Papers

Introduction to the first English issue

Dear Reader!

We came to a significant station when we started to publish articles and studies in English. This was a great basis for the First International Environmental Education Conference held in Eger in 2016, of which many of the presenters have undertaken to write in our present issue.

Our English edition was edited by and Dr. Pénzesné Erika Kónya and Prof. Dr. János Mika.

The content summary of the articles and studies was described by them in the Editorial Summary section.

Please receive and read our first English language review.

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Budapest, October 30, 2017.

Univ. Private Prof. Dr. Habil István Lükő

The Chairman of the Editorial Board

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Content of the present issue

Environmental education is the common feature of the issue, based on presentations in the First International Environmental Education Conference (IEEC2016) held in Eger, Hungary in April 26-28, 2016. Seven scientific papers are selected and completed by a book review.

The author of the first paper, Martin Haigh studies 'Connective Practices' which are effective educational activities and critical for sustainability education. They bridge the gap between knowledge of environmental problems and the attitude to do something about them. Three moments of pedagogic theory are employed for the application of sustainability education. From *Deep Ecology* comes the pedagogic ladder, leading to recognition of the Ecological Self. The Connective Practice concept comes from *Social Sculpture* and the provocative work of Joseph Beuys. Finally, *Invitational Education* adds concern for the learner's inner being. Learning invitations aim to remove the obstacles that hold learners back from positive creativity. After this theoretical and methodological characterization of the Connective Practices, two case studies illustrate the task of inviting learners to develop pro-sustainability values and affirm them by a personal creative response.

The second paper by Poudrier, Claude (Environmental Education and Active Citizenship) emphasizes the importance to include and activate the citizens starting from the age of 4 years. The Action Research for Community Problem Solving i.e. a model developed in Quebec, Canada is in the focus of the paper. For successful environmental education the experience of the author and objective surveys by a national network claims for the needs of the following characteristic features: Active participation in community life; Accountability and community belonging; Partnership development; Democratic daily life; Community roots and social responsibility.

This paper is followed by an overview of environmental problems and their education based on the experiences of the author (Taligás Tímea: Overview of main environmental challenges and the educational possibilities to tackle them). She points at the problem that the frequent reference at climate change hides the several other problems, as production of the required energy, providing drinking water and food in the appropriate quantity and quality, , or preservation of the nature. To solve these challenges we need environmentally conscious societies. The way to such societies leads through environmental education, everywhere.

After the review by an environmental scientist, the environmental problems and education are tackled in the third paper by Mika, János (Education in the Sustainability Development Goals (2016-2030), sustainability in the education), too. Both the problems and the education are discussed here according to the UN document in the title. Though sustainability is understood in its widest way (i.e. including the tasks from the society and the economy, as well), there are many environmental problems among the 17 Goals of the document and Goal 4

definitely deals with the long-term needs of education. The paper collects several other targets of the document, points at further needs of education not mentioned among the goals and provides graphs and maps that are recommended to use for teaching of and by sustainability.

One key problem, that has already cause irreversible changes, is surveyed by Nagy, Éva (The Comparative Analysis of the Biological Diversity in Schools) in the fourth paper of the issue. The study summarizes the methods that serve the teaching of species diversity and attempt to sum up the institutions where they are used. There are several questions tackled by the paper, e.g.: Do we give enough impressions for the young generation to taste the actual world, attracting their attention to sustainability? Do we spend enough time with our students getting acquainted with all animal and plant species, around us? In other words, does the biodiversity actually exist in our today's public education?

The next paper deals with a new effective tool in pedagogy (Rigóczki, Csaba and co-authors: Gamification on the edge of educational sciences and pedagogical methodologies). The paper provides a literature survey on the best practices in the field of gamification which field is explosively growing, though only a small percentage is linked to pedagogical methodologies. The paper explores the role of gamification in pedagogy, focusing on environmental education and analyzing the elements and mechanisms of the games. After a few interesting examples, the paper finally compares the characteristics of gamification with some acknowledged pedagogical paradigms in Hungary.

The topic of the final paper of the issue deals with the e-School4s, the e-school for sustainability in the Danube region. Several international conventions countries across the world integrate and implement education for sustainable development, and e-School4s is an innovative way to study sustainable development in schools. The paper present an inspiring example, the e-School4S Comenius project, the framework of which teachers and NGOs across borders collaborated to build interactive e-learning courses for secondary school students.

The issue is being complete by a book review on Ecosystem Services of Headwater Catchments (Edited by Krecek Josef et al, reviewed by Kürti, Lívia). Though this book is not focused on environmental pedagogy, but on the important questions of the environment occurring in a water catchment, the first two editors and four further authors participated in the IEEC2016 in Eger. Five chapters of the book deal with environmental education. The book was published by Springer Verlag in 2017.

Eger, Hungary, October 26, 2017
Erika Pénzesné Dr. Kónya and Prof. János Mika
guest editors

Connective Practices in Sustainability Education

Martin John Haigh[a]

[a]*Oxford Brookes University, Headington Campus, Oxford, OX3 0BP, UK*

Abstract

Connective practices are affective educational activities and critical for sustainability education. They bridge the gap between knowledge of environmental problems and the will, personally, to do something about them. Three sources of pedagogic theory are tapped for this application to sustainability education. From Deep Ecology comes the pedagogic ladder leading to recognition of the *Ecological Self*, the deep intuitive appreciation of being a part of the living Earth. The *Connective Practice* concept comes from Social Sculpture and the provocative artistic and political work of Joseph Beuys, whose notion of participatory *response-ability* envisages actions that unleash the positive creative potential of every individual. For Beuys, everyone is an artist and everyone can become a world-maker. Finally, *Invitational Education* adds concern for the learner's inner being. Learning invitations aim to remove the obstacles that hold learners back from positive creativity. It also fosters learner engagement by developing the positive aspects of the whole learning environment, building care trust, respect and optimism from the sum of people, places, processes, programs and policies. Two case studies illustrate the task of inviting learners to develop pro-sustainability values and affirm them by a personal creative response. In the *Karma to Climate Change* project, scriptural quotations and environmental information combine to invite learners to make a personal religious pledge to adopt a more pro-sustainability lifestyle. In the *Restoration of Wychwood Forest* project, learners join local community volunteers to plant trees and later reflect on the wider personal significance of their enacting sustainability values.

Keywords: affective education; service learning; active learning, Invitational Education; Joseph Beuys; Deep Ecology; Education for Sustainable Development.

1. Introduction

Connective practices are affective educational strategies that invite learners to build an emotional and conative connection beyond their individual selves and their immediate social circle. They aim to build participatory consciousness rather than on-looker consciousness (Sacks, 2007) and to overcome the knowledge-action, sometimes value-action, gaps that inhibit positive behavior, not least pro-environmental (Burford et al., 2015). In educational terms, they are strategies within transformative education that aim to "transform hearts and minds to serve the world" (cf. Cunningham, 2014, p.1). In the context of education for a sustainable future, the Connective Practice concept links with the pedagogies of Deep Ecology, Social Sculpture and Invitational Education. This paper suggests some practical ways of using connective practices to

enhance the educational benefits to learners from participatory engagement with environmental action in the community. It draws heavily upon the author's three decades in applied sustainability education.

1.1. Connective Practices : Why they Matter:

The development of connective practices, educational activities that are emotionally affective and personally conative, is critical in Education for Sustainability. They matter because, while the world is full of information about every aspect of environmental degradation, there is insufficient concerted will to do what is necessary to change human social behavior and so change the situation. Everybody knows about the problems (cognition) and many worry about the future (affection) but there remains a dearth of individual commitment to effective action (conation) (Hilgard, 1980).

When asked why, personally, they do so little to counter negative environmental change, most respond that the problems are just too big and too distant. They reflect that anything they do will be too small to make any difference.

Often they add in self-justification that, actually, the problem is not their personal responsibility but that of someone else, perhaps the Government, perhaps the business community, perhaps the United Nations. In 2009, Olav Kjørven, then United Nations Assistant Secretary-General, characterized the 20 year history of climate change negotiations as "everyone generally wanting to do as little as possible, while pushing for others to do as much as possible [and] making sure that someone else pays the bill" (Colwell et al., 2009, p.15). The problem is often compounded by "hubris – insolent pride and arrogance – brought about by our belief that human ingenuity and technological sophistication will solve every problem" (Smith et al., 1999, p. vii). In a rallying call to America's Hindu students to support the People's Climate March on April 29, 2017, Allegra Lovejoy of the Hindu Students' Council, quoted verses from the Devi Mahatmyam that describe how the Goddess restored peace and order, dharma, to the Earth by slaying two demons representing ego, self-interest, and attachment to worldly status and possessions (Lovejoy, 2017).

Obviously, there is a need to find a way of connecting learner, personally, more selflessly, and more proactively to the problems of environment and sustainability. There is a need to encourage them to feel more personal responsibility for those problems by reflecting that they result from the billions of small decisions different humans make every day and from their lack of care for the consequences. There are parallels in the arguments for democracy, one vote may make little

difference and, for this reason, many do not vote. However, many votes can change a government with far-reaching, not always positive, impacts on both society and its habitat.

1.2. Connective Practices in Education.

On a smaller scale, in the theatre of formal education, others seek ways of helping learners connect what they have learnt in their course of their studies (or work experience) and how they perform in life (Griffiths and Guile, 2003; Corbett, 2002). Connectivism theory, which emerges from on-line learning and networking, is something rather different. Here, the concept of connective practice is more closely linked to Contemplative Education and to E.F. Schumacher's idea that the culture of the inner human being is critical to the creation of a sustainable future (Miller, 2014). Similarly, education for Global Citizenship includes a desire to recast the learner as an active global citizen or, as Tagore puts it, a "visvakarma" (world-worker or world-maker) (Tagore, 1930, p.42). This is someone who accepts a personal responsibility to act for the welfare of all and so demonstrate the "union of education and life" (Tagore, 1961, p.43).

2. Connective Practices: The Educational Theory

The question arises how do you construct a Connective Practice and how can you ensure that the connection forged is conative as well as emotional? Here, three schools of affective education are trawled for insights on practice, construction and application. These are Deep Ecology, which was built from foundations in Indian thought by Arne Naess and followers, Social Sculpture, where the term Connective Practice originated, which is inspired by the art and political thought of Josef Beuys, and Invitational Education, a mode of educational practice founded by William Watson Purkey and others from roots in perceptual psychology and self-concept theory.

2.1. Deep Ecology Pedagogy

Deep Ecology education is constructed upon a theory of personal maturation rather than learning. This rises through three conceptual steps, each involving a redefinition of the personal self (Naess, 1987): Step 1, *Childhood*, involves the recognition of the Personal self - an individual with an individual will, including (as every parent of a two-year-old knows) the will to express contradiction. Step 2, *Adolescence*, is marked by the emergence of realization of the Social Self. Here, the small individual self becomes redefined in terms of a place in a larger Self, human society, first as part of a small social group such as family, peer-group, tribe, but eventually, hopefully, as part of the larger community of all humanity. In any case, the individual *I-self* becomes subsumed within a larger *we-Self* (Coward, 2000). This intuition manifests in the

world as eco-socialism, which Naess and colleagues dismiss as shallow ecology because it is wholly anthropocentric. For Deep Ecologists, Step 3, *Maturity*, is the goal and involves recognition of an *ecological Self*. Here, the small individual self and even the larger social Self become subsumed within a role inside the entirety of the living world, the community of all life. Stephan Harding argues: "When an ecological world view is well developed, people act from their whole personality, giving rise to tremendous energy and commitment. Such actions are peaceful and democratic and will lead towards ecological sustainability. Uncovering the ecological self gives rise to joy, which gives rise to involvement, which in turn leads to wider identification, and hence to greater commitment. This leads to extending care to humans and deepening care for non-humans (Harding, 1997, p.16).

Recognition of the ecological Self is a logical necessity of the argument of General System Theory (von Bertalanffy, 1968). However, Naess taught the Philosophy of the Mahatma Gandhi and, hence, ecological Self-realization has deep roots in Indian thought, where Self-realization is a spiritual goal. Here, Sāṁkhya-yoga philosophy contains a similar three step spiritual ladder in the form of Triguṇa theory, which raises learners from ignorance and indolence (*Tamas*), through engagement and action (*Rajas*), to serenity and sentience (*Sattva*) (Haigh, 2016a; Kumar, 2007). However, some degree of ecological Self-realization is essential in education for a sustainable future. Anthropocentric thinking has to be mitigated by an awareness that present human needs cannot always take priority because of the greater need to conserve and, where necessary, reconstruct, the wider human habitat for the future.

Of course, full ecological Self-realization is not easily achieved. It depends upon a kind of epiphany, a flash of insight, like that of St Paul on the road to Damascus or that achieved by Naess himself while employing Scandinavian *friluftsliv*, at his mountain hut at Tvargastein (Naess, 2016). Friluftsliv, "free air life", is about experiencing immersion and participation in Nature to the extent that a new sense of oneness within Nature emerges, a new level of consciousness and spiritual wholeness (Gelter, 2000). Harding (1997; 2006, pp. 42-44) repeats the famous example of Aldo Leopold (1949), the wild-life manager who gave the Deep Ecology Movement its slogan "Think like a mountain" (Seed et al., 1988). In the 1920s, Leopold was involved in a cull of wolves in Arizona and New Mexico because they competed with the sport of deer hunting and, of course, it was assumed that human welfare was the key criterion in environmental management. Leopold writes: "In those days, we never passed up a chance to kill a wolf. … When our rifles were empty, the old wolf was down… We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes – something known only to her and the

mountain. I thought that because fewer wolves meant more deer, that no wolves would mean a hunter's paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view" (Leopold, 1949, p.130). Leopold goes on to reflect how, with the wolves gone, deer overgrazed the hillsides and destroyed the land. Subsequently, he formulated his 'Land Ethic', noting that: "When we see land as a community to which we belong, we may begin to use it with love and respect" and that: "we can only be ethical in relation to something we can see, understand, feel, love, or otherwise have faith in" (Leopold, 1949). Harding (1997, pp.14-15) wonders: "What could Leopold have experienced in that pivotal moment in his life? Clearly, he is using the word 'mountain' as a metaphor for the wild ecosystem in which the incident took place, the ecosystem as an entirety, as a living presence, with its deer, its wolves and other animals, its clouds, soils and streams. For the first time in his life, he felt completely at one with this wide ecological reality… He felt that it had its own life, its own history, and its own trajectory into the future. He experienced the ecosystem as a great being, dignified and valuable in itself. It must have been a moment of tremendous liberation and expansion of consciousness, of joy and energy – a truly spiritual or religious experience. His narrow, manipulative wildlife manager's mind fell away. The mind which saw nature as a dead machine, there for human use, vanished."

The key to Deep Ecology pedagogy is the creation of a deep experience through direct participation. Its problem is that it requires a flash of insight that is unique to an individual learner – none of Aldo Leopold's colleagues shared his experience. So, this kind of special event is not something that can be preprogrammed into instruction. Even more seriously, when it happens, its impact on an unsuspecting learner is unpredictable. The Deep Ecology transformative flash of insight involves an expansion of consciousness, a self-critical reappraisal, in other words, a fundamental change in self-concept. It marks the crossing of a threshold of awareness.

