recent years there has been a developing critique which indicates that our current economic paradigm of high consumption material growth is not appropriate and that business as usual is not an option (Stiglitz et al, 2009; Sachs, 2012). Some commentators would argue that the very notion of ‘sustainable growth’ is a tautology since economic growth cannot of itself as presently constructed be sustainable. In relation to this, many commentators are also challenging the appropriacy of GDP as a useful measurement of human well – being. Stiglitz et al (2009) noted that ‘for a long time there have been increasing concerns about the adequacy of current measures of economic performance, in particular those based on GDP figures. Moreover, there are even broader concerns about the relevance of these figures as measures of societal well-being. The inadequacies of these figures from the perspective of sustainability-- economic, environmental, and social sustainability-- have been of particular concern’

Following on from this discourse, in 2012 it was reported that Jeffrey Sachs, special adviser to UN secretary -general Ban ki-Moon on the MDGs ‘ is clear that the old economic paradigm, which is based on a fixation of GDP growth, is leading us to disaster, but that we need to find a completely new way of measuring the success of society. He believes that **sustainable development goals** (SDGs) could be one route towards achieving that (Guardian online June 22nd 2012). If such a set of sustainable development goals could be agreed these could possibly set the parameters for a new notion of growth which did not depend on measurements of GDP. Education and learning would be essential to develop such a concept of sustainable growth and for a well balanced society which values societal well being and quality of life.

The politics of knowledge

Society has not always been constructed as it is presently. A few hundred years ago, religion and state held far higher sway than the economy, for example. The parameters within which we lead our everyday lives are constantly shifting but there are key elements which as human beings we seem to share in relation to overall well being (Dolan et al, 2011).

Education policy over the past three decades has been very successful in many countries in raising standards of literacy and numeracy (especially with regard to the Millennium Development Goals) - but mainly within a constrained and rather instrumental model of education. While many would argue that this model has been quite successful in delivering economic growth in many countries, it has not delivered sustainability. Since the birth of industrialisation, it has also presided over the fastest and most wide ranging ecological destruction of our planet. We are now said to be in a period of the 6th greatest extinction of natural life during our planetary history and a large body of scientific evidence attributes responsibility for this to our human actions. In addition, there is increasing evidence from the research on human well being (Dolan et al, 2011) that after achieving the important threshold of income to maintain a reasonably comfortable life, economic growth and increased wealth does not add to the sum of human happiness. In fact, many of the wealthiest countries have very low indicators of human well being. According to the 2012 New Economics Foundation, the country which seems to have the highest state of well being is Costa Rica with the USA only in 105th position out of a possible 151 countries (Happy Planet Index 2012). And while Costa Rica has one of the smallest ecological footprints, the USA has one of the largest. Yet at the same time, many countries around the world, especially those with ongoing endemic conflicts such as Haiti and Afghanistan, exist with the lowest levels of well being as they are still struggling to establish security and eradicate extreme poverty. Therefore, it is very timely to consider how we can learn to embed the values of community, social justice, and ecological stewardship within future economic models.

Quality education and ESD

Mary Pigozzi eloquently describes a vision of 'Quality Education' which brings together these economic, social and environmental concerns:

A quality education must reflect learning in relation to the learner as individual, family and community member and part of a world society. A quality education understands the past, is relevant to the present and has a view to the future. Quality education relates to knowledge building and the skilful application of all forms of knowledge by unique individuals that function both independently and in relation to others. A quality education reflects the dynamic nature of culture and languages, the value of the individual in relation to the larger context and the importance of living in a way that promotes equality in the present and fosters a sustainable future. (Pigozzi, 2003)

ESD has much to offer and a key role to play here in influencing the agenda both in policy and practice within this discourse around quality education. There is now a level of

consensus around the concept of education for sustainable development (ESD) at the international level which has been brought about by the work of UNESCO, the UN body with the lead role in promoting the education commitments derived from Agenda 21. UNESCO has identified the following elements which characterise ESD which is facilitated through participatory and reflective approaches. According to UNESCO ESD

- is based on the principles of intergenerational equity, social justice, fair distribution of resources and community participation, that underlie sustainable development;
- promotes a shift in mental models which inform our environmental, social and economic decisions;
- is locally relevant and culturally appropriate;
- is based on local needs, perceptions and conditions, but acknowledges that fulfilling local needs often has international effects and consequences;
- engages formal, non-formal and informal education;
- accommodates the evolving nature of the concept of sustainability;
- promotes life-long learning
- addresses content, taking into account context, global issues and local priorities;
- builds civil capacity for community-based decision-making, social tolerance, environmental stewardship, adaptable workforce and quality of life;
- is cross disciplinary. No one discipline can claim ESD as its own, but all disciplines can contribute to ESD;
- uses a variety of pedagogical techniques that promote participatory learning and critical reflective skills'. (UNESCO, 2007)

ESD stresses the importance of contextualisation, relevance and appropriacy of learning. It highlights the importance of breaking down barriers between formal, non formal and informal education. It makes the links between scientific knowledge and local, indigenous knowledge - all of which are needed for the future sustainability of the planet. An in depth indigenous understanding of local ecology, such as plant and forest lore for example, is essential for addressing issues of climate change. Traditional home building in earthquake zones, together with modern scientific know how has enabled safer dwellings to be built for people. Indigenous knowledge is of course often built up over many generations and centuries of experimenting –but this is rarely written down or recognised. As UNESCO (2012) emphasised, ‘when addressing global environmental change, the knowledge and priorities of indigenous peoples and local communities are seldom considered in decision-making. However, indigenous knowledge offers insights, precision and nuance, which complement science.’

ACCU (2009) has also detailed many examples of the importance of what they call ‘grassroots approaches to ESD’ in Tales of hope 11 (2009). These also highlight the importance of traditional spiritual values of care and community which are held by many indigenous groups and which in many ways embody the values we need for ESD.

Since the 1992 commitments of Agenda 21, policy and practice in ESD have developed considerably at the local, regional and global levels and in many countries there is now government policy in place in all areas of the formal education sector, from schools to higher education. In addition, national legal requirements on sustainable development in relation to other sectors, such as the built environment, have created space and demand for training at a range of levels. As the focus for the UN Decade from 2005 to 2014, education is now viewed as a prime lever for social change, described by UNESCO in the implementation plan for the Decade in the following way: ‘It means education that enables people to foresee, face up to and solve the problems that threaten life on our planet.’ (UNESCO, 2005) More recently ESD was further highlighted at Rio plus 20 Summit in 2012 when UNESCO again re stated the case for the importance of education and called for ‘mainstreaming ESD comprehensively into relevant national education policies and practices’ (UNESCO 2012).

The role of networks and learning communities of practice

Networks have long been an important mechanism for community action and engagement for mobilising groups of people around key issues, as, for example, the Occupy movement illustrates. Networks are not new to universities either but in the past many of these have developed in relation to subject specific areas, through for example, subject bodies like the Political Studies Association and the Geographical Association. Informal HE networks have also emerged through shared interest (particular projects, social networks).

However, a network is not necessarily the same thing as a community of practice as Wenger (1998) makes clear, although sometimes they may share some of the same characteristics. In their work on social networks, Wellman and Berkowitz (1998) focus on networks in relation to communications through interpersonal relationships via a level of informal structure. Lave and Wenger have drawn on this in their investigations of situated learning and communities of practice which looks at social networks more from the perspective of action and learning – many ESD networks can frequently more accurately be characterised in this way.