However, beyond such a threshold, paths diverge. Some find a gentle personal readjustment. Others experience acute psychological shock that causes deep personal questioning and re-evaluation. Still others become unsettled and enter a liminal state of distress and confusion (Mezirow, 2009; Haigh, 2014). The second two of these outcomes both stress the learner and lead to unpredictable consequences that most teachers might sooner avoid, for ethical and also health and safety reasons. Certainly, in the UK, many scoff at the notion that some educational processes threaten a learner's well-being (Furedi, 2004). Presuppositions of "emotional vulnerability", they say, must not "distract professionals and students from educational experiences that encourage risk, challenge and discomfort as part of striving for autonomy"

(Ecclestone, 2007, p.467). However, a 2016 Yougov poll of 1061 students reports that 63% already feel levels of stress sufficient to interfere with their everyday lives and that 71% of these identify academic work as the main cause. Overall, 27% report mental health problems, 77% relating to depression and 74% to anxiety, typically in combination (Aronin and Smith, 2016).

Providing an intellectual challenge is necessary and good teaching - but within limits. As Hans Selye (1956) pointed out, both too little stress and too much stress inhibit learning; too little leads to boredom and disconnection, while too much causes counterproductive anxiety. Optimum performance, *eustress*, is found somewhere between. It is hard to find an ethical or educational argument for adding to the distress, *dystress*, that many learners already feel. The teacher's challenge is to find that optimum level of stress that maximizes learning across a whole cohort, without damaging any individual within it. In this respect, Deep Ecology's ecological Self-realization may provide an apt goal but, for the majority, its pedagogy does not provide the way. Indeed, Geographers tend to settle on two lower levels of affect – topophilia, a fondness for particular places, and tropophilia, which means becoming affected by, stimulated by, challenged by and hence positively connected to the changing face of particular places (Holton, 2017).

2.2. Social Sculpture

Social sculpture arises from the work of the conceptual artist Joseph Beuys and reflects his belief that art has the power to transform society. This would be achieved by engaging society through participation, so transforming society by releasing the creativity of the people (Beuys, 2007). For Beuys, "art is now the only evolutionary-revolutionary power. Only art is capable of dismantling the repressive effects of a senile social system …. in order to build a social organism as a work of art … every human being is an artist who – from his state of freedom – the position of freedom that he experiences at first-hand – learns to determine the other positions of the total art work of the future social order" (Beuys 1973 in Tisdall, 1974, p.48). Such political ideas share much with the *Situationistes* who believed that they could improve the *psychogeography* of places by changing their subliminal messages through a process called *detournement* (Coverley, 2006). This was often achieved by spray painting, as on John Lennon's Peace Wall, opposite the French Embassy in Prague. However, Beuys action was to plant, together, 7000 oak trees and basalt stone columns in Kassel, Germany. He suggested that "each would be a monument, consisting of a living part, the live tree, changing all the time, and a crystalline mass, maintaining its shape, size, and weight." as a symbolic marker of new beginnings. Beuys chose oak trees because: "It has always been a form of sculpture, a symbol for this planet ever since the Druids, who are called after the oak. Druid means oak. They used their oaks to define their holy places."

Beuys saw his work as teaching and considered teaching to be his greatest work of art. He compared his approach with that of the shaman (Druid) who provokes affective responses by manipulating symbols. "Future goals for the project included: a) an ongoing scheme of tree planting to be extended throughout the world as part of a global mission to effect environmental and social change 'the purpose of educational activities'; b) a growth of awareness within the urban environment of the human dependence on the larger ecosystem through educational outreach; and c) an ongoing process whereby the society would be activated by means of human creative will" (Beuys quoted in Anon, 2011, p.9).

Unfortunately, Beuys' social sculpture is more political argument than practical enaction (Moore, 2012). It concerns building a positive, hopeful, role for art, one less esoteric and elitist and one more capable of effecting positive change in the world. For Beuys, everyone is, or can be, an artist in a socially engaged art that inspires the education, consciousness raising and political action "needed to overcome cold forms of rationalist thinking" (Sacks, 2011, p.96).

McGarry describes the Social Sculpture approach to ecological citizenship as an: "alchemical … approach to learning that expands the range of capacities available to the citizen and the citizen's immediate community… enabling both communal and personal forms of agency: new ways of being and doing in the world." (McGarry, 2013, p.iii). Its connective practices enable the development of empathy, empathetic imaginative contemplation and links between inner and outer thought processes. For Sacks (2011, p.89): "Ecology relates to the social organisms' capacity for life [and] as a living being that cannot be perceived today with our normal sense organs without practice" and it is the provision of that practice and, subsequent reflection on practice, that is critical. Social sculpture aims to connect learners with their hidden personal motivations as well as with the larger social and ecological organism. One typical teaching exercise asks learners to hold a handful of soil and humus in their hands and consider it as a living creature, an activity with echoes of Deep Ecology's Council of All Beings (Seed et al., 1988). A particular benefit of this approach is the way it changes the negative litany of personal responsibility to one of the freedom of response(ability), the capacity to do something in response to an obstacle or challenge, something guided by empathy, intuition and imagination, even if that something is largely symbolic (McGarry, 2013).

2.3. Invitational Education

If Deep Ecology pedagogy suggests the goal of mature ecological self-realization, and Social Sculpture suggests the way this may be achieved through creative participation, then Invitational Education shows how to help learners overcome the inhibitions that prevent them from active engagement and independent thought. Invitational teaching is "an intentional and caring act of

communication" that invites positive feelings and a desire to learn (Shaw & Siegel, 2010, p. 109).

Effective *learning invitations* encourage learners to engage and help them overcome the inhibitions that hold them back (Purkey, 1991). Certainly, many learners have confidence and self-motivation enough to tackle the challenges offered by their education but others do not. They lack sufficient self-confidence, self-belief and motivational fire. They have to be persuaded that they are capable of learning, that participation is a good thing for them, that there is help to be had if they need it, and that they will feel better when they engage. Without sufficient reassurance, they may be unable to overcome their mental obstacles and remain inactive, resentful, and frozen. Purkey uses the example of the 'wallflowers' in a dancehall who are too shy and self-conscious to join in and need to be coaxed onto the dancefloor, where they will relax and have fun.

An invitation is a signal that requests companionship or consideration. A good learning invitation is a signal that helps learners overcome their inhibitions and engage with an educational process. Its key is positive intentionality and its practice devoted to finding ways of intentionally modifying the sum of the (often nonverbal) signals that affect human self-belief (Haigh, 2011). The idea is constructed from perceptual and self-concept theory (Purkey and Stanley, 1991), but it has roots in John Dewey's *democratic ethos* (Dewey and Ratner, 1939).

So, Invitational Education aims to design learning experiences that exert positive psychological influence and to create "environments and climates where people want to be and where they want to learn" (Paxton, 2003, p. 23). Such learning experiences emerge from the combined influence of people, processes, and places, as supported by empowering programs and policies, in other words, from the constructive alignment of the messages transmitted by, and contained within, any given learning project (Biggs, 2003, Haigh, 2011). In sum, the invitation encourages belief in both the value of the learning and the learner's own capacity to achieve goals, which are supported by trust in the authenticity teacher and teaching and confidence in the care and support of the institutional context (Pajare, 2001).

Haigh (2016a) identifies five styles of positive learning invitation, which he links to Triguṇa theory. Using the terminology of Sāṁkhya-yoga, they are styled, respectively: sattvic, rajo-sattvic, rajasic, rajo-tamasic, and tamasic. Shorn of the technical details the five are described as follows.

The first invitation involves attraction by good example and the will to be good. Here the invitation is produced by a role model who inspires the learner to follow their path. One example is Satish Kumar, a leader of the UK's Deep Ecology movement, who describes how he was

inspired by the Bhoodan (land gift) Movement of the Gandhian Acharya Vinoba Bhave. Kumar writes: Vinoba "went to the landlords and said, 'If you have five children, consider me, the representative of the poor, as the sixth child, and give me one-sixth of your land to distribute among the landless.' And it was quite a miracle. He collected five million acres of land in gifts ... So, I … joined Vinoba and walked with him for three years … But for Vinoba, the land-gift movement was only one aspect of his work. The people who walked with him were his students" (Kumar 2007, p.12). Their engaged participation invited discussion and learning. Together, they provided the kind of political theatre that is envisaged by Beuys and his concept for Social Sculpture and, as Kumar demonstrated, the practice connected him to solving the problems of the Earth (Kumar, 2007).

The second style invokes the desire to do good so engaging compassion, empathy and the desire to make situations better. Problem based learning, which aims to build the skills and expectation of problem solving, a key skill valued by employers, is used in many applied disciplines but it originated in medical education (Walker et al., 2015). Problem based learning is often a communal activity, undertaken as group-work, and it yields the reward of success, achieving successful solution and, often, doing some good if it tackles a real world problem (Pawson et al., 2006). The approach is often linked to the 'disaster' case-study approach (Taylor, 2014). However, here, the focus is, typically, positive and focuses on the construction of a solution.

The third style of learning invitation invites action for its own sake namely the joy of accomplishment, the 'adrenalin rush', perhaps accompanied by a form of self-assertion and self-validation. This creates a problem common in Geography and Geology fieldwork, for example, where the activity involved in accessing a field site, climbing a mountain for example, may become more important to the learner than the site that the climb was intended to access. However, in the Integral Education system of Sri Aurobindo, training and enhancement of the physical body is seen as a necessary first step. Sri Aurobindo argued: "… the body is the material basis, the body is the instrument which we have to use ….the body is the means of fulfilment of dharma, and dharma means every ideal which we can propose to ourselves and the law of its working out and action" (Anon, 1995, p.13). His disciple, The Mother added: "those who practice physical culture, scientifically … acquire a control over their bodies that is unimaginable for ordinary people ... [achieved] ... by material means and an enlightened use of human will … spiritual mastery and the material mastery … one is always incomplete without the other" (Anon, 1995, p.33). Research suggests that the experience of mastery, whether of a

physical or intellectual skill, is the most important source of self-belief and self-efficacy, which is why action is a key learning invitation (Usher and Pajare, 2008).

The fourth evokes the spirit of competition and the will to win and to defeat. The lure of victory invites the learner to be the best, to overcome and destroy rivals, to gather the spoils and so, ultimately, to beggar their neighbor. In a way, this invitation is inherent to our system of education that rewards the 'best' with good grades, prizes and so forth and then holds them above those who achieve less. This encourages hard work and engagement, certainly, but it also encourages conflict and base instincts such as pride, greed and selfish behavior. Haigh (2016a) repeats a fable from the Indian Mahabharata epic, which concerns training for archery (Ganguli, 1883-1896, Mahabharata, Adi Parva, Sambhava Parva, Section 124-125). The teacher sets his class a test. He offers a target and asks what each contestant sees? One sees the target, the tree where it stands, and the whole environment after the fashion of Deep Ecology. He fails this test. Another sees nothing but target's eye. He passes. However, later, this winner uses subterfuge to have a rival of superior skill disabled simply to preserve his being the best. Competition breeds pride, envy, stress, discrimination, greed and dishonesty, as the Olympic doping scandals prove, as well as resentment depression and despair among those who are not winners. In fact, it is the source of many of the destructive attitudes that pervade our modern world. Invitations based in competition appeal to ambition and to some, usually selfish, future goal.

The fifth style of learning invitation invites action by evoking repulsion from bad example. Here, the teacher acts as devil's advocate to hold up a mirror that shows learners some unpleasant aspects of themselves, their life or their environment and so provoke their desire to react and make the situation better. Of course, much of Beuys' work was based in subtle forms of provocation. However, in technical education, the provocation is often given the form of diagnosing what went wrong. Much case-study analysis in the applied disciplines: engineering, medicine, business, etc., describes some kind of problem, failure or disaster. The question discussed becomes what were the causes, what can be learnt from the experience and what can be done to prevent such problems in the future? Learning from past mistakes is a fundamental aspect of education and key to the practice of preventative, reactive and aspirational ethics (Harris et al. 2005).

In sum, Invitational Theory contributes by focusing, not on the consequences or methods of using connective practices, but on the motivations of participants and upon the intentional design of appropriate reward systems. Reviewing the five styles of learning invitation enables a critique of the pros, cons, relative strengths and appropriateness of each style, which abets the design of invitational systems that are best suited for particular education tasks and contexts.

3. Two Connective Practice Case Studies

Three sources of theory for the application of the Connective Practice concept to sustainability education have been discussed. Deep Ecology provided the concept of the ecological Self that is achieved by a deep intuitive recognition that one is a part of, not apart from, the global system, which it would call Gaia (Harding, 2006). Social Sculpture, arising from the artistic and political provocations of Joseph Beuys, contributes the notion of the connective practice as well as its essence of universal, affective, creative, participatory, positive response-ability that aspires to unleash the creative potential of the whole of society for the benefit of a better world (Beuys, 2007). Everyone can be an 'artist' and everyone can be a *visvakarma*, the world-maker envisaged by Rabindranath Tagore. Finally, Invitational Education encourages concern for the inner being of the learner. Its learning invitations aim to overcome their inhibitions by considering different forms of motivation and reward. It also emphasizes the role of positive intentionality in fostering learner engagement with education, not only sustainability education. This is achieved by considering the whole learning environment and intentionally creating positive messages of care, trust, respect, and optimism from the sum of people, places, processes, programs and policies (Haigh, 2011).

The question remains: how can this be applied in practice? This section explores two case studies of connective projects that have deeply involved the author (Haigh, 2016b; Chauhan et al., 2012; 2009). The first involves creating a culturally appropriate sustainability education for one of the larger British Ethnic Minority communities, in this case, Hindu people of mainly Indian origin, who are now first, second and sometimes third generation citizens of the UK. Peer reviewers often comment on the intellectual discomfort they feel when emphasis is given to unfamiliar Indian authorities and theories. This case study deals with the reverse of this situation. Sustainability education messages in the UK tend to be framed in the language and thought of the majority English community. Often these ideas seem alien to audiences in Britain's cultural and ethnic minorities. Consequentially, they have little conative effect. The challenge was to create a cross-cultural community educational program that invites such people to explore more pro-sustainability lifestyles. The *Karma to Climate Change* project sought to connect British Hindus to pro-sustainability behavior patterns using resources from their own culture and religion.

The second case study involves an attempt to connect British undergraduates with the world outside their university, to build a connection with both the natural world and local community and invite them to ground their classroom learning in sustainability within the realities of the outside world. It adopts the conventionally familiar method of engaging the learners in tree

planting but moves beyond simple physical exercise, first by embedding the experience within the academic curriculum and then by fostering reflection on the meaning of such participatory pro-sustainability actions.

3.1. Connective Case Study 1: Karma to Climate Change Project.

Sustainability education employs connective practices to persuade people to consider their behavior and avoid unconscious waste and pollution. The *Karma to Climate Change* project was designed to help the British Hindu community reduce its ecological footprint (Chauhan et al., 2009; Sita Rama das et al., 2014). In Hindu tradition, every thought and every action has an effect called *karma*, which attaches each individual to the material plane and to a cycle of reincarnation. The Laws of Karma, not unlike the Laws of Science, suggest that for every action there is a reaction, good, bad - not necessarily equal, but a line of credit or debit to be settled in the future. Bad karma is created by short-sighted self-indulgent behavior, which may yield immediate gratification but, ultimately, causes distress - much as inhaling tobacco smoke leads to respiratory disease and much as reliance on fossil fuels causes carbon dioxide emissions that lead to climate change. By contrast, good karma is created by respect for dharma, far-sighted and dutiful action, compassion, good citizenship, healthy living and treating both people and the habitat with care and respect. These actions can seem challenging at the time but, in the long run, they lead to good consequences and a brighter future. Better still, however, is *niskarma*, which means no karma. Karma-free actions are those undertaken as service to, and whose results are surrendered to, God. These lead to spiritual advancement and, ultimately, to liberation from the endless Hindu cycle of rebirth.

Because of reincarnation, each life carries karma in three forms. First, there is a reservoir of karma from past lives that remains to be resolved, partly in the present life. Second, there is new karma, created in the present life, whose consequences will also be experienced in the present life and, third, there is new karma, created in the present life, which will affect a future life (Klostermeier, 1986). In the same way, environmental degradation and pollution has impacts that affect the present generation and create burdens that future generations will have to carry.

The educational problem was how to alert the Hindu community to the link between their present lifestyle and future environmental consequences and so invite more pro-environmental behavior; in other words, how to invite behavioral change away from the generation of bad karma and toward the generation of good or niskarma? The core team assembled for this work consisted of three individuals, two from the Indian diaspora and the author. Creative input as well as logistics and project management was led by Sheila Chauhan, then a recycling manager

for Local Government. Inspiration, leadership and both spiritual and practical guidance was provided by His Grace Sita Rama das, founder of the Lotus Trust (thelotustrust.org), an educational agency that aspires to transform lives and improve the environment (Sita Rama das, et al., 2014). The author took responsibility for post-project reflection, data analysis and the creation of a post-project written legacy. The key insights were, first, that Britain's major Hindu festivals provided a way of reaching the community at the time when it might be most receptive and, second, that the tradition's respect for the spirit of renunciation and its concept of the *vrata*, a vow or resolution associated with religious observances, provided a path.

The campaign employed a tented educational experience, which was fielded at the Janmashtami Festival that celebrates Lord Krishna's appearance on Earth, at the Bhaktivedanta Manor temple at Watford, northwest of London. This is the largest Hindu Festival in Europe. In 2013, it attracted around 70,000 devotees across two days (BBC News, 2013). For a few years, the project's 'Eco-tent' became a regular feature on the festival grounds. Simultaneously, smaller versions were fielded at other festivals including the annual Diwali celebrations in Trafalgar Square in central London, which attracts 10-15,000 rather more diverse participants, as well as some smaller events including the Shaka Festival in Wembley, 2010, and two annual meetings of the National Hindu Students Forum.

The educational agenda of the *Karma to Climate Change Ecotent* exhibition aimed to lead individual and family participants through some of the core precepts of Hindu religion and philosophy, through the challenge of sustainability, which was cast as a personal responsibility, and toward reflection upon what greater personal contribution they could make. The Ecotent's sequence of exhibits engaged with four step educational process. Step one involved instruction in the form of a trail through a series of both religious and sustainability-related tableaux, scriptural quotations and audio/visual displays. Step two engaged self-appraisal; each participant was encouraged to complete a modified *ecological footprint* questionnaire, here rebadged as a *karmic footprint calculator*, which assessed the environmental impact of their lifestyle in terms of the number of Planet Earth's (one, two or three) that would be needed if everyone lived the same way (Best Foot Forward, 2007). Step three fostered reflective introspection; each participant was encouraged to discuss their questionnaire scores and, usually, to justify why they were as high as they were. Step four engaged action; participants were guided towards thinking of some small or larger change they could make that would reduce their karmic burden (ecological footprint) on the Earth. Most Hindu's begin their day with a recitation of the Gayatri mantra and the request to Mother Earth (Bhumi-mata) to allow them to place their feet upon her. Here, they also are reminded that Lord Krishna's appearance was requested by Bhumi-mata in order to reduce her

heavy burden of evil kings and people. So, especially at Janmashtami, the idea that good Hindus should aim to be less of a burden upon the Earth is not hard to convey. The final step is to consider pledging to make a pro-sustainability change in their lives by writing their personal vow to Lord Krishna upon a wall of pledges, or sometimes by attaching their message as a leaf on a pledge tree (Chauhan et al., 2009). The two main versions of the display are described and illustrated with photographs in Chauhan et al. (2009) and Sita Rama das et al. (2014). However, in both cases, the design moves the learner from knowledge, through consciousness raising, introspective personal reflection, and toward engaged targeted action (Jensen, 2002). The hope was that connecting pro-sustainability behavior to religious observance might have a lasting effect on some of those who participated by converting awareness to intentionality (Chauhan et al., 2011).

Questionnaire Rank (Options from less to more sustainable)
1. Electricity supply (fossil fuels - renewable sources)
2. Holiday travel (by air - by car - by bus or train)
3. Purchasing Decisions (by price and quality - organic, fair trade, low food miles - local or home produced)
4. Local Travel (car - bus (car pool) - cycle or walk)
5. Diet (non-vegetarian - vegetarian - vegan)
6. Priorities (me and my family - my community - the world and its future)
7. Money and Possessions (make me proud, I want more - just sufficient for comfort - not important to me)
8. Wants (More and better - sufficient for comfort - no more than I need to live)
9. Advocacy for Sustainability (I do nothing - occasionally - set a good example/encourage others)
10. Food (Mostly pre-packed convenience foods - a mixture of fresh and convenience foods - mainly organic, fresh and home produced)
11. Recycling (I don't bother - partly recycled or reused - most recycled, reused or composted in my garden)
12. Switch off Electrics (I leave them on - switch them off - use low energy lightbulbs etc)
13. Water use (I use a power shower or bath - a shower)
14. Home Insulation (full home insulation and double glazing - partial - none)
15. Fashion (When one of my possessions falls from fashion I throw it away - make do as long as it functions)

Figure 1. Self-appraisal questionnaire. Results in rank order.
Red on the chart indicates those topics where the participants indicated that, currently, they performed badly in sustainability terms; green shows where they did well; blue represents intermediate or mixed self-assessments.

More than 3,000 individuals and family groups participated in these events. Figure 1 ranks the responses to those self-appraisal questionnaires that were left with project researchers, 1075 in total. On the down side (red), these show that most were unaware of the possibility of sourcing their energy from renewable resources, that most were involved in long haul holiday travel, made purchasing decisions on the basis of price and quality more than environmental impact, and travelled by car. One the positive side (green), few were concerned about fashion, and most were concerned to conserve electricity and water by whatever means possible.

More than 1900 pledges were made on the pledge wall. The list includes several topics that were not included in the questionnaires; although arguably most should have been. They are

highlighted in amber on Figure 2. There are also several items the questionnaire combined that are treated separately. However, the broad pattern is clear. In general, participants pledged to do better those things that, already, they did well (green). In most cases, apart from local transport, their less pro-sustainability behavior featured much less in the pledges. There were suspicions about Green Energy suppliers, reluctant to give up long haul travel because of their wish to visit family or go on pilgrimage in India, and a lack of interest in the merits of organic and locally produced food.
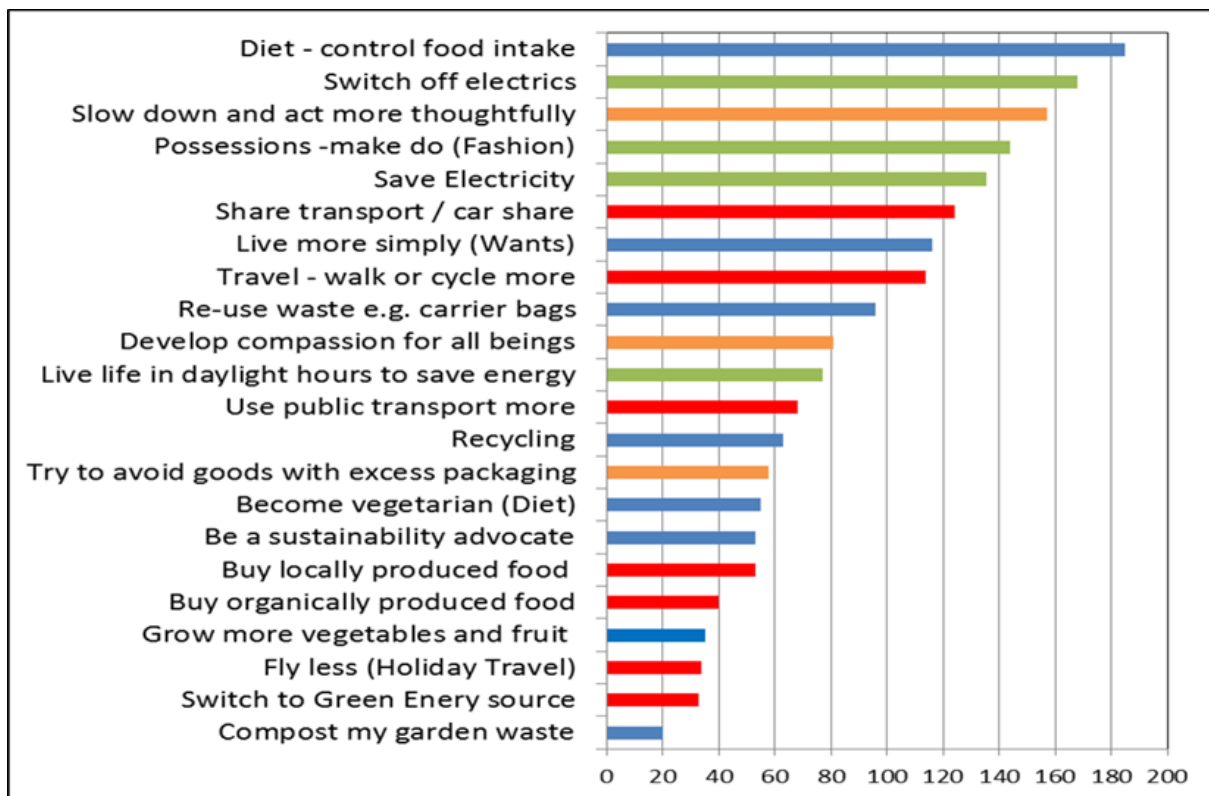
Figure 2. Number of pledges made in rank order. For obvious reasons, most participants committed to a single pledge but a few made more. (Green indicates where the self-appraisal questionnaires indicate existing strong pro-sustainability behavior, red the opposite, blue intermediate or mixed and amber indicates where the pledge was not mentioned on the questionnaire.)

The Karma to Climate Change project connected everyday knowledge and awareness to something personally conative by connecting that knowledge to scriptural injunction and religious devotion through the culturally specific contexts of karma and vrata, the religious pledge. The project also highlights the limits to this approach by showing that there are things that that will not be renounced, such as long haul travel, and that the approach only works where there is already knowledge and awareness. In this case, lack of awareness, about the provision of renewably sourced energy or lack of conviction about the merits of organically produced or local produce, meant that the connection was less often made.

The Karma to Climate Change project concluded in 2011, partly because it had saturated its audience and partly because the Lotus Trust wanted to move to a new venture, the production of *Ahimsa* - ethically pure milk, (i.e. milk production that places animal welfare first). However, the message about consciousness raising was taken aboard and, for several years ahead of its launch, the new project was preceded by massive publicity about the problems of conventional and even organic milk production, which involves the slaughter of healthy cows after a very few years of life and almost all male calves on the day of their birth, of course, alongside scriptural invocations. The Ahimsa milk project is discussed by Sita Rama das et al. (2014) and in regular updates on the Lotus Trust website.

3.2. Connective Case Study 2: Restoration of Wychwood Forest.

Involving learners in tree-planting is a common educational strategy at all levels of education. Usually, this is done in the name of environmental improvement or carbon-sequestration to combat climate change. However, tree planting is a simple action that can have deep personal significance for those involved. They may reflect on the environmental benefits of their actions, in terms of restoring land to Nature, combatting climate change, improving landscape aesthetics, etc. For Beuys: "the tree is an element of regeneration which in itself is a concept of time…[and]…a symbol for this planet" (Beuys, 1982, in Demarco, 1982, p.46).

However, tree planting activities may have deeper affective impacts. Those involved may reflect that the tree they planted may outlive themselves, possibly by many centuries. Like parenting, it offers a connection with a future that lies beyond their own life-spans and, in this case, possibly beyond those of their children and grandchildren. Hence, it encourages thinking about intergenerational ethics. Equally, like parenting, this activity has the power to connect the tree-planter to the welfare of another living creature. Tree planters commonly care for their trees and also for trees their loved ones have planted. In the author's *Cradle for Nature* project, which concerns the community-based forestation of degraded former opencast coal-lands in South Wales, some of the initial volunteers have remained with the project for decades, some rejoining the annual field camps for more than 25 years (Haigh, 2018; 1998)

Here, the subject is the *Wychwood Project*, a Local Government supported community volunteering initiative aimed at engaging young people in community projects. Its logo declares that it is about restoring landscapes and inspiring people (www.wychwoodproject.org). Its goal is to restore parts of the former Royal Hunting Forest of Wychwood, including awareness of its history and identity. In 1086, Wychwood Forest covered much of what is now West Oxfordshire District, England, perhaps 310 km^2, which, although never entirely forested, is a landscape now

much degraded by years of neglect. To counter this, the Wychwood Volunteer program encourages (especially young) people to volunteer their help in conserving and restoring its landscapes and wildlife habitats. As the local university, for 4 years, Geography undergraduates at Oxford Brookes University were enabled to volunteer to plant trees with the Wychwood volunteers as coursework for a larger exercise on education for sustainability, (global) citizenship, ethics and team building (Haigh, 2016b).

Arguably, the very act of working with and alongside volunteers from the local community is a connective practice, although reports from those students involved suggest that its affective impact is quite small. However, students hidden away in the academic 'Ivory Tower' and student-focused social whirl of a university can be largely oblivious of the local community. In Oxford city, there is a long history of often not very positive interactions between 'town and gown'. It might be hoped that engaging learners in helping the community solve its problems and achieve its dreams would help build bridges of empathy and understanding. Such positive participation, as with all such *Service Learning* should be good both for the university, demonstrating its relevance, and for the community, which benefits from the physical and technical assistance that the university provides (Jacoby, 1996).

As Jacoby emphasizes, service learning involves more than just participation in good works in the community, it also requires structured reflection to connect the experience with its learning goals (Jacoby, 1996). Here, this process was initiated by inviting student participants to attach to trees, which they themselves had planted, a message of 18 words describing their hopes for the future (Haigh, 2004, 2016b). Preparatory classes discussed the function of Buddhist prayer flags, the *Karma to Climate Change* pledge wall described above, Diana Bell's *Remembering* installation from our local Museum of Modern Art, Oxford (Bell, 2004) and Yoko Ono's *Wish Tree*, which has invited >1 million participants to attach their personal messages for peace to a tree branch (Imagine Peace Tower, 2010).

At the end of their tree planting experience, learners were required also to complete a participation questionnaire, which functioned both as the off-campus class register and the first step in a process of guided reflection continued through following classes (Figure 3). The questionnaire, following the ideas of Sri Aurobindo and Deep Ecology, moves from near the learner to further away. It begins with their selves. Participants reflect on what they have just finished doing and the activity's meaning in their course curriculum and for themselves (if any). It then moves outwards to consider what this exercise might mean to their instructors, something many found very difficult. Finally, it links the activity to sustainability via the concept of *Global Citizenship*.

| 1. "My deepest hope for the future and the world is…"; the 18 word message that I posted on the trees that I planted … |
| 2. Given the curriculum of 'The Ethical Geographer' module, the purpose of this exercise is… |
| 3. But, what (if any) significance does this exercise hold for me, personally? |
| 4. What (if any) significance might this exercise hold for my instructors, who designed this event? What is their real purpose? |
| 5. What do I understand by the term: "Global Citizenship"? What are its main components? |

Figure 3. Guiding reflection: tree planting participation questionnaire

A complete analysis of the testimonies and questionnaires obtained by all iterations of this exercise is published in Haigh (2016b). The present report excludes data from on-campus plantings, which proved less affective, partly because of some cynicism about the motives of the university in allowing the work. Just 89 of the total of 283 participants supported the four off-campus tree planting events but they are the focus of the following analysis. This analysis is based on independent-sample t-testing. Here, values of p indicate the probability that the observed result could be due to chance alone. Where this is <1 in 20 (i.e. $p<0.05$), it is suggested that the finding is significant.