Network theory has provided some insights into relationships though it has largely focused on communications in relation to business efficiency in organisations. The goal of ESD is much more complex and multi level than any organisational goal, of course. ESD has a focus on developing relationships in order to transform practice and has a responsibility to both present and future generations. The notion of learning communities of practice thus seems very relevant to the goals and aspirations of ESD.

Developing a virtual learning community of practice for sustainability

An early example of a virtual learning community was the UK distance learning masters programme in Education for Sustainability which was set up in 1994 by a consortium of Non Governmental Organisations (NGOs) through a collaboration with London South Bank University (LSBU). After 1992 governments were very slow to act on the educa-

tional commitments of Agenda 21 so in many cases NGOs decided to take the initiative. In this instance the NGOs comprised both environmental and development agendas and included Oxfam, Save the Children Fund, Action Aid, Intermediate Technology, Council for Environmental Education, Development Education Association and World Wide Fund for Nature (WWF), which provided most of the financial backing and leadership of the project. From the start it was envisaged the programme would be primarily by distance learning and one of the challenges was to develop a strong and supportive learning community. Initially this was through paper based materials which were developed and posted to students while tutoring was conducted mainly by phone or letter. It is hard to believe now but in 1994 there was no email or internet communication available at universities in the UK! However, this did not mean that it was impossible to create a virtual learning community, but it did make it more difficult. Students were encouraged to send in their biopics and a student Guide was produced each year with information on individual student interests and contact details. A newsletter was also written and sent out on a termly basis with course updates and information about relevant conferences, books etc optional day schools were held and a written report was circulated to students around the world.

‘Communities are social systems intended to serve specific purposes’ (Daniels 2009), however, Jocey Quinn (2010:45) critiques the term ‘learning community’ as she feels that is too unproblematised and limiting and she puts forward an argument for the concept of ‘imagined social capital’. However, to Wenger learning communities are not different from communities of practice. In fact to him a community of practice provides the opportunity for learning, both for the acquisition of knowledge and for the creation of knowledge (Wenger, 1998: 214).

However, Wenger was mainly talking about informal learning within the workplace and not about a specific formalised learning environment. The EFS community was specifically set up for the purpose of learning so how could this equate to a community of practice? Wenger describes 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, 2006). There is a relationship here to notions of social capital. An effective ESD learning community of practice might be considered to fulfil the criteria identified by Wenger (1998, 2006) but would clearly also need to include the key components of ESD (UNESCO 2007) and would need to demonstrate a commitment to the values and principles of ESD.

The EFS programme described above could be described as an ESD learning community but to what extent is this a community of practice? EFS students clearly shared a concern and passion for what they were doing as evidenced by their coursework and commitment to become agents for change. Their coursework indicated a range of work in formal, non formal and informal settings end of year evaluations indicated a shared ethos and a strong belief in the shared values of the course (QAA, 2001). Interaction with tutors was taking place on a regular basis but interaction between students was of course impeded by the difficulties and slowness of communication. The development of the internet has provided a tool which has changed this situation immeasurably.

Challenges and Opportunities of the virtual world

The use of the internet in university courses has increased exponentially in the last five years, with most HE institutions now offering a range of distance or blended learning course, at least partially mediated by on line provision. This has thrown up a wide range of challenges and opportunities. Manuel Castells (1996, 2000) maintains that we are moving from the capitalist industrial age into the capitalist information age and the basis of the technological means by which it acts has changed from energy to information. New technologies allow for the collapse of space and for the potential for rapid and asynchronous communication which also changes the relationship to time. ICT has created new nodes of power centres within networks. Some networks, such as that of financial capital, are global in scale while others are local or organisational. Some can be captured by powerful interests and lobbying groups while others can be used in radical challenge to an established system, such as during the Arab spring.

There is no doubt that the internet has provided unprecedented access to information and that it is changing the way that human beings relate to information, and to news media. In relation to ESD, Chet Bowers (2000) is also concerned that computers are a culturally mediating and transforming technology and he warns about the fact that they are perpetuating unsustainable western perspectives of consumption. He recognises that the use of ICT is here to stay but that that we need to adopt a cautious and critical approach – otherwise there is a danger that environmentally destructive cultural practices will only increase.

There are also implications for the world's environmental resources as each new on line innovation requires more and more energy to maintain servers and consumers vie to buy the latest gadgets, while often consigning older models to land fill. Valuable minerals are being exploited in vulnerable parts of the world in order to satisfy demand and are implicated in conflicts such as that of the Congo. ESD practitioners need to be wary of adopting the use of new technologies uncritically and indeed this underlines the importance of critical thinking skills and competences as part of any ESD programme.

The development of social media and networks has also led to a blurring between the public and private spheres. Sites such as Facebook have provided opportunities for people to exchange and share personal photos, ideas, information on an unprecedented scale - which has enabled close friendships to be maintained and developed across space and time. At the same time, it has brought dangers to some when private information has become public or when the virtual world has enabled people to practise deceit and deception.

Unequal global access is also an issue, although this is changing fast but currently many areas of the globe still have limited availability of broadband and wifi. This is the case in many of the poorest countries in Sub Saharan Africa (SSA) and this can limit the potential to develop accessible virtual learning communities in these regions. Some African students on the EFS programme have found their internet very slow and have been unable to contribute as much as they would like to group discussions. Many do not own personal computers and are forced to use internet cafés which are expensive and also provide a very noisy and public environment.

Another implication for the increasing use of new technologies is the danger that people may become more detached from their own local communities and friends. This would

clearly have implications for ESD if that were to be the case – because ESD learning communities of practice operate on so many different levels – from personal to local to global. Wellman et al describes some critics’ concerns that ‘we will become increasingly home centred and disconnected from our friends family, and communities (Wellman et al, 2001:301). However, according to Atkinson (2012, 10) ‘on examining the evidence there are a number of case studies which counter this view. In broad terms, local community broadband has the potential to tackle social isolation, providing the opportunity for social interaction. But it also has a broader function. Far from reducing community feeling, the virtual communities that it helps shape can build social capital. It can act as a forum to discuss local issues, giving local people the opportunity to express their opinions and potentially have an impact on local policy. It can help build local campaigns’. Atkinson also notes that a UK Department for Culture Media and Sport (DCMS) report encourages the development of community broadband and talks of the internet as ‘a participative, generative network promoting interactivity, collaboration and conversation’ (DCMS, 2009:22). The Community Broadband Network (CBN) is a UK social enterprise which supports and helps develop community led broad band initiatives. This has enabled access to the internet for a number of isolated communities in sparsely inhabited areas. Other initiatives are providing access for people with disabilities or chronic ill health. Atkinson highlights one such initiative where ‘members of the local community have been working with Dundee University on projects for independent living for those subject to chronic ill health and for the introduction of so called tele-medicine. A fast and reliable community broadband network is key to this’ (Atkinson, 2012).

All these concerns are important but essentially the internet is primarily a tool for communication, and like all tools it is one which can be used both positively and negatively. It should also be remembered that it is a tool which is socially constructed, that is to say, it is shaped by people – albeit with a range of different views, interests and power. Hence the importance of the critical dimensions in ESD – with regard to both sources and information and also to the wider implications of the use of ICT in education. The protocols for the use of social media and new technologies are still developing and ESD practitioners can contribute to this by ensuring that ESD principles and practice are part of this process. As a tool for the construction of virtual learning communities of practice, the way these are developed will of course depend on the values and ideologies of the people involved and it is important to bear this in mind when examining the potential for ESD. It is the role of new technologies as a tool which will be examined here, in relation to supporting the development of learning communities of practice.