The first question asked participants to record the 18 word message that they had attached to their trees. The main themes concerned environmental sustainability (47), followed by peace on Earth (29), the welfare of future generations (17), the welfare of self or family (11) and prosperity (8). Forty-seven of the participants recorded themselves as female and 40 male. T-testing showed that only significant difference was that a higher proportion of the females hoped for family wellbeing ($p=0.044$).

Question 2 asks the participants what purpose this tree-planting activity served in their education. Many thought that was to help them think about their role in Nature (37) and about giving something back to the environment (34). A few (10-13) mentioned ethics, their ecological Self, the future, and carbon neutrality. There were no significant gender linked differences in these responses.

When asked what the experience meant to them personally, most replied that it allowed them to do something for the environment (42) and helped them remember their personal responsibilities for sustainability (24). Smaller numbers felt that they were doing something practical (21) to help the future (16) and/or the local community (13) through volunteering (12). However, a few valued the exercise merely as a change from the classroom (14), a means of gaining assessment (5) or a futile gesture (5). Significantly more females felt that the exercise was about doing practical work ($p=0.023$) and/or connecting them to their personal responsibilities ($p=0.027$).

Few felt able to imagine what was in their teachers' minds. However, some thought it was something to do with education for sustainable development (23) or the future (10), or having them reflect on their life styles (12). Just 6 considered it might be about building links with the community. Significantly more females felt that the teachers intention was for them to reflect upon their life practices (p=0.019) and that the activity was simply education for sustainable development (p=0.044).

The final question asked participants, at least those in the final year of the exercise, just 25 in all, to suggest what they thought was included in the concept of Global Citizenship. Four topics led the field: social justice (16), sustainability (14), interdependence (12) and personal responsibility (10). Despite the messages they attached to the trees, peace on Earth and the welfare of future generations were hardly mentioned.

This case study employed tree planting as a connective practice. In the *Cradle for Nature* project, which involves the community-based forestation of degraded former opencast coal-lands in South Wales, participant testimony shows clearly that the project has connected these volunteers with the fate of their trees (Haigh, 2017; 1998). However, in the present case, the trees themselves get hardly a mention and very few participants expressed any interest in returning to see how their trees fared in the future.

So, the question arises, did the academic context and reflective exercises detract from the connective power of the act of planting? Here, the students' 18 word hopes-for-the-future and the academic context of education for sustainability may have directed the learners thoughts to larger issues. This might explain why thoughts about helping the local community were not in the forefront. However, the Deep Ecological concept of connecting with another living creature also went missing and, as their comments on global citizenship indicate, the attitudes of most learners remain firmly anthropocentric. It is possible that another kind of connective practice, such as working with disadvantaged people, might have had much greater affect in this respect.

For many years, environmentalist followers of the Mahatma Gandhi have tried to restore degraded communal lands in the Himalaya by having children from the local Primary School plant trees. The logic is simple, no-one would cut down the tree planted by their child or dare damage the tree planted by the child of their neighbors. Instead, these trees were cared for and specially tended (Haigh, 1988). Certainly, some of the Wychwood planting work has this aspect, especially the two occasions when the student volunteers helped plant out a Community Woodland for a local town.

So, while tree planting is a simple action that can have deep personal significance, this is not universally the case. Certainly, the activity is useful for encouraging the idea of self-agency,

response-ability, meaning that it makes participants aware that they can make a personal contribution to the welfare of their habitat. Those involved may reflect on the environmental benefits of their actions, in terms of restoring land to Nature, combatting climate change, improving landscape aesthetics, etc. Similarly, these activities may have deeper affect, encouraging those involved to reflect on the world of the future because the tree they plant has the capacity to outlive them by many centuries. In some participants, it may assume an affect similar to parenting, an investment in a future that lies beyond their own life-span and even that of their children. Equally, like parenting, this activity has the power, in theory rather more than practice, to connect the tree-planter to the welfare of another living creature. Tree planters commonly care for their trees and also for the trees their loved ones have planted. However, it is clear that such feelings cannot easily be created in the contexts of tree plantings by schools or universities or any situation where the symbolic meanings of the planting are diluted by other concerns, such as passing examinations and completing coursework. So while such contexts are readily used to foster deeper reflection about the learner's personal responsibilities to the environment and for sustainability, few achieve the intuition of ecological Self-realization or even its weaker Geography alternatives: topophila and tropophila (Holton, 2017).

4. Discussion

Connective practices are affective educational strategies that aim to create a deep, emotional bond between learners and the subject of their learning. Their aim goes beyond that of creating awareness, knowledge or even understanding by seeking to target and direct the learner's ethical and empathic sensitivities. Typically, they employ active, participatory, means to construct a sense of, yes - personal responsibility, but more importantly conative personal response-ability, the creative impulse to make a difference, no matter how small or symbolic, through personal engagement and action. In case study 2, above, several learners dismissed the action of tree planting as a futile gesture, something that would have no long term effect and, in a technical sense, probably they are correct. However, no matter how minimal may be the impact on carbon mitigation, the action was a performance that carried a message, it was something that was seen to be done, something that suggested some people cared, and an act of environmental altruism that invited others to make their own responses to the challenges of sustainability and environmental change.

Educational connective practices are effective because they engage participants through participatory action that demonstrates a public commitment. Participation may be as small as one scribbled promise to God posted, among many others, on a wall, as in case study 1. However, as

in all constructive and experiential learning, it is the public demonstration of a commitment that helps focus the learner's reflective thoughts on the action they have taken: why it is justified and what more could be done. Creative activity tends to construct a desire for more creative activity, a commitment that builds connection.

Returning to educational theory, connective practices are strategies that address the higher levels in the Bloom-Krathwohl taxonomy of educational objectives, especially where this t addresses the affective domain, rather than the psychomotor (skills) or cognitive domains (Krathwohl et al., 1964). In a revision by Anderson et al. (2001), the cognitive domain climbs upwards from *Remembering* through *Understanding*, to *Applying, Analyzing, Evaluating* and *Creating*. Connective strategies clearly tackle all levels from *Understanding* upwards but their key contribution is that they access the often neglected highest level of *Creating*. In the affective domain, the taxonomy's levels reach upward from *Receiving*, becoming aware, through *Responding*, which involves active participation, through *Valuing*, which means internalizing a feeling that the activity is worthwhile, to a phase of *Organizing*, which involves prioritization and the resolution of internal value-related confliction, and, finally, *Internalizing*, where the new values are reflected in the everyday performance of the individual. If the educational strategy achieves its goal, then the values of the learning are expressed in everyday behavior. Here, connective practice case study 1, demonstrates a real capacity to invite learners to make observable lifestyle changes. Case study 2 does the same - but mainly for that small proportion of participants who move on to more voluntary work or who carry the notion of response-ability into their lives.

5. Conclusion

Coincidentally, while writing this paper, the author received an email from W.W. Purkey, founder of Invitational Education, asking what led the author to explore Invitational Education. The same email also answered the question, in part, by avowing the movement's commitment to "efforts to create, sustain and enhance truly democratic, caring and welcoming" education (Purkey, 2017).

Beyond this, Invitational Education's value lies in its holistic approach to the educational environment. It aims to create positive messages from the interactions between people, places, processes, programs and policies working together in constructive alignment. More importantly, it explicitly recognizes that many learners are self-inhibited from learning by a simple lack of belief, often self-belief, and by a helpless sense of alienation, which learning invitations seek to overcome. Only when that initial threshold of willingness to engage is overcome can connective

practices begin their work of developing Beuys-style response-ability, the capacity and desire to make a creative contribution. Self-efficacy, or better creativity, invites acts of self-expression in the material world, which can be guided into positive paths by appropriately designed learning invitations. When reinforced by activities that are truly affective, these may encourage the kind of spiritual opening out envisaged by Sri Aurobindo (Anon, 1995) and Satish Kumar (2007). When these engaged activities are sufficiently connective and when they encourage response-ability for the welfare of the living Earth, at whatever scale or level, they signpost the long path towards ecological Self-realization, that deep connection with the whole of the living world. However, even when they fall well short of this goal, they help learners realize the highest levels of educational objective in both the cognitive and affective domains of the Bloom-Krathwohl Taxonomy, namely creativity and the internalization of values.

Some practical approaches have been illustrated by two case studies, which show how to invite learners to develop values and affirm them by creative acts that support sustainability and the needs of future generations. Joining the above email discussion, John Novak (2017) pointed out that: "we transform by way of the rich connective transactions we participate in" adding that the education outcome "depends on the quality of our participation". In the first, scripturally-based information invites learners toward making a public commitment in the form of a personal religious pledge to engage in a (slightly) more pro-sustainability lifestyle. In the second, learner participation in environmental restoration by tree-planting with a local community volunteer group is employed as an invitation to reflect on the larger significance of this action both for themselves and for their role as 'global citizens'. In both cases, the aim is to empower those involved to use their own independent creativity for further action and to personally enact their own sustainability values.

Acknowledgements

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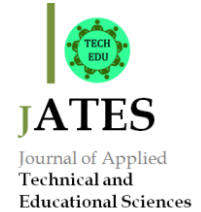
Environmental Education and Active Citizenship

Claude Poudrier[a]

[a]Director of the Program in Environmental Education & Citizenship (PEEC), Trois-Rivieres, QC, Canada

Abstract

Now at the 21st Century, education needs to be adapted to youth and children of our time. Learners are requesting active education into concrete situations of pedagogy. The model of «Action Research for the Community Problem Solving» (AR:CPS) responds to this need perfectly. As an example, in his last speech, former President of USA Barack Obama has raised the importance for active citizenship to engage people into the «problem solving process». This is what the Program in Environmental Education and Citizenship (PEEC) has developed as an expertise in the last 20 years. This approach can be applied in any situation, technical as educational. The program has been shown to build critical, reflective and empowering democratic skills and to inspire its participants to engage fully in problem-solving within their communities. Evaluation of the outcomes since 1993 suggest that this is a method that is considered beneficial by participants, by their communities as by educational institutions at all levels, and that it may provide a more effective mode of education for environmental citizenship.

1. Introduction

For the past ten years an environmental and citizenship education training program has been offered in Québec in fifteen or so school boards, two private schools, Dawson College, Day Care Centers, Université du Québec à Montréal, and seniors. This training program is designed for all groups of ages, starting at 4 years old. That includes elementary, secondary school teachers, education consultants and also for adult education and pre-school educators.

The program is called Program in Environmental Education and Citizenship (PEEC).

The PEEC is based on an educational model known as "Action Research for Community Problem Solving" (AR:CPS). This model leads students and learners to become actors in, for and with their communities. Program evaluations conducted thus far have shown that students, teachers, parents and school administrators are very satisfied with this model, its application and its outcomes.

The AR:CPS approach advocates a citizenship education learning strategy that leads actors of all ages to:

- Identify a problem of concern to them in their community.
- Analyze the problem by considering its different issues.
- Identify potential solutions.
- Select the one that best fits the situation.
- Develop and implement an action plan.
- Evaluate the process and its outcome.

This model opens up the community to the school. The immediate environment, as seen by the actors, becomes a source and tool for learning. The students select and develop projects based on a problem-solving approach. The students identify various problems in their school or neighborhood, such as vandalism, vacant lots, rundown buildings, bullying, waste of energy or drinking water, etc.

The model proposes thirteen steps for developing community projects linked to the social, physical or biophysical environment (see in the Box on the next page).

The teacher leads the first two steps. The students then become partners in the decision-making process and gradually take on all or part of the project management. The teacher now acts as a guide, a resource person. Throughout the process, the students log everything they experience in a journal. They record their findings, comments and even feelings (new knowledge, awareness, understanding, participation strategy, perseverance, state of mind, communication).

Developed in the United States by William B. Stapp in 1988 (Bull, J. et al., 1988) the AR:CPS model often aimed to change the conventional school environment and to improve teaching and learning conditions in schools. In fact, not only can this model lead young people to solve community problems, it can also offer solutions and avenues for thought about school-related teaching/learning problems.

AR:CPS Thirteen Steps

1. Process planning by the teacher, in collaboration with all concerned partners: principal, colleagues, parents, community members, etc.

2. Diagnosis evaluation of students' abilities in solving problems, in order to spot their "deficiencies". As the project goes along, the teacher will have to try to develop required abilities through appropriate teaching and exercises.

3. Students' awareness of community problems. An exploratory visit of immediate environment is an excellent way to discover these problems and become sensitive to them.

4. Listing of noticed problems. The brainstorming technique is then useful. Problems may be classified and their interrelations underscored.

5. Identification of criteria for the selection of a problematic situation to be solved.

6. Selection of problematic situation.

7. Search for information on this problematic situation. It may be documentary researches, interviews, observations, etc. A lot of information comes from community environment itself.

8. Clear definition of problem inherent to the analyzed situation.

9. Search continuation on the problem now clearly defined.

10. Examination of possible solutions (again, brainstorming session).

11. Development of criteria for the selection of preferred solution.

12. Development and implementation of action plan.

13. Evaluation of action considering expected effects and follow-up.

2. Active participation in community life

In March 2005, the Canadian Policy Research Networks (CPRN) published the results of an online survey of ca. 200 young Canadian adults aged from 18 to 25 years. (Canadian Policy Research Networks, 2005) The survey was designed to identify young adults' priorities in relation to six themes predetermined by an advisory committee made up of people of the same age. The survey results revealed that young people truly want to be active citizens (be involved in decisions). This was the second time that the CPRN confirmed Canadian citizens' desire to participate in bringing about the changes they want. In fact, another CPRN study in 1995 had revealed the same hunger for participation. (Peters, 1995)

As was mentioned previously, the AR:CPS model leads students to take concrete actions in their communities, given that the strategy is geared toward having them solve a real problem by developing and then implementing an action plan. It is also worth noting that students explicitly take part in decisions, since they themselves choose the local issue they will work on. Step by step, they make their way through a democratic process by remaining the leaders of their project.

3. Accountability and community belonging

In an article addressing the changing boundaries of citizenship, Jane Jenson, Director of CPRN's Family Network, defined citizenship as both a status and a relationship (between state and citizens). (Jenson, 2001) According to Jenson, the boundaries of citizenship involve three dimensions: rights and responsibilities, access and belonging. She also questions how citizens' formal equality can be turned into real participation.

So far, the evaluations of AR:CPS projects have demonstrated that student participation in community problem solving strongly promotes the development of their sense of accountability and community belonging because these young people are the leaders of the projects they create in collaboration with a guide (teacher or other person). This methodology thus contributes to developing students' sense of responsibility toward their communities.

4. Partnership development

New research studies led by the CPRN have taken up the challenge of redefining Canada's social model. Mary Pat MacKinnon, Director of CPRN's Public Involvement Network, addresses this issue in her article Citizens' Values and the Canadian Social Architecture: Evidence from Citizens' Dialogue on Canada's Future. (MacKinnon, 2004) According to MacKinnon, citizens want to play a larger role in the democratic process and would like greater concrete opportunities to engage with decision makers on issues that affect their collective quality of life.

The AR:CPS approach gets students to work in partnership with the members of their communities, which leads them to improve their quality of life by solving real issues through local engagement. "Collaboration, team work and coordination are the new buzzwords. Nowadays, no actor can act alone," stated Denis Saint-Martin, Research Associate with CPRN's Family Network and professor of political science at the Université de Montréal. (Saint-Martin, 2004)

5. Democratic daily life

To confirm the importance and need for our society to involve citizens in decision making within, for and with their communities, the CPRN launched its Focus on Youth program in August 2004 to mark its tenth anniversary. Naturally, one of the core goals of the program was to identify effective approaches for engaging youth in their community's democratic process. One of the effective methods suggested was the AR:CPS model.

In the same vein, the Conseil supérieur de l'éducation du Québec stated that no citizenship education program can yield tangible results if the students do not have concrete opportunities to apply the values, rights, responsibilities and civic involvement they are taught in class. (Conseil Supérieur de l'Éducation, 1998) The link between teaching and practical experience in school is therefore crucial for successful citizenship education. Moreover, an environment most conducive to citizenship education is one that offers students frequent opportunities to exercise their citizenship.

The AR:CPS model does just that: it creates multiple opportunities for students to apply their citizenship education skills because it spans the entire school year. This strategy also helps students develop aspects that are key to active participation in democratic society, such as critical thinking, communication, persistence and collaboration.

6. Community roots and social responsibility

The Conseil supérieur de l'éducation du Québec also stated that citizenship goes hand in hand with the development of community roots. From that perspective, we must create a dynamic that stimulates interaction and participation and that teaches individuals to be actors. (Conseil Supérieur de l'Éducation, 1998)

The AR:CPS approach follows those guidelines because it engages students to serve their community and encourages them to take an active part in democratic society and to develop their sense of social responsibility. Giving meaning to school learning, developing critical thinking skills and creativity, and giving students the chance to learn and acquire experience outside the conventional framework are clear messages that emerged from a report published by the Canadian Education Association on the importance of fostering the minds of young Canadians. (Canadian Education Association, 2004) This report also mentioned that parents want their children to fully participate in the life of the community. From that viewpoint, the AR:CPS model seems to meet the needs of Canadian society, that is, to involve citizens, regardless of age, in decisions that concern them. In doing so, they will be able to contribute to improving their quality of life and that of others not only by building the foundations of their knowledge but also, and above all, by developing the behaviours and attitudes that are key to citizenship education.

7. Summary

The benefits for learners (no matter the group of age), teachers, principals, parents, community members and stakeholders are clearly showed by the Research Center in Education and Ecocitizenship (Sauvé, 1992, Université du Quebec à Montréal-UQAM). Moreover, the PEEC is the only program in Environmental Education and citizenship recognized by the Ministry of

Education in Quebec. Educational organizations in different countries have requested the expertise of PEEC (USA, Mexico, South Korea, China, France, Finland…).

Also, the National Film Board of Canada (NFB) has produced a documentary called « Hope Builders ». http://films.nfb.ca/hope-builders/. This film shows how young students of 11-12 years old apply the AR:CPS model for solving the problem of vandalism in their community.

To facilitate the work of the « guide » who leads a group of learners into the 13 steps of AR:CPS (ex: professors, teachers, educators, community workers) the PEEC provides tools to the « guides » and learners as logbooks, each one corresponding to the group of age of learners.

Even if it's becoming a stereotype, as educators, our dream is still to bring the learners to express and apply their ideas for a better place to live.

Again, the AR:CPS model contributes to achieve that dream.

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Main environmental problems and how to deal with them in education – a review

Tímea Taligás

*University of West Hungary, Faculty of Forestry, 4. Bajcsy-Zsilinszky, Sopron 9400, Hungary
Hungarian Academy of Sciences, Research Centre for Astronomy and Earth Sciences GGI, 6-8. Csatkai Endre st.
Sopron, Hungary
e-mail: taligas.timea@agrar.mta.hu*

Abstract

Nowadays people begin to recognize that there are problems in our environment and they must do something about it. The purpose of this paper is to presents the most important environmental problems without a priority order. For example, we have to provide the required energy, drinking water and adequate food as well to ensure the livable environment for everyone. In order to solve these problems, it is important to understand that we have to examine them as a coherent system. Environmental education is a good opportunity to spread this mindset among students of all ages. In the second half of this study education methods are presented where environmental problems can be effectively addressed in pedagogical practice. The paper argues that environmental education is the first step to solve and to prevent aforementioned global environmental issues.

Keywords: environmental problems; sustainability; environmental education

1. Introduction

Climate change is the most popular and well-known environmental problem, that raised awareness of society, economy and politicians. On one hand this is good, as people start to do something, try to find solutions for the climate change, but on the other hand it takes away attention from other environmental problems. There are many environmental matters besides climate change that cause problems already or will cause in the near future, e.g. energy production, providing drinking water and food in the appropriate quantity and quality for everyone, or to preserve the nature. These are just the most important ones. The effects of climate change are the most obvious, but there other problems with more subtle effects. All these problems need to be addressed. To solve these environmental challenges it is necessary to have an environmentally conscious society. The way to such a society could be through environmental education. If people grew up aware of the interconnected nature of the environment, and felt responsible for global problems these could be solved or even be prevented easily.

2. Environmental Problems

Based on the Nobel Prize winner, Richard Smalley's work (2005), Szarka (2012) rethinks the most important problems that threaten humanity focusing on the environmental impacts. These are energy and raw materials (minerals), fresh water, soil (agriculture), and livable environment. These are the most basic conditions for the welfare of society. All these conditions are connected as a system; therefore they should be addressed together, as a whole.

2.1. Energy and raw materials

In the near future there is no need to fear about running out of raw materials (Schulz and Briskey, 2003; Szarka, 2008). However the availability of the rare earth elements might be a cause for concern since most of them are used in electrical devices and their consumption is increasing (Alonso et al., 2012; Koltun and Tharumarajaha, 2014). Modern man uses twelve times more energy than 100 years ago. Our energy supply is based on the cheap, easily available fossil resources (crude oil, coal, natural gas). The raw material reserves are limited and their mining, transport and manufacturing impact the environment (Sorrell et al, 2010). Nuclear energy has a huge impact on environment and it could be hazardous as well. Our energy requirements are not manageable by renewable energy alone. The biggest problem is not the type, but the amount of energy used. Decreasing energy consumption would be the best solution.

2.2. Fresh water

Although 70% of the Earth's surface is made of water, but only 3% of it is freshwater, and two-third of that is ice and snow. The biggest part of the freshwater supply is ground water that is hard to access. Freshwater supplies are limited and humanity simply consumes more than nature can provide. Surface waters are already contaminated and we started to get to ground water sources too. The distribution of drinking water is uneven, the poorest regions are lacking drinking water, while in contrast, advanced countries use drinking water in excess (Nield, 2005).

2.3. Soil resources

Soil is the source of life. The population is growing, so more and more fertilizer is used to ensure sufficient quantity and quality of food. The overuse of fertilizers is polluting the soil, the surrounding water reserves and the atmosphere. The agricultural soil erodes faster than it could be regenerated (Szarka, 2012). Our ability to increase food production is limited, it will not grow infinitely. The human impact on the surface of the Earth is larger than the natural processes (Crutzen, 2002). Overconsumption is the biggest concern in the case of soils, too.

2.4. Environment

Changes in our environment are most visible in the case of weather, climate and biodiversity. It is not known exactly how big of an effect we have on Earth's climate, but the effect and the change is undeniable. People won't necessarily be able to adapt to changes this quick. Extreme weather conditions cause problems both directly by affecting health and indirectly by making food production harder.

The general consensus between scientists is that climate is changing. Some researchers state that the weather is changing because of human factors and that this is a problem that should be dealt with immediately (Takács-Sánta, 2007, Bartholy et al., 2011, Gelencsér, 2017), while others say that these human factors are insignificant and that this takes attention away from more important problems (Smalley, 2005, Szarka, 2012, Harangi, 2017).

All throughout Earth's history species evolved and went extinct, but the rate of species formation was always greater than the rate of extinction over larger time periods which ensured biodiversity. Humanity increased the rate of extinction 100-1000 fold, which is unprecedented. Biodiversity is beneficial for both humans and the environment: soils with lower biodiversity have lower yields, balances get thrown off and ecosystems are destroyed (Vida, 2013).

Over the last one and half century humanity has altered the composition of the atmosphere considerably. Greenhouse gases (nitrous oxide (N_2O), carbon-dioxide (CO_2), methane (CH_4), sulfur-dioxide (SO_2)) and aerosols have increased in concentration, while stratospheric ozone reduced (Beaulieu et al., 2011, Gelencsér, 2017). Some scientists (Keeling, 1960, Dlugokencky et al., 1994) think that the increasing concentrations of these gases have a big effect on climate change and they have other serious associated health risks. "Eco-friendly" technologies and slowing down consumption could help reducing these effects.

A new ozone-depleting gas has been identified: N_2O besides being a greenhouse gas has an ozone-depleting effect as well. The biggest source of N_2O is agriculture and soil. In areas where farmers use fertilizers with high nitrogen content the emission is considerably greater (Ravishankara et al., 2009). This is a sensitive subject: people have to eat but also need an ozone layer to protect them against the sun.

More and more trash is generated and the wasted resources mean that we put a greater strain on natural resources than necessary even without taking waste management into account.

3. Solutions for global environmental problems

Jancsovszka says that (2016) global environmental problems are only solvable through international collaboration. The aim of this collaboration would be to ensure continuous

development while not endangering the needs of future generations. This was the topic of multiple international conferences in the last decade.

The Sustainable Development Goals is a system that includes global aims, targets and indicators that the UN members will have to take into account in the next 15 years during their political decision-making processes (http:// http://www.un.org/sustainabledevelopment/, UN, 2015). This went into effect in January 2016. It includes 17 sustainable economical, environmental and societal goals (Jancsovszka, 2016).

It's not enough to sign an agreement like this, but to keep in line with its goals people need to make them part of their everyday lives. There are successful agreements but they are few and far between. People can't expect politicians to solve these issues through laws and policies, these issues need actions from the general public as well. Grass-root organizations can provide solutions and substantial gains, starting from individuals. This is where environmental education is really important.

4. Environmental problems and education

The goal of environmental education is to teach people to live in harmony with and to protect and preserve the natural, built and social environment. This is a process through which people get to learn about their environment and about living in a sustainable fashion (Havas, 1993, Malatinszky, 2009, Wals et al., 2017). Children are especially open to environmental education, because their habits are still malleable. As people get older, their habits and their way of life becomes more and more difficult to change, so education has to begin early. Environmental education is not a simple subject; it's more of a mindset and a practical method to create a globally conscious society. Most of the big environmental problems are already known, but we need to improve on transferring this knowledge, along with a system-conscious viewpoint to the next generation.

4.1. The role of schools and sustainable development

Varga et al. (2011) investigated the role of schools taking public action in the fight for sustainable development. School studies have to get closer to everyday life and students should take part in more projects that need cooperation between different social groups. The first objective should be to obtain the knowledge necessary for a sustainable development.

4.2. Development: the key to sustainability could be geosciences

Lampert (2011) developed a method and study matter based on one of the 12 issues of GEO-FIFIKA (published in 2008) books, because he thinks that the problem of sustainable

development will be solved by geoscientists. In his opinion all of the other well-edited and easy-to-understand issues could be used to teach any age group with the appropriate methods and additions. Based on this method study matter could be developed based on the other issues as well.

4.3. Developments: Soil, a less interesting subject

Halbritter (2011) didn't find enough teaching material about soil so he developed one of his own. He constructed a practical class (field work, collecting samples, empirical investigation, lab experiments and water-permeability tests) where students learn by experiencing what they would normally learn about by reading books.

There is more and more teaching material focusing on this kind of knowledge and if any field is lacking, Lampert and Halbritter are good examples that useful material can be developed for any field.

4.4. Computers and environmental education

Nowadays computers, tablets and smartphones are a part of everyday life. Halácsi (2011) says that internet use can improve the global viewpoint and systematic view of students, and that it's fundamentally important in getting to know global processes. Studies proved that a deeper understanding can be achieved if students talk about real-world problems and they actively participate in looking for solutions. A good example for this is BEAGLE (Biodiversity Education and Awareness to Grow a Living Environment) and Carbon-dioxide detective project.

Games are a key to how children learn. To connect games and environmental education with technologies we get environmental protection PC games (Szigeti and Horváth, 2012).

5. Conclusion

There are many environmental problems to solve: energy, drinking water, quality food for everyone, climate change and preserving nature just to name a few. These problems are just symptoms of our increasing consumption, so it is not practical to make them a priority; instead the root of the problem needs to be eliminated and we need to change the way people think. Environmental education could be a good solution to solve these problems. With an environmentally conscious society it is possible to solve or even to prevent the problems.

It is not a new idea; long ago this thought was natural, as this Chinese proverb says:

„If you are planning for a year, sow rice;

If you are planning for a decade, plant trees;

If you are planning for a lifetime, educate people."

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Education in the Sustainability Development Goals (2016-2030), sustainability in the education

János Mika

Eszterházy Károly University, Eger, Leányka 6, H-3300, Hungary. E-mail: mika.janos@uni-eszterhazy.hu

Abstract

The United Nations (UN) accepted the Sustainable Development Goals (2016-2030) for mankind, including 17 Goals and 169 Targets. Sustainability is understood in its widest sense, considering society and economy as equally important pillars, as environmental safety. Fulfilment of these aims needs active and prepared participation of future generations, hence education of these tasks is inevitable. In the paper, a reasonable classification of the Goals is provided, which is missing in the document. This classification sorts the 17 Goals into five groups: *Primary needs of humans* (Goals 2, 3, 6 and 7); *Equality between humans* (1, 4, 5 and 10); *Efficient, sustainable production* (8, 9, 12 and 13); *Landscapes in danger* (11, 14 and 15) and *Worldwide cooperation* (16, 17). Goal 4 is devoted to education with 10 Targets, whereas eight further Targets of six Goals literally mention education or synonyms. Having them briefly presented, the paper critically notes those Targets, where education is also requested, but not mentioned by the document. There are also recommendations on how to teach sustainability in the various secondary school subjects. Reversely, examples are also provided to convince the Reader about possibility and usefulness of applying sustainability to support practically all school subjects and to develop key competences by selected aspects of sustainability. In the Appendices, there are global and European indicators, to be used in education of and by sustainability.

Keywords: SDG (2016-2030); education; school subjects; key competences; global and European indicators

1. Introduction

The term Sustainable Development was effectively distributed by the Bruntland Commission Report (1987) as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* Nowadays, the scope of the Sustainable Development is much wider than the initial concept of environmental sustainability (e.g. Goodland and Daly, 1996). Society and economy are not only preconditions of ensuring environmental sustainability, but both economy and society add to the problems to solve. A recent survey of original and complex concepts of sustainability is provided by Kiss and Morelli (2015). (In this paper, the expressions *sustainable development* and *sustainability* are used as synonyms.)

The sustainability paradigm largely differs from the old paradigm of economic development, according to which the damaging social and environmental consequences were seen as inevitable and acceptable. However, at present it is obvious, that major damage or serious threats to the well-being of humans and the environment are risks for economic development, as well.

Since its establishing, the UN tries to provide peace and prosperity on Earth, as to ensure fair distribution of the goods. Sustainable development as a concept reached public consciousness at in connection with the second Earth Summit (Rio de Janeiro, 1992), where the UN affirmed the program entitled *Tasks for the 21st Century (Agenda 21)*. A few years later, in 2000, world leaders formulated eight main goals for the period 2000 - 2015, i.e. the Millennium Development Goals (MDG). Environmental sustainability was only one of the eight goals of the document.

The UN accepted the *2030 Agenda for Sustainable Development* for 2016-2030, including 17 Goals in 2015. This document, integrating all aims of mankind into Sustainable Development, is in the focus of the present study. These goals are compared with the relevant UN documents by Vladimirova and Le Blanc (2015), their financial aspects are considered by Klapper et al. (2016).

The UN organization for education and science, the UNESCO provides teachers' toolkits on sustainable development, the most recent member of this series is dated from 2017 (UNESCO, 2017). The target readers of this series are primary and secondary teachers, as well as those decision-makers, who are responsible for the content and aims of the education, as well, as teacher educators who work in preparation and training of the school teachers.