Key elements of a virtual learning community of practice

There are a variety of types of ESD learning communities of practice centred around different kinds of nodes. Some examples of these are identified below:

A formal taught course

The EFS programme at LSBU started life as a distance learning course before the advent of new technologies but in the last 5 years the improvement in on line communication has enabled the learning community to develop into a more active local and global learning community of practice.

(See <http://www.lsbu.ac.uk/sustainability/> for the ESF Learning Community web site)

This has been a gradual process and development has been incremental and not without some teething problems when technical support has been found wanting. In particular the role of the VLE has increasingly provided a space for sharing of ideas and concerns on a more regular interactive basis. We have found that the pre requisites for this are the following elements:

- A safe space to talk and share
- Time to get to know each other
- Discussion area-lightly moderated
- Freedom to make mistakes
- Clear ethical protocols which all sign up to
- Well structured, relevant activities (learning objects)
- Applying theory to practice
- Time and space for individual reflection and feedback from tutors

Because on line technology also provides for synchronous as well as asynchronous communication, this enables students who live at very different parts of the globe with varying time zones to communicate effectively with each other and with tutors. Previously distance learning (DL) tutors had to plan carefully for telephone discussion with their students and it was not always possible. On line activities can be planned with this in mind so that responses can be made over a period of days or weeks – thus giving greater flexibility and time for reflection. However, it should be noted that many students are (understandably) still wary of committing their thoughts on line and need a great deal of encouragement and incentive to do so.

The availability of Skype and other on line video links has also meant that it is possible for students to have face to face conversations from time to time with their tutors and with each other. As other social media have developed, Face book has also provided a more informal setting for students to meet and share views and of course the internet has provided them with the ability to set up their own private groups away from the eyes of tutors when they so wish.

New technologies do set up a range of expectations in students, however, and it is important to manage these effectively. For this reason it is important to set up clear protocols and to keep to them. For example, there is a danger that the increased ease of access will encourage students to contact tutors at all hours of the day and this is just not manageable.

In personal sustainability terms for tutors this would be quite impossible so clear parameters need to be set.

Where the use of the VLE has been most effective has been in strengthening and supporting relationships which have been made initially face to face, from actual to virtual. An example of this is with a cohort of EFS African students who first met at a residential week in Kenya. They selected a moderator for each course unit to remind them and chivvy them to input discussion and to share ideas. Taking such responsibility seemed to work well in establishing a group sensibility and dynamic and enabled some rich interaction, with limited intervention from tutors. A few months later two of the students were involved in a very serious car crash and were in hospital for some time. In many cases they would have dropped out of the course or at the very least would have repeated the year but through the VLE the word went out to their fellow students in Kenya, Tanzania, Uganda, South Africa, Mozambique, Swaziland and Ghana. As a result of this they received immense pastoral and moral support and encouragement and went on to complete their coursework by the end of the year! This could not have happened without the firm establishment of relationships at the residential but it was not possible without the VLE and other new technologies.

A shared professional interest

Teacher education is an example of a shared professional interest and two of the most extensive and effective teacher education ESD networks at a regional and national level are the Baltic and Black Sea TE network and the UK TE network for Equity and Sustainability. Both these networks are run by a steering group and are able to organise annual/ bi annual conferences where participants can share practice, debate and discuss new ideas. Most of the communication is conducted virtually and there is a web site where resources and conference papers are shared. Contacts between network members are via email lists and newsletters. The networks are at the same time part of the local educational arena, national arenas and international arenas. They are both also involved in the wider UNESCO ESD Teacher Education network and so have a global reach also and they demonstrate key elements of communities of practice.

A review of the work of the UK network by Inman, Rogers, Mackay and Wade (2011) demonstrated that it ‘functions as a community of practice in a number of ways; locally (within institutions), regionally, nationally and internationally. At a regional level meetings take place between tutors from ITE providers in a particular region to share practice around integrating ESD/GC into Initial Teacher Education programmes; at a national level the steering group meets termly and an annual conference enables dissemination and brings members of the community together. The sharing of practice has already resulted in innovation and change in teacher education courses at some individual institutions’ such as the Open University and University of East London. (Inman et al., 2011) These programmes influence student teachers at these institutions, the pupils they teach while on teaching practice and potentially, their practice throughout their teaching career. The internet has enabled ‘The multilayered nature of the UK Network (*which*) means that there is a two way flow of information between the different communities of practices (regional, national and

international) of which the Network is comprised.’ (Inman et al., 2011). What this network does not have yet, however, is a virtual forum for the exchange of ideas and debates between members of the network - these take place at face to face events or through journal articles, though the scope is limited by the formal setting of a conference or steering group. Although there are several NGOs involved in the UK Teacher Education network the focus is also (intentionally) centred on teacher education and discussions take place within these boundaries. There is limited engagement with non formal settings and informal education at present though there is certainly scope to do so in the future.

A global initiative

The RCE initiative of the UN Decade for ESD (2005-2014) aims to develop a global knowledge network for transformative education to promote sustainable communities. RCEs have largely developed organically in response to regional contexts and needs, while at the same time being part of a wider global network. All RCEs have to be accredited by the UN University at a global level, but most have started from individual universities and build on existing networks, as well as creating new ones. They are all committed to the vision and the goals of ESD and in this sense they could be said to share Wenger’s key dimensions of practice which underpin the concept of the community of practice ‘Mutual engagement ; A joint enterprise; A shared repertoire’(Wenger, 2007: 73).

In essence an RCE is virtual by nature and ‘not a physical centre but an institutional mechanism to facilitate capacity development for sustainable development. An RCE is a network of existing local-regional institutions mobilised to jointly promote all types of learning for a sustainable future. RCEs, both individually and collectively, aspire to achieve the goals of the Decade for ESD’ (Mochizuki and Fadeeva, 2008). The RCE initiative offers a framework to develop actual and virtual communities of practice for sustainability because they are active at local, regional and global levels and the internet has enabled inter communication across all these levels.

RCE have four elements: governance; collaboration ; research and development; transformative education (‘contributing to the transformation of the current education and training systems to satisfy ambitions of the region regarding sustainable living and livelihood’) (UN-IAS 2012). Their goals are to:

- re-orient education towards SD,tailored to address issues and local context of the community in which they operate
- increase access to quality education that is most needed in the regional context
- deliver trainers’ training programmes
- lead advocacy and awareness raising efforts to raise public awareness about the importance of educators and the essential role of ESD in achieving a sustainable future (UN-IAS, 2012)

In addition RCEs are cross sectoral and involve educators at all levels of formal and non formal learning and are therefore able to draw on scientific, local and indigenous knowl-

edge. They are based on the UNESCO principles (see above) and in the framework for ESD with its emphasis on interdisciplinarity, lifelong learning, participation, formal, non formal and informal education. (UNESCO, 2007). As Wenger points out, ‘Practice does not exist in the abstract. It exists because people are engaged in actions whose meanings they negotiate with each other’ (Wenger, 1998:74). This ongoing negotiation of meaning is integral to the success of all RCE projects and is a consistent part of mutual engagement. The internet can provide a valuable tool for negotiation and discussion across regions and countries and the speed of response can enable misunderstandings to be sorted out more quickly. Nonetheless this same ability for instant response can lead to unrealistic expectations, for example, in seeking partners for a new project. And as most discussions are conducted through the medium of the English language, this may give rise to some confusion and misunderstanding. It also raises many questions in relation to the development of knowledge and understanding more generally – which is something ESD needs to pay attention to but which is beyond the scope of this paper.