The 8th World Environmental Education Congress (WEEC, 2015) Summary Report writes *"possibilities for education and learning for a transition away from ... global systemic dysfunction and towards a healthier, more equitable and balance way of living. Not by propaganda, force or prescription but rather by discovering, (re)connecting, questioning, disrupting, experimenting, reflecting and, indeed, continuous learning."* These sentences are our motivations to recommend the Sustainable Development Goals for educational purposes.

2. The UN Sustainability Goals (2016-2030)

The United Nations accepted the 2030 Agenda for Sustainable Development including 17 Sustainable Development Goals (SDG, 2015) including 169 more detailed targets. These goals spread over all environmental, social and economical aspects of sustainability, all over the world. The 17 established Goals, comprehended in Fig. 1, are not ordered into any logical structure.

Figure 1: The pictograms of the 17 Sustainable Development Goals (Harvey, 2016)
(Note, that these pictograms exist in different versions, especially for Goal 3, 9 and 15.)

Table 1: Grouping of the 17 Goals (2016-2030). All original texts are denoted by ("."):

Group of Goals	Numbered Goals G
Basic human needs	"**2.** End hunger, achieve food security and improved nutrition and promote sustainable agriculture." "**3.** Ensure healthy lives and promote well-being for all at all ages." "**6.** Ensure availability and sustainable management of water and sanitation for all." "**7.** Ensure access to affordable, reliable, sustainable and modern energy for all."
Equality and justice	"**1.** End poverty in all its forms everywhere. " "**4.** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." "**5.** Achieve gender equality and empower all women and girls in their social role." "**10.** Reduce inequality within and among countries."
Efficient, sustainable economy	"**8.** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all." "**9.** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation." "**12.** Ensure sustainable consumption and production patterns." "**13.*** Take urgent action to combat climate change and its impacts.*"
Protecting vulnerable environments	„**11.** Make cities and human settlements inclusive, safe, resilient and sustainable. "**14.** Conserve and sustainably use the oceans, seas and marine resources for sustainable development. "**15.** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."
Cooperation towards common goals	"**16.** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels." "**17.** Strengthen the means of implementation and revitalize the global partnership for sustainable development."

*"Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change."

Even the coloring of the logos do not coincide with any classification of the Goals, though it would be rather useful in memorizing and understanding the goals, i.e. from educational aspects. Hence, a trial is made to classify the goals keeping their original numbering in Table 1. We cannot recommend this classification as the one and only solution. E.g. Goal 7 (energy) is not a human need itself, just the use of it may help them, or Goal 1 (poverty) is also related to basic needs, etc.

The SDG were recommended as a document reflecting the important *5P* for mankind: *people, planet, prosperity, peace, partnership* (SDG, 2015: p. 2). These concepts, however, do not really accompany the document. The first two groups of our classification, the basic needs (No. 2, 3, 6 and 7) and the equity group (No. 1, 4, 5 and 10) deal really with *people*. The next two groups, the production (No. 8, 9, 12 and 13) and the zones in danger (No. 11, 14 and 15) fit to *prosperity* and *planet*, respectively. *Peace* and *partnership* point at the smallest group, cooperation (No. 16-17).

The original 17 Goals contain altogether 169 Targets. From these, 126 Targets contain quantitative objectives, mostly related to 2030. The rest of the Targets point at organisation needs as preconditions of the objective targets. As a rule, the quantitative targets are marked by numbers, and the latter ones by letters. Let us cite examples for both related to Goal 1:

> **1.1** By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day."

> **1.b** Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions."

Let us remark, that there is one Goal which is problematic to select into any of the groups. This is *Goal 13. Climate action*, since climate change is the only environmental problem which is tackled as a separate Goal in the SDG (2016-2030). All other problems, like reduction of biodiversity, ozone depletion, etc. are considered in other goals as their effects on the vulnerable spheres or on the human health. Another remark is that this Goal refers to the Paris Agreement (2015) which deals with several aspects of climate change, not mentioned by this Goal.

3. Education in the SDG

3.1. Goal 4 on Education

One goal among the 17 ones is devoted to education (*Table 2*). The first three targets (4.1 – 4.3) list the tasks according to the age of the pupils, emphasizing that free basic and secondary school education should be available for everyone. Pre-school and post-school educations are

also included, though they may be of lower priority, as it is reflected by the sequence of the targets.

The next three targets (4.4 – 4.6) are qualitative requirements of education, such as: providing vocational skills for successful employment; inclusivity of the schools in various aspects; as well, as literacy and numeracy should fully characterise the younger generations.

Goal 4.7 requests knowledge on sustainable development, whereas the background conditions (4.a – 4.c) require development of inclusive schools; special financial funds and education-oriented professions in higher education and enhance the education of teachers.

Table 2. Original text of Goal 4 devoted to education, and its targets in the SDG (2016-2030)

Target	"Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"
4.1	"By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes"
4.2	"By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education"
4.3	"By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university"
4.4	"By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship"
4.5	"By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations"
4.6	"By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy"
4.7	"By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development"
4.a	"Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all"
4.b	"By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries"
4.c	"By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States"

One should note that there is a missing aspect of higher education which is the key for any society to be able to successfully adapt the newest elements of innovation. This means not only technology, but social aspects of organizing our work or everyday life. Training capable intelligence is not mentioned in Goals 9 either.

In Section 3.3 we will provide several examples in connection with those Targets where education is required to fulfil the aims but education is not mentioned, but let us see, where and how education is reflected in the Targets of the SDG (2016-2030).

3.2. Education explicitly mentioned in other Goals

There are eight further Targets in the SDG where education or related expressions are definitely mentioned (Table 3). They represent six Goals. Three of them (2.2, 2.5 and 3.7) are related to food and health. Another one claims to reduce number of young people without both job and school. Furthermore, two Targets that emphasize necessity of education on sustainability and on its partial aspect, climate (12.8 and 13.3, following 4.7 see above in Table 2). Finally, two Targets mention knowledge transfer, as an aim of partnership and cooperation (17.6 and 17.16).

Table 3. Targets of SDG (2016-2030) definitely mentioning education or its synonyms

Target
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and **equal access to** land, other productive resources and inputs, **knowledge**, financial services, markets and opportunities for value addition and non-farm employment
2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and **fair and equitable sharing of benefits** arising from the utilization of genetic resources and associated **traditional knowledge**, as internationally agreed
3.7 By 2030**, ensure universal access to** sexual and reproductive health-care services, including for family planning, information and **education**, and the integration of reproductive health into national strategies and programmes
8.6 By 2020, substantially reduce the proportion of youth **not in** employment, **education or training**
12.8 By 2030, **ensure that people** everywhere **have** the relevant **information and awareness** for sustainable development and lifestyles in harmony with nature
13.3 **Improve education,** awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and **enhance knowledge sharing** on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism
17.16 Enhance the Global Partnership for Sustainable Development, complemented by multi-stakeholder partnerships that , expertise, technology and financial resources, to support the achievement of the Sustainable Development Goals in all countries, in particular developing countries

Besides these Goals (4 for education, 2, 3, 8, 12, 13 and 17) definitely mentioning education, in fact, all the other ten Goals are somehow related to education and to its result, knowledge and competence. These Goals are detailed in the next Section.

3.3. Education implicitly needed to fulfil other Goals

The various challenges to be met by Mankind in the next 15 years require much improvement mostly requesting new knowledge and competence from many of us. In general, this means learning or education on the other side. *Table 4* displays a list of the ten Goals not mentioning education explicitly, and selected aspects to be considered in respect to the given Goal, if one wishes fulfillment of it. The missing education could also be mentioned concerning the Targets.

If conditionally classifying our knowledge as natural sciences, social sciences and technology, the missing aspect require all these sectors in equal distribution, i.e. five times (50% of the ten Goals): Natural sciences are noted in connection with Goals 1, 6, 11, 14 and 15. Social sciences have significant effect on Goals 1, 5, 10, 11 and 16. Education of technology is inevitable to meet the challenges of Goal 1, 6, 7, 9 and 11.

Goals 1 (Poverty) and 11 (Urban problems) need all kinds of knowledge, sorted above in three classes. Goal 6 (water and sanitation) needs natural and social sciences, all the other Goals from the ten investigated in this section need only one of the above science groups.

It is sad that the working groups elaborating the various Goals did not consider these aspects.

Table 4. Goals not explicitly mentioning education, though learning is inevitable to fulfill the given targets

	Goal	Missing aspect
1.	End poverty in all its forms everywhere	Lack of education and poverty do interact. Good education helps to eradicate poverty.
5.	Achieve gender equality and empower all women and girls	In many societies the equal right of female members of family is not obvious. Equality should be learned there.
6.	Ensure availability and sustainable management of water and sanitation for all	To achieve this goal highly educated directors, well trained staff and developers are needed, at all levels.
7.	Ensure access to affordable, reliable, sustainable and modern energy for all	This is a fast developing complex industry, hence life-long professional learning is inevitable.
9.	Build resilient infrastructure, promote inclusive, sustainable industrialization and foster innovation	This, knowledge- and innovation-intensive Goal needs the best technological education.
10.	Reduce inequality within and among countries	Acting against interests in keeping the inequalities needs high level education of social sciences.
11.	Make cities and human settlements inclusive, safe, resilient and sustainable	Geography as natural and social science, in one, helps to understand the urban problems. However, specific multidisciplinary education is needed to solve them.
14.	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	People have no experience with the oceans, hence this goal especially needs higher education.
15.	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Acting for this goal needs the highest level and interacting natural science education. The task needs not only educated theoreticians, but communicators to convince or overcome those of counteracting interests.
16.	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Knowledge is not enough to reduce crime and terrorism. Social sciences help to understand. Teaching by good examples finds the solution.

4. Opportunities of educating of and by sustainability

Sustainability can be included into education in two ways. Either we teach components of sustainability, and turn the students' attention towards its aspects or we use sustainability to achieve other educational goals e.g. to emphasize topics of given school subjects, or to develop competences. Focusing at the SDGs, the first way is described in Section 4.1 and the second one is compiled in Section 4.2. Appendix A and B provide examples to be applied in both directions.

4.1. Aims to educate the sustainability goals and targets

Since sustainable development contains all aspects of our life, if the school subjects have any connection to the present, past or future of mankind, this should not be difficult to find places in any school subject where one or the other aspect of sustainability can be successfully presented.

Table 5 presents selection of school subjects of the secondary schools in Hungary, arbitrarily classified as social sciences, human culture and natural sciences. The initial number of the subjects was 19, but *Dance and motion* would be difficult to apply for education of sustainability, whereas in case of *Visual art* too many goals should be mentioned. So, the number of school subjects is 17, i.e. the same as number of Goals in the SDG (2016-2030). We equally distributed each Goal among the subjects, aimed to find characteristic subjects for each Goal.

Though it would be too long to explain how to include sustainability into each subject, but we shortly do it for one subject from the three groups. From among the six subjects of *Social sciences*, we refer to the Native language and literature, providing excellent possibilities to use such abstract concept as e.g. *inclusive societies, accountable institutions, abuse, trafficking, torture and illicit financial flows* (Goal 16) or *tax and revenue collection, official development assistance, mobilize financial resources, debt relief and restructuring, stakeholder, race vs. ethnicity, dissemination and diffusion, environmentally sound technologies, duty-free and quota-free market access* (Goal 17).

Table 5. The two most relevant sustainability goals feasible to emphasize in the secondary school topics in Hungary (http://kerettanterv.ofi.hu/03_melleklet_9-12/index_4_gimn.html)

School subject	Goals to explain
Social Sciences (6)	
Native[a] language and literature	Goal 16. Peace and justice; Goal 17 Partnerships for the goals
Foreign languages[b]	Goal 8. Good jobs, economic growth; Goal 15. Life on land
History[c]	Goal 1. No poverty; Goal 10. Reduce inequalities
Economy[c]	Goal 2. No hunger; Goal 8. Good jobs, economic growth
Philosophy	Goal 12. Responsible consumption; Goal 17 Partnerships for the goals
Ethics	Goal 5. Gender equality; Goal 14. Life below water
Human culture (5)	
Physical education and sport	Goal 3. Good health; Goal 10. Reduce inequalities
Song and music	Goal 13. Climate action; Goal 15. Life on land
Theatre and dance	Goal 5. Gender equality; Goal 16. Peace and justice
Motion picture and media	Goal 1. No poverty; Goal 14. Life below water
Technology and way of living	Goal 4. Quality education; Goal 7. Renewable energy
Natural Sciences (6)	
Mathematics	Goal 4. Quality education; Goal 13. Climate action
Information technology	Goal 9. Innovation, infrastructure; Goal 12. Responsible consumption
Physics	Goal 7. Renewable energy; Goal 9. Innovation, infrastructure
Chemistry	Goal 6. Clean water, sanitation; Goal 11. Sustainable cities and communities
Biology	Goal 2. No hunger; Goal 3. Good health
Geography	Goal 6. Clean water, sanitation; Goal 11. Sustainable cities and communities

[a]Hungarian, in most cases; [b]two of them compulsory in the secondary schools; [c]inc. social and civic knowledge

Note, that these examples are written in their original English wording, here. In national languages, finding the correct expressions need additional preparation of the teachers until the common education tools provide these correct translations and explanations.

From five subjects of the *Human culture* group let us select the subject Motion picture and media which demonstrate the selected Goals (see in Table 5) in the most straightforward manner. Poverty (Goal 1) is mostly seen in the developed countries or in those locations of the given country where majority of the students do not appear at all, or spend as short time, as possible. Concerning the wonderful but also threatened underwater life (Goal 14) it is even more difficult to find any personal experience among the pupils. So, good selection of movie scenes with brief explanations helps the students to discover and internalize both aspects of sustainability.

Finally, from six subjects of *Natural sciences* Geography is the subject where the selected Goals can be easily demonstrated. Facts of water availability and canalization (Goal 6), and the urban problems, mostly connected to over-population (Goal 11). Both aspects can be efficiently presented over each continent of the world and in the detailed description of a given country.

Another tool to expose various aspects of sustainability and to convince our audience about the usefulness of the systemic approach to our life is to collect all related Targets to one problem. In Table 6, there are those 21 Targets collected, which are related to the selected problem of *water management*. This means the 8 Targets which are obviously related to the problem in Goal 6, but there are further 13 Targets of nine further Goals, that are devoted to poverty, food, health, energy, cities, sustainable production and consumption, climate, oceans and lands.

The first four targets are related to such threats, as shorter and longer term weather extremes and pollution of water by water-born diseases and by chemicals. The eight Targets of the Goal 6, focused on water and sanitation, denote aims concerning quantity and quality of water (first three Targets) and defines tools for water management to achieve them (next three targets). The two number.letter Targets urge professional capacity building, especially in the developing countries, and participation of local communities to solve the problems.

In the nine remained targets there are two pairs which are relate to the cities, the oceans and the lands, i.e. the vulnerable environments. For the cities the aim of decreasing the victims of environmental catastrophes and enhancing the resilience against them are requested. Concerning the oceans, reduction of marine pollution and of effects of inadvertent CO_2 pollution, leading to acidification of the oceans, are declared. Concerning adequate treatment of freshwaters and combating desertification is emphasized concerning the water problems. The remained three Targets point at water energy as the widest form of renewable energy, whereas two other Targets practically repeat the requests decrease the environmental pollution and the effects of disasters.

Table 6. Example of focusing at one problem: the water management in 21 Targets of the SDG (2016-2030)

Targets
1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability **to climate-related extreme events** and other economic, social and **environmental shocks** and disasters
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, **drought, flooding** and other disasters and that progressively improve land and soil quality
3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, **water-borne diseases** and other communicable diseases
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, **water** and soil **pollution** and **contamination**
6.1 By 2030, achieve universal and equitable access to safe and affordable **drinking water** for all
6.2 By 2030, achieve access to adequate and equitable **sanitation and hygiene** for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
6.3 By 2030, improve **water quality** by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
6.4 By 2030, substantially **increase water-use efficiency** across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially **reduce** the number of people suffering from **water scarcity**
6.5 By 2030, implement **integrated water resources management** at all levels, including through transboundary cooperation as appropriate
6.6 By 2020, **protect and restore water-related ecosystems**, including mountains, forests, wetlands, rivers, aquifers and lakes
6.a By 2030, expand international cooperation and capacity-building support to developing countries **in water- and sanitation-related activities** and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
6.b Support and strengthen the participation of **local communities** in improving water and sanitation management
7.2 By 2030, increase substantially the share of **renewable energy** in the global energy mix
11.5 By 2030, **significantly reduce** the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including **water-related disasters**, with a focus on protecting the poor and people in vulnerable situations
11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, **resilience to disasters**, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly **reduce their release to** air, **water** and soil in order to minimize their adverse impacts on human health and the environment
13.1 Strengthen resilience and adaptive capacity to **climate-related hazards** and **natural disasters** in all countries
14.1 By 2025, prevent and significantly **reduce marine pollution** of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
14.3 **Minimize** and address the impacts of **ocean acidification**, including through enhanced scientific cooperation at all levels
15.1 By 2020, ensure the **conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems** and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
15.3 By 2030, **combat** desertification, restore degraded land and soil, including **land affected by** desertification, **drought and floods**, and strive to achieve a land degradation-neutral world

4.2. Supporting education by sustainability goals and targets

Besides treating sustainability as a topic of our teaching, it is easy to find examples in the majority of school subjects, where sustainability may be used as supporting tool for particular subject topics, as provided in Table 7 for the six above subjects of natural sciences.

Let us explain the examples of just one school subject, Physics. Importance of material sciences can be made well understood by explaining how solar energy is transforming into electricity in the solar cells, or what kind of and how strong forces the rotors of a wind-mill should compensate. Solution of the energy accumulation could provide examples for various basic laws of thermodynamics. Working of a dynamo can be illustrated in water energy plants, together with potential and kinetic energy, as a by-product.

Table 7. Examples for teaching school topics supported by referring sustainability in the various natural sciences

Sciences	Examples for teaching the given topic referring sustainability
Informatics	automatic switches to alternate the energy sources, information mining
Mathematics	Fibonacci numbers (reproduction of animals), decision matrices, angle functions
Physics	material sciences, solution of energy accumulation, working of a dynamo
Chemistry	bio-energy formation and utilisation, save the devices from corrosion, etc.
Biology	optimize for green mass (instead of grain mass), recognition of bird flies towards wind mills
Geography	spatial distribution of the energy sources, role of local social structure and financial ability

Development of the nine key competences fixed by the National Core Curriculum (NCC, 2012) for Hungary is an equally important goal of the education than learning of the thematic school-subjects. (They are derived from the eight EU competences by separating the science and mathematical competences.) In Table 8 the key competences are listed, together with examples how the given competence can be improved by studying the Sustainable Development Goals.

In case of mother tongue and foreign languages, the abstract nature of sustainability may help to learn expressions that are rare in everyday talking, together with possibly enhanced interest of the pupils to individually elaborate specific topics of sustainability. For mathematical, scientific, technical and digital competences the common core is to convince the pupils how important these competences are for sustainability of mankind, i.e. how important those pupils can be for the society who develop high level in one or more of these similar competences.

For the next three competences, i.e. for Social and civic competence, Sense of initiative and entrepreneurship, and Aesthetic and artistic awareness and expression, sustainability may be too complex to be directly applied to improve these competences, but pointing at just one Goal, e.g. taking over the hunger of people or saving the underwater world for animals is well applicable to improve these competences, too. Finally, for improving the Efficient and independent learning competence, the rather interdependent nature of sustainability is an attractive feature.

Of course, both the school subjects and the competences can be supported by sustainability not at the very abstract level of the SDG Targets. They must be interestingly illustrated which requests extra efforts from the teachers. After the Conclusion, Appendix A and B are devoted to help providing such illustrations for teaching by and of sustainable development.

Table 8. Examples of possible use of SDG (2016) to develop key competences

Key competence	Examples of using SDG to develop the KC
Communication in the mother tongue	
	• learn new words of various aspects of SDG
Communication in foreign languages	
	• find extra motivation in understanding the SDG
Mathematical competence	
	• emphasise examples where math is used to fulfil one or other SDG
Competences in science and technology	
	• emphasise examples where science is inevitable to fulfil one or other SDG
Digital competence	
	• besides the Internet, expose IT as a key to improve efficiency of mankind
Social and civic competence	
	• emphasise good examples of co-operation in natural catastrophe threats
Sense of initiative and entrepreneurship	
	• emphasise successful firms e.g. in renewable- and low-carbon industry
Aesthetic and artistic awareness and expression	
	• endangered landscapes may be picturesque examples to enjoy and understand
Efficient and independent learning	
	• request individual analysis of interesting SDG aspect to learn for learning

5. Conclusion

The concept of sustainable development gained new importance after the United Nations declared the 17 Goals for mankind in 2015. As it is also mentioned in the Introduction of the present study, this renaissance of the concept should be reflected by the education, as well.

Lack of logical order in these thoughts about our Future hampers the understanding and memorizing them by a student. Section 2 provides a classification of the Goals having defined *Primary needs of humans* (4 Goals); *Equality between humans* (4 Goals); *Efficient, sustainable production* (4 Goals); *Landscapes in danger* (3 Goals) and *Worldwide cooperation* (2 Goals).

Section 3 introduces the Goal 4 and its eight Targets which are completely devoted to education. This Section points at those eight targets in six Goals which definitely contain the word *education* or its synonyms, too. Finally, this Section lists and comments the other ten Goals which do not directly refer to education. These comments establish the aspects in each Goal which make easily understood that fulfilment of the goals is impossible without learning in its narrow or more general meaning.

In Section 4 possibilities for teaching of sustainability are provided in two ways Firstly, 17 secondary school subjects are listed and the two most characteristic Goals of the SDG (2016-2030) are joined to each subject. Secondly, an example of the possibility to collect all Targets related to a selected topic is illustrated in the example of water management. This section also gives examples how teaching natural sciences can be supported by sustainability, and how the key competences can be improved by studying sustainability. These, possibly abstracted educational possibilities are supported by worldwide and European illustrations in form of Figures in the Appendices A and B.

APPENDIX A. Global facts behind the Goals – illustrations for education

In this Appendix A, there are figures recommended to use in education of sustainability, more specifically, the UN Sustainable Development Goals. The illustrations are grouped according to the classification of the 17 Goals in Section 2. The altogether 25 images are selected from the UN SDG Report (2016). The figures are supplied with explaining texts, so we would write about the common messages of the selected Figures A1-A6.

Figure A1 provides us facts that global hunger and health conditions are though improving, but still not satisfactory. The fresh and waste-water data show the dark side of the picture, only.

Figure A1. Illustrations for *Basic human needs* (Goals 2, 3, 6): Facts about hunger and health (left side figures, upper and lower), as well, as fresh and waste-water conditions (right side) (UN SDG Report, 2016: pp. 4 and 6)
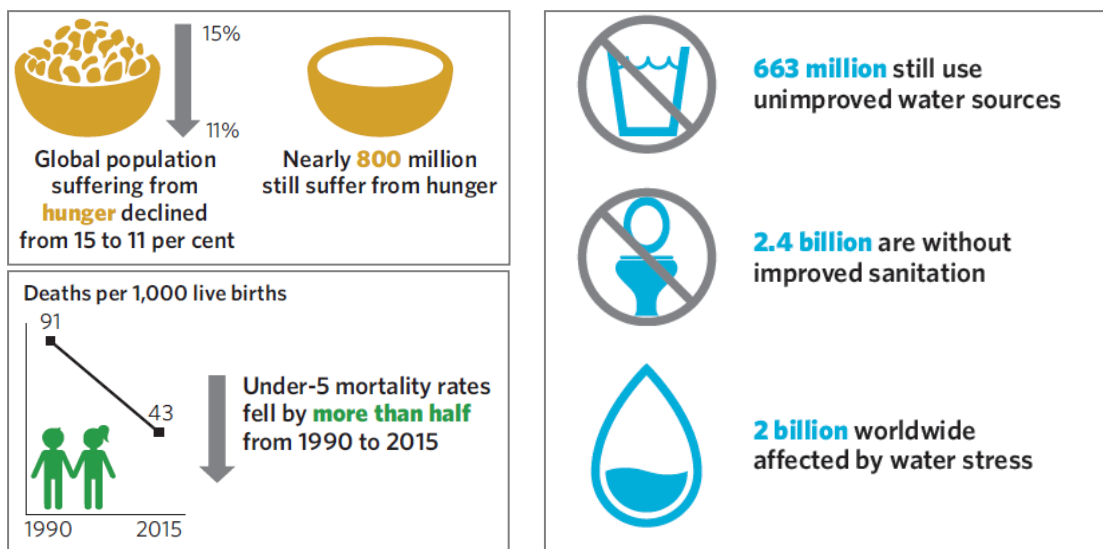

Figure A2. Illustrations for *Energy, climate and oceans* (Goals 7, 13, 14): Facts about energy (left side figures, upper and lower), natural disasters and fishery (right side, upper and lower) (UN SDG Report, 2016: pp. 6 and 9)
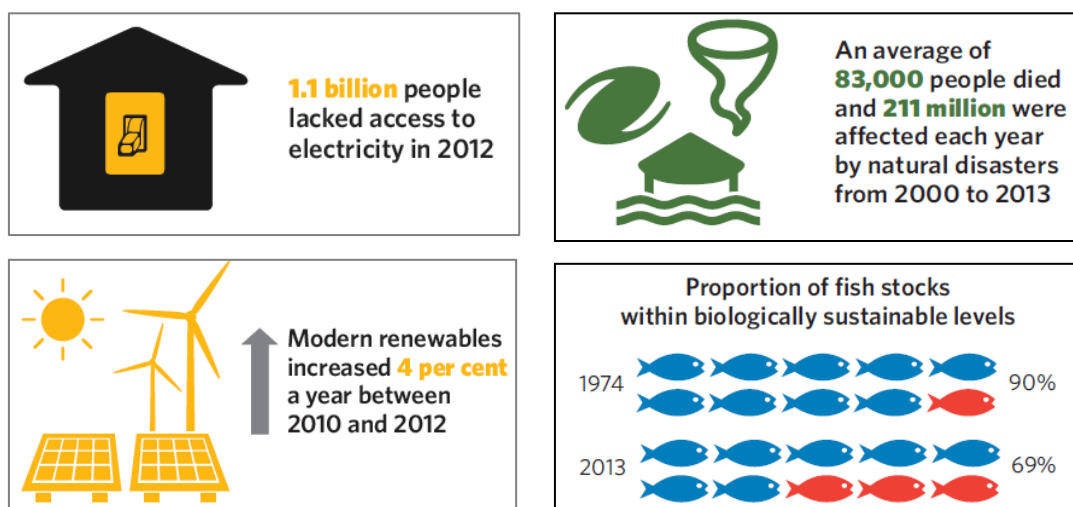
Figure A2 comprehend sorrow facts and good tendencies on energy supply, together with the numbers natural catastrophes and the degrading fish stocks. The right pair of images are related to the "Basic human needs" group of goals. Natural disasters are possibly related to climate change, whereas conditions of fish stock represent a key problem of the underwater world.

Figure A3 illustrates proportions of poverty, illiteracy, gender inequality in the politics and, as positive impression, decreasing gap between poor and average households in the majority of investigated countries, though the income gap is increasing in almost the half of the countries.

Figure A3. Illustrations for *Equality and justice* (Goals 1, 4, 5, 10): Facts on poverty and illiteracy (left side figures, upper, lower), gender and income inequalities (right side upper and lower) (UN SDG Report, 2016: pp. 3, 6 and 8)
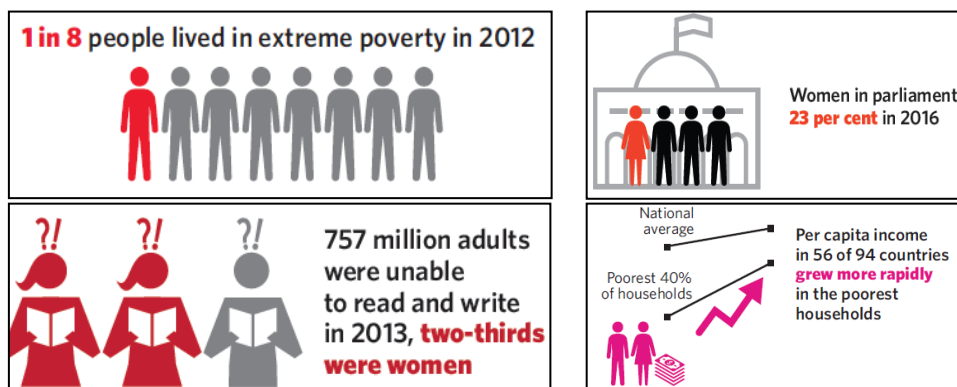

Figure A4. Illustrations for *Efficient, sustainable economy* (Goals 8, 9, 12): Facts on GDP and footprints (left side figures, upper and lower), productivity and phones (right side, upper, lower) For the abbreviations: GDP – Gross Domestic Product, LDC – Least Developed Countries. (UN SDG Report, 2016: pp. 7 and 8)
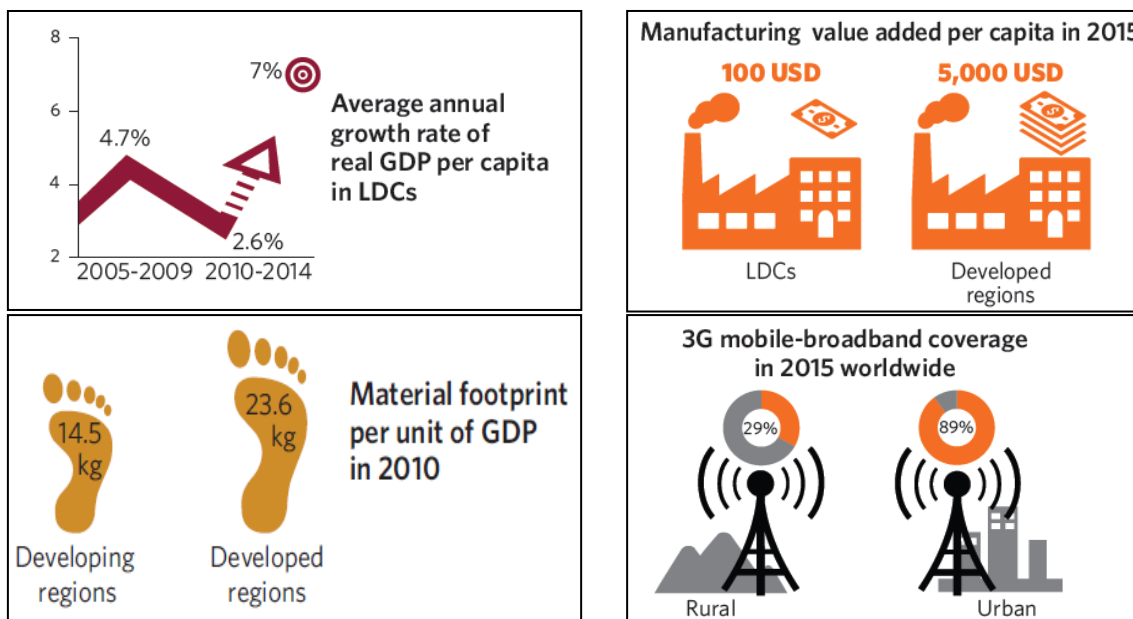

Figure A4 compares developed and less developed countries and regions in their GDP rates, material footprints, per-capita productivity and mobile network availability, world-wide.