Wenger’s analysis mainly concerned the work of apprentices in formal work settings but in the case of ESD and the work of RCEs, this engagement is not necessarily of course a statutory part of each person’s job description. In fact many members of RCEs are volunteers and contribute to the RCE outside their contracted work. However, as Wenger points out, ‘Homogeneity is neither a requirement for, nor the result of, a community of practice’ (Wenger, 1998:76). In effect, the mutual engagement towards the goals of ESD enables mutual support on a learning journey that participants volunteer to take. Obviously within the RCE Community there will be different levels of involvement, some members will take more peripheral roles and some more integral and dynamic and these are likely to change over time. And there is no need for all members to be in constant agreement with each other. On the contrary ‘disagreement challenge and competition can all be forms of participation’ (Wenger, 1998:77).

However, the development of each RCE project’s ‘joint enterprise’ is the result of a collective process of discussion and negotiation’.... and is defined by the participants in the very process of pursuing it’. (Wenger 1997:74) The action research approach that underpins much of ESD and the work of RCEs has also meant that the overall parameters are constantly evaluated and reshaped and then the learning from this is used as a basis to shape the next project in a rolling cycle of research and development. The ‘shared repertoire’ where participants develop shared language and histories has developed over time is demonstrated in a number of RCE publications that have emerged from the collaborations.

Most (though not all) RCEs are coordinated by universities, such as RCE Crete which is coordinated by the UNESCO Chair ICT in Education for Sustainable Development at the University of Crete – these maintain an important position in their local and regional communities: they offer a wide range of employment to local people and they also impact on the natural and built environment. Universities are of course not only part of the local community but are also part of the national and global communities through their wider networks and responsibilities. The concept of the RCE recognised this fact and aimed to promote transformative education for sustainability by developing a global learning space for exchange of ideas and knowledge. They would do this by creating a network of networks. This would be needed to be largely virtual in order to encompass all the key players

and organisations though it would be supplemented and supported by periodic face to face contacts as appropriate. However, this is not to downgrade the personal contact relational elements which are always key to the success of such communities of practice. Without mutual trust, understanding and shared goals, RCEs would be very ineffective.

In January 2012 there were 100 RCEs across the globe, supported by a secretariat at UNU Institute of Advanced Studies (UN- IAS), with a bi-annual conference where delegates come together to share ideas and develop collaborative synergy. The RCE initiative is also linked in with the global UN milestones and events towards sustainable development which has give it potential to be a mobilising mechanism at a global as well as a local level. Of all the three types of ESD communities of practice, it is the RCE which to me best addresses the criteria put forward by Wenger for effective learning and action and which offers the greatest potential for development and creativity. This is not to say that the others are ineffective, on the contrary, but they are working within the parameters of a formal setting with academic boundaries – which undoubtedly affect their ability to develop and negotiate shared meaning and activity.

The role of virtual learning communities of practice in ESD

Strengthening Local and global dimensions

The shrinkage in space and time which new technologies have brought about has allowed a much greater amount of interaction and participation at local and global levels. This is a key dimension of ESD (UNESCO, 2007) and it enables learning to take place in different geographical locations, each possibly drawing from the other as practitioners interact across time and space. At the same time, access to internet information sources allows participants to refer to both national and global policy and practice and contextualise their work more coherently.

RCEs (Regional Centres of Expertise in ESD) are both a local/ regional network and a global network; they are also often members of national and wider international (for example, European) networks. As such, individuals and organisations can share ideas and knowledge by interacting at a range of levels. While it is the **quality** of relationships that matter there is no doubt that the internet has brought in opportunities for supporting and strengthening these relationships in a way that would not have been possible without it. RCEs have a structure (albeit loose and flexible) and accountability to UNU and to other RCEs within the networks. This offers a strong sense of solidarity and mutual support in developing learning communities and networks for sustainability which have the power to play an active role in creating and promoting the learning that is needed for local and global communities to live sustainably. In taking on a lead role in RCEs, universities have the potential to stop being part of the problem and to become part of the solution to the urgent challenges facing people, place and planet by actively mobilising sustainable communities locally and globally.

Creating new knowledge

Wenger notes that ‘the very characteristics that make communities of practice a good fit for stewarding knowledge—autonomy, practitioner-orientation, informality, crossing boundaries—are also characteristics that make them a challenge for traditional hierarchical organizations’. Many organisations in the business sector have taken up this idea in order to innovate and improve performance but these characteristics can run counter to the organisational management style. The goal of ESD, however, is much more complex and multi-level than any organisational goal, of course. ESD focuses on developing relationships in order to transform practice and has a responsibility to both present and future generations. These characteristics therefore chime well with the development of new learning and knowledge for ESD.

The EFS programme at LSBU provides an early example of cross sectoral, transdisciplinary education, where academics engaged with experienced practitioners to share learning and develop new knowledge. ESD lends itself to this kind of engagement as it requires the involvement of all sectors and all areas of learning and understanding, formal, non formal and informal. This three sector engagement is illustrated in the diagram below.

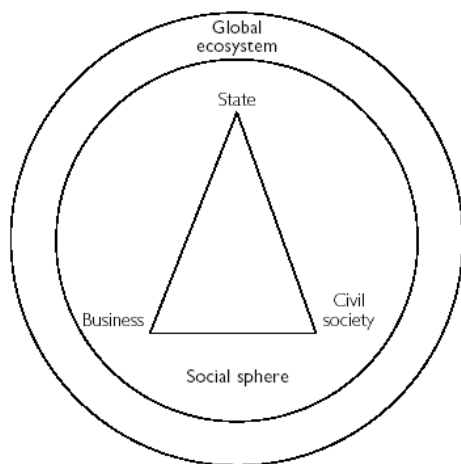


Figure 1. Dependent Three Sector model. From Parker, J ‘An Introduction to Education for Sustainability’ Unit One EFS programme 2009

ESD is still an emerging transdisciplinary concept, growing up and being constructed in an internet age. The virtual world provides immediate access to differing interpretations and new ideas which are essential to its development. Students, along with tutors are knowledge creators and practitioners and are learning, reflecting and applying their ideas to a wide range of situations and contexts across the globe. The internet gives them the opportunity to share and confer about their experiences, no matter where they are based. For nearly two decades the LSBU EFS community has been involved in changing the ESD

landscape, both through professional practice and also through involvement with NGOs and other networks. This work has included curriculum development in Fiji, Tanzania, South Africa, Canada and Hong Kong (Wade & Parker 2008). Other graduates have been involved in national and international policy making, such as the Ramsar Convention on Wetlands and the World Summit on Sustainable Development (WSSD). (For some illustrations of this learning and practice see <http://www.efsccommunity.t83.net/> and also, 'Journeys around Education For Sustainability' edited by Parker and Wade, 2008).

The RCE concept was actually first conceived as a way of enabling the latest scientific and technical knowledge to be reflected more in what is taught in schools by breaking down barriers between scientists and educators (Mochizuki and Fadeeva 2008 372). As such, RCEs were first perceived as knowledge hubs, which brought together a range of discipline and sectors, to provide responses to ESD challenges in the region. This model of RCEs did enable universities to build on their strengths as knowledge hubs as well as to build new knowledge through social and organisational learning. In principle, this model enables the sharing of scientific and technical information for the benefit of local communities and has enabled, for example, schools in one of Nairobi's largest informal settlements, Kibera, to develop successful water harvesting projects and school gardens. RCE Greater Nairobi presents an example of an RCE which was very strongly founded on the principles of community development for sustainability and indeed it was first developed through an NGO, Kenya Organisation for Environmental Education (KOEE) and was only in 2010 fully adopted by Kenyatta University.

ESD has recognised the importance of making links between formal and non formal educators, and the need to breakdown some of the hierarchies of knowledge which transcribe this. Educational expertise in responding to community needs has generally resided with community and adult educators rather than with educators from the formal sector. Although this area has lacked government support and validation, the formal sector has much to learn from its experience and expertise. RCEs can provide the mobilising mechanisms for this to happen, as in RCE Greater Nairobi which was originally set up by the NGO, Kenya Organisation for Environmental Education. This has of necessity developed largely through face to face interaction, but in other parts of the world where web access is more reliable the internet has enabled communication and interaction across the sectors. Many RCEs have set up web sites to provide an external face and to encourage wider participation. RCE Rhine Meuse, for example, is building a web space for all European RCEs to participate and share joint enterprises where appropriate.

The RCE community of practice also offers opportunities to apply expert knowledge as well as to develop new knowledge in response to local and regional problems and concerns. RCE Greater Nairobi, together with UNU and a number of other African universities has been very involved in developing a new masters programme for the African region on Community Development. In this instance the RCE identified a regional need which was shared with several other African countries and UNU provided the global knowledge networks to enable the course to be developed.

In Malaysia, a worm composting project at RCE Penang brought together scientists and members of the local community to use technology from University of Sains Malaysia which enabled the local community to use waste from paddy, cow dung and general village

waste to increase their income by 100 per cent (Sanusi and Khelgat-Doost, 2008: 493). In this case, RCE Penang was able to combine expert (global) scientific knowledge with local community knowledge to provide solutions to issues of sustainable livelihoods.

Transparency, accountability and democracy

New technologies can provide a tool for providing transparency and accountability which in turn can support democratic, participatory processes which underpin ESD.

UNESCO's International Teacher Education (TE) ESD network, which was originally set up by a group of university rectors, is now recognised as one of UNESCO's flagship projects which is contributing to the UN Decade of ESD. The global network aims to support the development of local / regional networks and there is a considerable amount of synergy between the two. Without the internet it is unlikely whether this initiative would have taken off and certainly without the internet it would have been impossible to disseminate shared resources in an open and accessible manner (www.UNESCO/esd).

In the case of the UK ESD/GC Teacher Education Network, research undertaken by the network 2011-12 (unpublished) indicates further that the network is seen as supporting the dissemination of ESD ideas and resources and is largely perceived as non hierarchical, democratic and accountable, despite being coordinated by one particular research centre at LSBU. However, it is important not to exaggerate the effects of new technology here. Undoubtedly, ICT has enabled and supported this sense of participation, but this has gone hand in hand with strong face to face relationships built up over time and a strong participatory and democratic ethos within the LSBU Education Research Centre (www.lsbu.ac.uk/ccci).

Engagement and action

Educators who seek to effect radical social change obviously need to be active both within the mainstream and outside the mainstream. Communities of practice, such as the one at London South Bank University (above), provide opportunities to do just this as they 'build and strengthen alliances – locally, nationally, and globally – with other groups and social movements in order to intervene successfully in 'educational reform' movements' (Ginsberg et al 1991 :29). In the case of the UK Teacher Education Network, recent research highlighted the importance attached by members to feeling part of a movement for change and a considerable majority felt that the network itself had been successful in achieving this. One of the aims of the network is to influence policy and practice and many participants were clear that this had been achieved at least partially within their departments and institutions.

The EfS Programme at LSBU has retained its active engagement with NGO networks and, for example, in 2002 the Team co-coordinated an intervention at the World Summit on Sustainable Development (WSSD) in partnership with WWF-UK and Oxfam. Graduates of this programme have gone on to become champions of ESD in many different countries and to form influential networks for change. Organisations they are involved in include the

London Sustainable Schools network, RCE Wales, RCE Ireland, Kenya National Environmental Management Agency, UNEP's programme in mainstreaming environmental sustainability across African universities (MESA), Botanic Gardens Conservation International

RCEs as a mobilising mechanism for ESD

To quote Hans Van Ginkel (Sterling et al 2012), who was instrumental in setting up the RCE initiative, 'This approach also has a tremendous *mobilizing* potential. Characteristically the successful RCEs would run a large number (a *'portfolio'*) of highly attractive and effective E/SD projects, each of these run by two or more member institutions coming from different sectors of society.'

At the heart of ESD and RCEs is the commitment to the transformation of society and the re orienting of education systems towards sustainability. Through their networks the RCEs bring together a wide range of organisations and key people to develop a more holistic, joined up approach to solving some of the problems of the region. They are not constrained by the barriers of the formal sector frameworks as their remit is to work beyond and across these. For example, members of RCE Greater Nairobi include various ministries (such as Education, Environment and Natural Resources, Planning), public schools, the National Museum of Kenya, University of Nairobi and Kenyatta, National chamber of Commerce, Nature Kenya. London RCE also includes a wide range of stakeholders from civil society, business and local government organisations. Among the partners of the London RCE are WWF-UK, Government Office for London, Development Education Association, Botanic Gardens Conservation International, London Remade, London Sustainable Schools Forum, Oxfam Education, Humanities Education Centre, London 21, Bromley Sustainable Schools, London Environmental Education Forum, Sustainability and Environmental Education (SEEd), Academy of Sustainable Communities, People and Planet student network, and Conserve Africa.

In the UK, one of London RCE's initiatives was developed in response to the needs of local communities around the Olympic Park. This enabled a number of local groups to come together, to make links with local universities of East London and Greenwich to consider how to ensure a positive sustainability legacy from the Olympic development. In a sense the RCE performed the role of broker in bringing these groups together to make common purpose while leaving them the autonomy to decide on future plans. This enabled several different groups to join together, for example, from the formal sector (school, universities) and non formal (youth groups, NGOs). RCE/EAST (Toronto) was originally an initiative of the City Council, led by Toronto Zoo. However, when Toronto University became part of the RCE this helped to promote 'the university's objective of engaging in outreach and helping to impact upon the development of public policy, through interdisciplinary engagement in environmental concerns' (Stefanovic, 2008: 423).

RCE Penang co-ordinated by Universiti Sains Malaysia is also closely involved with local communities and sees its role as threefold:

- helping students to be aware of the world in which they live and to gain an understanding of ‘the interactions between multifaceted economic, social and environmental problems(including the contribution of individuals to these processes) and a familiarity with perspectives on these issues from other societies and cultures’. (Sanusi and Khelgat-Doost, 2008: 493)
- helping societies to find through its network, social and technical solutions through academic research and professional experience
- developing partnerships between policy makers, decision makers, NGOs and key individuals who are involved in SD related activities at local, regional and international levels

Their Citizenship programme is an example of community engagement in training high school students to identify problems and issues in their communities, and to use an interdisciplinary approach to try to solve them (Sanusi and Khelgat-Doost, 2008: 492).

RCEs are in their early development and there is still much need and potential for development if they are to become really effective. Their structure and framework allows for this and as through their mobilizing mechanism they have the ability to develop strong ESD learning communities of practice - and to address the urgent tasks that we all face in learning and living sustainably within the shared resources of our planet.

Conclusion

In this paper I have tried to show how learning communities of practice are integral to ESD and I have explored some of the potential of new technologies in developing and supporting local and global communities of practice for ESD. The opportunities and challenges of the fast paced changing technological scene are immense: innovations continue apace and it is important to try to keep abreast of them and of their implications for the way our world is shaped. It is of course unlikely (and not to be desired) that virtual communities of practice are ever going to supersede actual face to face involvement and it is important to see the two as going hand in hand. ESD principles and practice also have a great deal to offer to the online world generally in addressing some of the dangers identified earlier.

However, as tools for learning, communication and information sharing, new technologies have great potential despite some of their drawbacks. And it is clear that the virtual world can provide an important creative and enabling space for ESD learning communities of practice. As stated at the start of this paper, the case for change has never been more urgent for our planet and for human kind. As members of ESD learning communities of practice we need to harness all the advantages provided by the new technologies in learning to live more sustainably. Time and space are shrinking in more ways than one and we need to change our unsustainable ways as a matter of urgency – or time and space for a sustainable planet may soon be running out!

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Acknowledgement:

This work has been developed within the framework of the ICTeESD project that has been funded from the European Commission (ERASMUS Multilateral Programme Virtual Campus Project No. 510212-LLP-1-2010-1-GR-ERASMUS-EVC (2010-3494). The content of the paper reflects the views of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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SUSTAINABLE SCHOOL INDICATORS: APPROACHING THE VISION THROUGH THE SUSTAINABLE SCHOOL AWARD

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Abstract

The Sustainable School Award is a project for schools that aims to integrate a sustainability perspective into all aspects of school life through “sustainable school indicators”. It complies with the implementation strategy of the International Plan of Action of the Decade for Education for Sustainable Development (2005-2014) and the Strategy of UNECE. In this paper we present the vision of a “sustainable school” and an attempt to connect theory and practice of ESD in order to approach this vision. A brief report on the first year of the implementation of the project in Greece is also presented.

Key words: *sustainable school indicators, sustainable school, sustainable development*

Introduction

For more than thirty years Environmental Education (EE) has been the main vehicle for raising the environmental awareness of students and seeking to change their attitudes and behaviors in relation to the environment. The school was one setting for environmental education, with teachers the main facilitators of attitudes and behavior change.

A number of authors have reported on the intrinsic and acquired problems of EE in Greece (Flogaitis, 1993; Flogaitis 2005; Kalaitzidis & Ouzounis, 2000), problems that have prevented it from realizing its potential. Greek schools have features that are not consistent with the principles of sustainability (Papadimitriou, 2010) and in order for the school to be a significant agent in moving society towards sustainability it has to be the very object of this change (Orr, 1992; Sterling, 2002). The introduction of Education for Sustainable Development (ESD) (Skoullou, 1995; Papadimitriou, 1998; Flogaitis, 2006), which is considered the successor of Environmental Education, accentuated this failure due to the higher requirements of this new kind of education (Papadimitriou, 2010).

The theory and practice of ESD suggests that the participation of the whole school community to promote sustainability is necessary, and consequently it should adopt a “whole school approach (Henderson, 2004; Gough, 2005). Many countries have adopted

the “sustainable school” as a policy goal, such as the United Kingdom (Huckle, 2009), Sweden (Green School Award), Australia (Henderson, 2004) etc.

The experiments of the 19th and 20th centuries produced progressive schools that had advantages in relation to sustainability (for example the freedom and self-management experienced by pupils at Summerhill School in England) and such schools had some impact on mainstream schools. Progressive schools resulted from and inspired people of educational vision and included such innovations as the active participation of students in learning process, the cooperative approach to learning, the democratic functioning of the school leadership etc. The limits of reform were and are however shaped by the dominant educational paradigm, which reflects prevailing structures of economic and political power.

The sustainable school

The sustainable school can be viewed as one element of a future utopian sustainable society. The basic idea of the "Sustainable School" is the integration of sustainability in every aspect of school life, namely the administration, the learning process, management of buildings, transportation to and from school, the school's relationship with the school community (Huckle, 2010). The management of the school reflects and reinforces what students learn in the classrooms through the ways in which it runs the campus (use of energy and water, transport and travel, food, etc) and at the same time such learning is further strengthened by the ways in which the school and its students learn alongside local and more distant communities. The active involvement of students and staff in reflecting and acting on sustainability themes creates a sense of responsibility which in turn is transferred to the interactions between the school and the wider community (Living Sustainably, 2009). To facilitate discussion, we can classify the characteristics of sustainable school into three general domains of organization (Papadimitriou, 2010): the pedagogic (curriculum, school culture, teaching and learning process), social and organizational (organization, administration, relations with the wider community and other bodies) and the environmental-technical-economic (school environment, buildings and yard).

The “sustainable school” label covers a range of variants on the light green to dark green spectrum that ranges from conservative (light green) to radical (dark green). At the light green end the school will be adopting environmentally friendly measures such as recycling and energy saving (ecological modernization, faith to solutions deriving from technology, doing more with less) that offer no real challenge to and even support the status quo. At the dark green end, the school will be adopting a holistic approach to sustainability, including challenging the dominant production and consumption patterns, the dominant values of the consumer society, the dominant distribution of power and financial resources, while at the same time, challenging the dominant schooling values. The dark green approach implies a more thorough reform or radical change of both environmental and social interactions in the school, allowing students and teaches a more democratic process of decision making. The current UK government has taken down the webpage that set out the guidance on the previous government’s sustainable schools policy. Eco-schools (managed

and promoted by the NGO Keep Britain Tidy) is now the main vehicle encouraging more sustainable schooling in the UK.

The pedagogical domain

The sustainable school adopts participatory and student-centered approaches that develop students' skills, abilities and qualities for critical thinking, intercultural understanding and willingness to participate. These are key attributes of active citizenship. Team teaching around issue-based topics is the pedagogy best suited to sustainable schools. Active student participation in the planning of the lesson, the teacher's function as coordinator of the discovery of new knowledge by the students themselves, the introduction of new technological innovations in the learning process, are all aspects of sustainable school, which relate to improving the conditions of the learning process, while improving the overall functioning of the school. Principles of EE and ESD should be integrated into all aspects of the curriculum (UNECE 2005). The hidden curriculum teaches students much about sustainability through the day-to-day relations between people and between people, energy, materials, and plants/animals on the school campus.

The social and organizational domain

The social and organizational domain includes the school relations with the local community, local government, relations with parents etc. The administration must put sustainability at the heart of school design and everyday practice. The sustainable school adopts the democratic and participatory process of decision-making. A proper atmosphere of cooperation should be established so that the school generates improvement plans and undertakes the relevant actions to implement the plans and achieve the goals. The democratic operation, from the administration to the function of student councils, best fits the sustainable school. The decisions taken with democratic procedures are respected by all members of the School Community. Local government has an important role in school life as it distributes the annual grant, is responsible for repairs and improvements of school buildings, taking advantage of school programs to educate and enlighten local citizens, etc. But even more important is the democratic functioning of the teachers' assembly (staff meeting) in each school, as its decisions largely determine the nature of school life.

The environmental domain

The main objective of SSA in the environmental domain is to reduce the ecological footprint (Wackernagel, M. & Rees, W., 1996) of the school, and through the students, of the ecological footprint of the families. At the same time, in an era of financial crisis, reducing the ecological footprint will result in reduced spending for running the school building. According to surveys (Santamouris, 2008) in Greece 30% of the energy consumption goes to buildings. The Greek school buildings in particular, are very costly in terms of heating,

because none of them was built according to the principles of green building. Besides heating, paper consumption is also booming. Only an insignificant percentage of the paper consumed at school ends up in paper recycling. The contribution of schools to increase greenhouse gas emissions could also include the consumption of fuel to transport children to school in their parents' car.

For all these reasons, schools are organizations which produce waste and consume significant quantities of resources, contributing to global warming. The impact of the school is not confined within the narrow limits of its campus, but extends to the broader social environment and affects a substantial part of society.

The sustainable school award

In Greece, thousands of schools implement optional school projects, short and medium term, every year. The topics of these projects are about environment, sustainable development, human health, jobs, culture and civilization, intercultural issues, human or animal rights, theater, consumerism etc. The quality of the projects sometimes is high and deserves to be recognized. However, most of them are implemented in isolation, detached from the school community and restricted within the limits of a class. Teachers and students need to be supported and motivated in different ways in order to improve the quality of the projects, prolong their duration for the profit of both the students and the local society, and infuse the school community with the principles of sustainability. Introducing incentives for more active student participation in the common effort can often improve the significant achievements of these optional projects.

World Conference on "Education for Sustainable Development» (UNESCO, 2009), among others, urges all states to reorient education towards sustainability, to benefit the organizations of civil society in order to encourage debate on Education for Sustainable Development and to undertake initiatives. These positions agree also with the Article 36 of the Strategy (UNECE, 2005), "NGOs are important sources of informal and non formal learning, able to implement processes of social empowerment (Strengthening of the role of civil society) and to integrate and transform the scientific knowledge and facts into understandable information. Their role as intermediaries between governments and the public should be recognized, promoted and strengthened".

In response to the above, the "Sustainable School Award" was established by the Council for Environmental Education of the Hellenic Society for the Environment and Culture, in order to recognize, promote and enhance the efforts made by schools in different thematic areas, but within the broader context of the ESD. Also the Sustainable School Award (SSA) was instituted to disseminate good practice sustainability in schools.

The Sustainable School Award (SSA) is a project for schools in the form of a contest. The object is for schools to integrate sustainability in all their functions and in particular in the three domains mentioned above, namely: the educational, social-organizational, and environmental. The school that decides to participate in the SSA has to visit the website www.aeiforosxoleio.gr to subscribe. Following the subscription the school undertakes the

activities implied by the sustainable school indicators. At the end of the school year the school inserts the value of each indicator at the website, in order to receive its score.

Sustainable school indicators

For each one of the above mentioned domains the Council for Environment. Education d has introduced indicators (quality criteria), which facilitate comparisons among the schools participating in the project. Indicators are becoming one of the most commonly applied and promoted evaluation strategies in sustainable development and ESD (Reid, Nickel, and Scott, 2006). The SSA indicators are based to an extent on the set of "sustainable development indicators" of the UN (UNESCO, 1997, Breiting et al, 2005), and have taken into account the "Indicators for Education for Sustainable Development" developed by the UN-ECE (2007, 2009). Similar approaches are suggested by UNESCO (UNESCO Lens, 2010) and by the Department of Environment and Heritage (Australian Government, 2005). It encourages schools to undertake an audit to identify areas for improvement in key areas of ESD (cultural, environmental, and economic aspects of ESD). This can help schools to set targets for change and improvement. As Mogensen and Schnack state (2010) "Indicators cannot be seen as a mechanism that aims to prescribe and test the "correct" content (knowledge, skills and values) in ESD, but rather must be formed in ways that stimulate and qualify students to become future citizens, who can make sound judgments, think critically and independently, and who can and will play an active role". The same authors state that quality criteria (or indicators) are considered starting points for reflection. The literature may indicate a variety of indicators (Morgensen & Mayer, 2005, DfES, 2007, Living Sustainably, 2009, Australian Government, 2005) that all can come under the three domains mentioned above. The difference is that the "Sustainable School Award" has introduced in Greece a set of Sustainable School Indicators that are measurable, so they constitute a new approach to the idea of sustainable school. The full list of the Sustainable School Indicators can be seen in Annex 1. Each indicator receives a value, including a maximum score that summed up with the rest of the indicators to give the overall score of the school. The scoring of the indicators is designed to give greater or lesser weight to some of them. For example, it gives less weight to the existence of solar panels on the roof of the school and greater weight the reduction of electricity consumption. The SSA accepts as candidates all types of schools: nursery schools, primary and secondary schools, vocational schools, special schools. Each school competes with the schools of the same category (nursery, primary, secondary, vocational). Each indicator implies an action taken by the school in the direction of sustainability. For example, the indicator "Total number of teaching hours per subject, employing teamwork teaching approaches, per cent (%),implies an effort by all the school community to increase the incorporation of teamwork teaching in the teaching strategies of the school. The indicator "Number of social and pro-environmental actions of school (e.g. planting trees, participating in social fundraising, taking care of animals, etc.), implies that the school will undertake initiatives to contribute to the improvement of the local environment and local society, through different actions and activities. The indicator

“Does the school have composting systems?” implies that the school will start a composting program, etc.

Results of a questionnaire survey

The “Sustainable School Award” was introduced in Greece for the first time during the school year 2010-11. One hundred and forty (140) schools across the country declared participation in the project-contest. Of these 22 senior high schools, 51 high schools, 54 primary schools, 10 kindergartens and special schools. After the conclusion of the first year of the project, the participating schools were asked to fill in a special questionnaire (Annex 2) different of the indicators’ one (Annex 1). The questionnaire was answered by teachers and principals of participating schools. Only 35 schools out of the 140 that declared participation in the S.S.A. returned a completed questionnaire (25%). This negative attitude towards evaluation is a persistent feature of most Environmental Education projects and programs (Morgensen & Mayer, 2005, p.87). Some possible reasons for the low response of schools could be: A. A fear for evaluation, as this is not a common practice in Greek schools (abandoned already from the early 80’s). B. A negative attitude towards behaviorist approaches to education. C. Lack of interesting and meaningful activities at school, in the framework of the Sust. Sch. Award. A review of similar programs around the world reveals a lack of research and evaluations reflecting upon the achievements, lessons learnt and critical success factors of whole school sustainability programs, like Eco-Schools, Green School Award, Enviroschools (Henderson, 2004). This process would enable programs to capture both quantitative and qualitative data in order to reflect upon progress, learn from experience and ways to improve (Bolstad, 2004).

The questionnaire sought information about (mainly) improvements in the hidden curriculum, after the implementation of the sustainable school program and participation in the corresponding contest (see Annex 2). Because it was the first year of the implementation of the SSA, there were no comparative data from previous years to depict improvements in school life, the questionnaire asked for estimations from the participating school principals and teachers. Under these circumstances the results of the survey should be treated with care. Mostly they indicate some attitudes, they do not depict with accuracy and validity all the potential opinions and attitudes. The main findings of this survey are the following:

- The initiative for the school to participate in the SSA derived mainly from the Principal.
- The school activities related to the SSA begin mainly in October and end in middle May.
- In most of the participating schools environmental education projects were implemented as a result of participation in the SSA.
- All schools that responded to the questionnaire have formed student environmental teams. The student teams are formed mainly on a class base.

- Most of teachers said they would participate in the project in the next year and nobody said a negative intent.
- All the teachers said that they will continue the good practices developed within the SSA project, whether it continues or not.
- All schools developed collaboration with non-governmental voluntary organizations.
- All schools said to participate in activities in the local society (e.g., fundraisers, care of stray animals, etc.).
- Most of schools responded that they have developed relationships with schools in other countries within European Union programs (Comenius, e-Twinning, etc).
- Most of the teachers said there were positive changes to the hidden curriculum, as a result of the participation in the contest.
- The rate of teacher participation in the different activities implied by the indicators was very high. Similar or even higher rates are claimed for student participation.
- The most active student teams are recycling, reduction in electricity and water consumption teams.
- The less active student teams are those that dealt with issues related to the educational sector (introduction of ICT, teamwork approaches to teaching).
- A major change considered by teachers as a result of the participation in the SSA, is a significant change in the school climate. Student and teacher participation in the design and implementation of different activities in and out of school has led to the development of better relationships of trust and cooperation both between students and between students and teachers. This effect is depicted in the reduced number of punishments and penalties imposed to students.
- Teachers reported as difficulties the limited spare time for high school students, the relative difficulty of coordination when teams are mixed, the need for more and closer contact between coordinators of the SSA and schools, the lack of adequate teacher training, the complexity of some indicators, etc.

Innovation

Significant change occurs in schools participating in the "Sustainable School Award" project as they redirect their work towards sustainability and overall greening. To summarize the innovative elements of the SSA:

- Most of the "Sustainable School Indicators" are original
- Measurable "indicators for sustainable school" are used for the first time to assess effort and achievements of schools in the area of "sustainability". No references were found in the relevant literature, about appointing a certain value for the fulfillment of a target in the form of an indicator.

- It is the first time that “whole school approach” is implemented in both large scale and with such positive results in Greece (Kalaitzidis, 2001).
- High percentage of participation of both teachers and students are observed. According to estimates, the average rates of participation of teachers and students in medium and long term school projects in Greece does not exceed 12%.
- The SSA integrates various innovative actions taken in one school, under the umbrella of sustainability. Thus, the final effect achieved is greater than the sum of the individual achievements of the teams participating in each individual action or project.
- In the framework of the SSA the existing experience and knowledge inherent in schools by former environmental and other projects is reclaimed, giving them new content, as determined by the active and wide participation of the school community.
- Teachers claim that SSA has reinforced at a high level the hidden curriculum and improved the school climate.
- The SSA had a catalytic effect on student-school relationships, as evidenced by the rapidly evolving reduced punishments imposed on students.
- The specific and crucial role of school director who encouraged the school to participate in the SSA was confirmed.
- The SSA allowed a big part the members and stakeholders of the school community to take ownership of the initiatives and incentives to participate in the innovation, while promoting the development of their environmental consciousness.

Conclusions

The Sustainable School Award is a project in the form of a school contest. It is running under the auspices of the Ministry of Education. It puts forward indicators in order to help schools guide themselves towards sustainability. The indicators are original and have been formed taking in account recognized indicators about sustainable development and indicators about Education for Sustainable Development. They cover the three domains of school function (Pedagogy-Social-Environmental) and are 40 on total. During the first year of the project 140 schools took part, while in the second year 180 schools. The project is facilitated by a special website (www.aeiforosxoleio.gr) where the participating schools insert the values of each indicator to receive their score. An evaluation with the use of a questionnaire for the first year showed optimistic results about the effort towards sustainability through the Sustainable School Award.

Acknowledgement:

The author would like to express deep thanks to John Huckle for his support in writing the present article.

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Annex 1

Sustainable school indicators

A. Pedagogical indicators

1. Incorporation of sustainability issues in school subjects (e.g. health education, different cultures, gender card, human rights, cultural heritage, etc) per cent (%).
2. Total number of teaching hours per subject, employing teamwork teaching approaches per cent (%).
3. Incorporation of ICT for teaching of all subjects, used to develop cooperation skills, critical and creative thinking to solve problematic situations.
4. Number of educational visits, in order to improve the environmental, social and cultural awareness of pupils.
5. Number of events (cultural, environmental, etc.) organized by the school in collaboration with pupils and teachers, for pupils, parents or local community members.
6. Number of optional school activities and projects (e.g. Environmental, Health Education, Cultural Education, Comenius, e-Twinning, pupil competitions, etc.) implemented in school.
7. Number of punishments imposed to pupils.
8. Percentage of dropouts.

B. Social and organizational indicators

1. Does the school implement a Sustainable Management Plan (S.M.P.) and an Activity Program (S.A.P.)?
2. Part of the total number of school teachers (%) who are actively involved in Sustainable Management Plan (S.M.P.).
3. Percentage of pupils who are actively involved in the Sustainable Management Plan (S.M.P.).
4. Total hours of professional development seminars attended by school teachers
5. Total hours of professional development seminars attended by the school Principal.
6. Number of teacher meetings (other than mandatory) on teaching and learning approaches, to plan joint projects related to education for sustainability, to develop strategies to link the school with the local and international community, to reflect on the school accomplishments, etc.
7. Number of pupil-council meetings on issues relating to environmental management of the school, teaching methods, safety issues, etc.
8. Number of pupils' general assemblies with the same topics as above.
9. Has the school undergone an aesthetic improvement by students in collaboration with teachers, parents, municipality, etc?
10. Number of School Councils convened in order to inform the school community, to reflect on school issues (teaching methods, environmental management, etc).
11. Number of social and pro-environmental actions of school (e.g. planting trees, participating in social fundraising, taking care of animals, etc.).
12. Number of lectures on sustainability issues given by out of school specialists who visited the school.

13. Number of collaboration meetings with the local school activities adviser-consultant.
14. Members of the Parents' Association who voted in the last election (%).
15. Number of visits to the website of the school during the school year.
16. Does the school canteen offer organic food to pupils?

C. Environmental-economic-technical indicators

1. Percentage of pupils going to school on public transportation, bike / private car / feet.
2. Weight of recyclable materials (paper, glass, metal and plastic) that were recovered per pupil and teacher.
3. Weight of waste going to landfill per pupil and teacher.
4. Number of copier paper sheets per student and teacher.
5. Water consumption per pupil and teacher.
6. Does the school employ a system for storage and use of rainwater?
7. Electricity consumption per pupil and teacher.
8. Does the school use environment-friendly detergents for cleaning?
9. Weigh electric-electronic devices and batteries given for recycling per pupil and teacher.
10. Is the central heating system checked annually for compliance with Eco Audit?
11. Consumption of oil or natural gas for heating per pupil and teacher
12. Is the school building insulated?
13. Power of photovoltaic systems installed in school.
14. Does the school run a vegetable garden, flower garden or a roof garden?
15. Number of plants and trees across the surface of the school (courtyard included)
16. Does the school have composting systems?

Annex 2

Questionnaire

1. Who has taken the initiative to suggest the Sustainable School Award to the school?
2. When did the school start the SSA activities?
3. How many student teams for implementation of Env. Educ, Health Educ., etc, at school have you organized?
4. Were these teams mixed or pure classes?
5. What percentage of the pupils did not participate to any activity?
6. What percentage of the teachers did not participate to any activity?
7. What were the most active pupil teams?
8. What were the less active pupil teams?
9. What factors influenced the success of the active pupil teams?
10. What factors influence the relative failure of the less active teams?
11. What major changes have taken place at your school, in the framework of SSA?
12. What minor changes have taken place at your school, in the framework of SSA?

13. What were the most serious problems you have faced during the implementation of the project?
14. What was your school accomplishments attributed to the SSA?
15. Are you going to participate next year?
16. If there will be no more SSA, are you going to continue the good practices that you have developed during the SSA?
17. What changes do you suggest for the SSA?
18. Do you have any cooperation with NGO's or other bodies?
19. Do you participate in the social activities on local scale?
20. Do you have relations with foreign schools? If yes in what framework?
21. Have you observed changes in the hidden curriculum of your school as a result of your participation in the SSA?
22. If yes, how can you describe this change?

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