Figure A5 provides examples of problems in urban life and loss in forests and biodiversity. The common message is: The tendencies are mostly improving, but there are still very bad indicators concerning these vulnerable domains. Total area of the forests was 4,00 billion ha in 2014 (World Bank, 2017), so the relative loss of forests is considerably decreasing, as well.

Figure A5. Illustrations for *Protecting vulnerable environments* (Goals 11, 15): Facts on urban problems (left side figures, upper, lower), loss of forests and species (right side, upper, lower) (UN SDG Report, 2016: pp. 8, and 10)
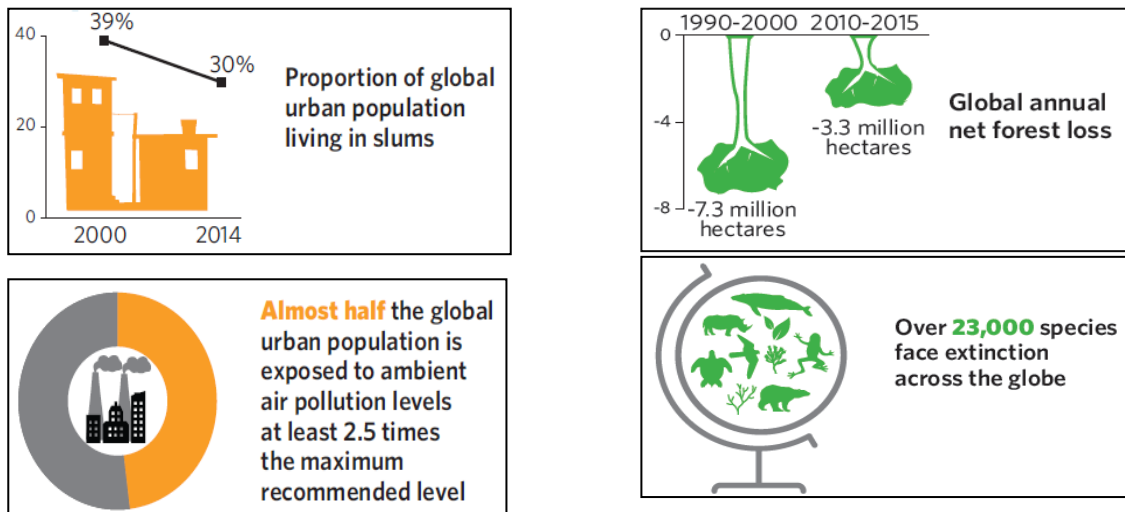

Figure A6. Illustrations for *Cooperation towards common goals* (Goals 16, 17): Facts on risks for children (left side figures, upper, lower), supporting fund and censes (right side, upper, lower) (UN SDG Report, 2016: pp. 10, and 11)
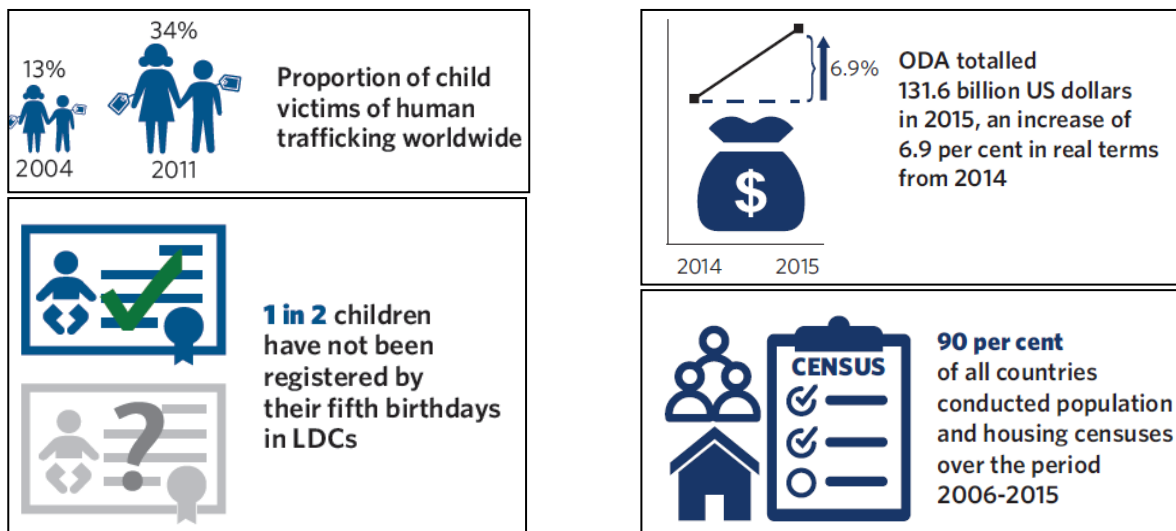
Finally, Figure A6 provides examples that support the need for strong institutions, including registration of inhabitants and statistical census, together with good tendency of Official Development Assistance (ODA) and bad tendency of child trafficking. (Increase of children's percentage reflects increase in absolute numbers, as global trafficking increases (UNODC, 2016)

In addition to the global illustrations, the next Appendix collects European indicators.

APPENDIX B: Selected facts from Europe – illustrations for education.

Figure B1 reflects the uneven distribution of population in the 28 countries of the European Union, as well, as of the trans-continental road network. For population, topography and climate conditions may explain the differences. For the roads, they are partly just questions of definition.

Figure B1. Illustrations for population density (capita/sq. km, in 2011: left figure) and Trans-European road network (2013, right figure) in the 28 EU countries (CSO, 2016: Figures 1.4 and 1.23)
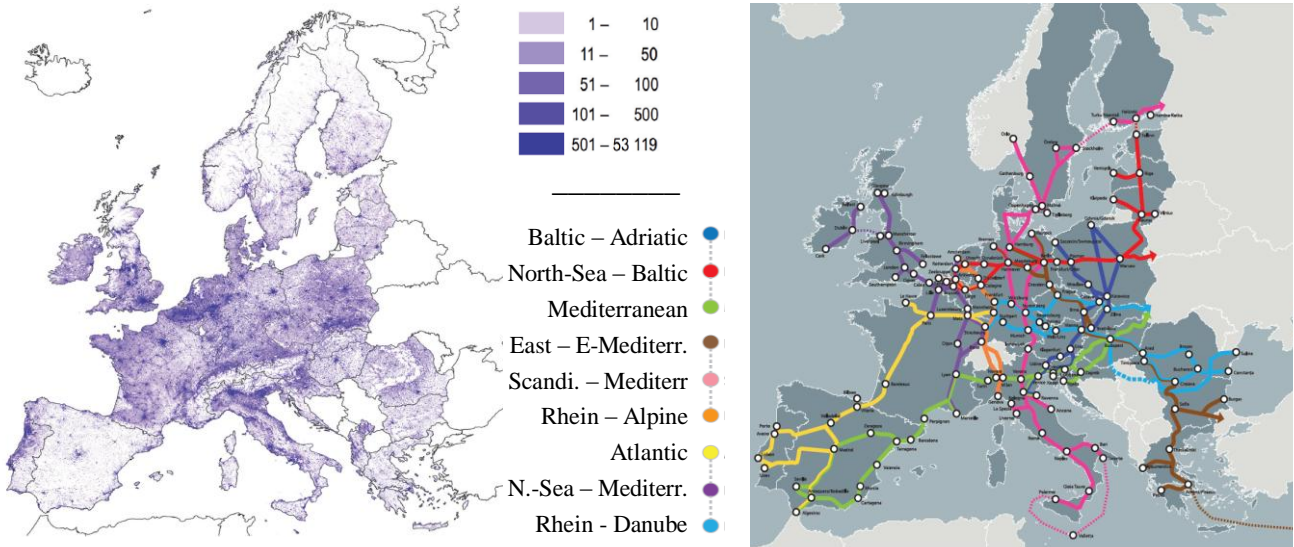

Figure B2. Illustration for education: percentage of people with higher education (university and college) diploma in the 28 EU countries compared to the total population in 2015 (CSO, 2016: Fig. 1.7)
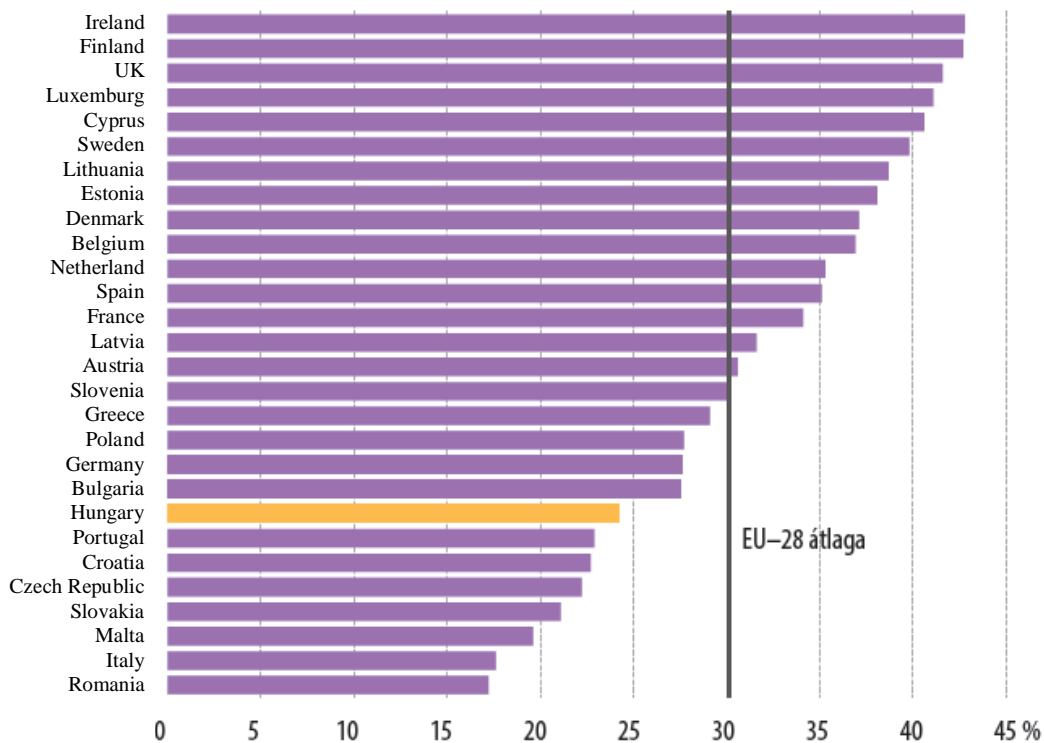
Figure B2 lists the proportion of population in the 28 countries holding diploma of higher education. In its first third (9 countries) one finds seven countries from the core EU-15 countries, only Lithuania and Estonia represent the more recently joined 13 countries. In the less educated third, only Italy and Portugal represent the core EU-15 from this set of nine countries.

Figure B3. Illustrations for social and productivity conditions in the 28 EU countries: Percentage of active workers compared to the 15-64 years' population and active workers' per capita productivity compared to the EU mean (both in 2015, left side figures, upper, lower), percentages of people living below the EU poverty threshold and of new enterprises existing after two years (both in 2014, right, upper and lower) (CSO, 2016: Figs. 1.8, 1.9, 1.10 and 1.18)
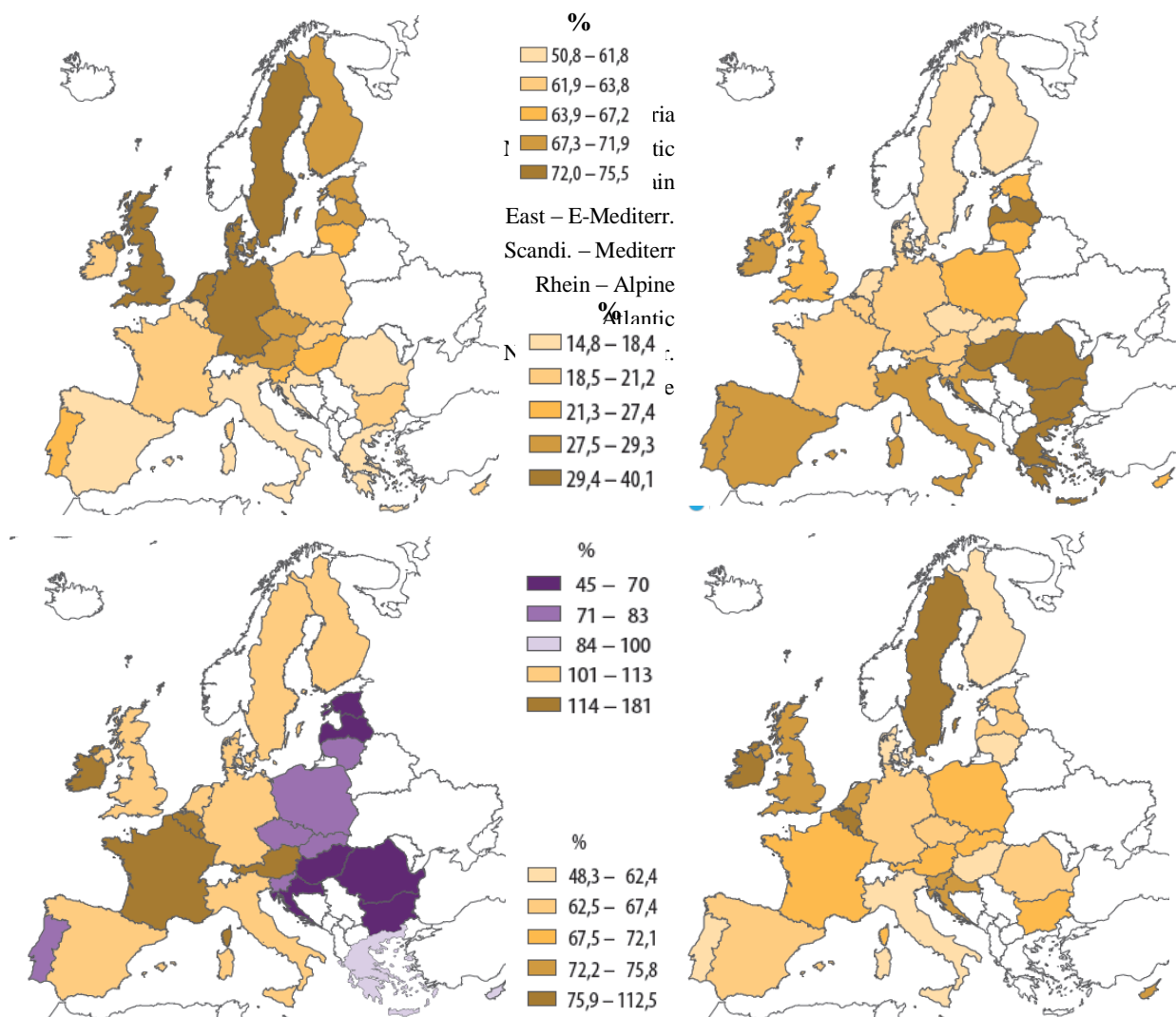
Figure B3 provides four maps on distribution of social and productivity in the 28 EU countries. Our present aim is not to analyse all these aspects, what can be done by the teachers who apply any one or all these figures according to their listeners. For example, on the active workers' per capita productivity (lower left panel of Fig. B3), one can emphasize that besides the differences between east and west, even the western countries are not of same colour, i.e. productivity.

In order to point at similarity between the maps, the Spearman's rank correlation between is calculated per capita productivity and the proportion of poor households. Its -0.41 value indicates that high productivity of a country often coincides with low poorness proportion, and vice versa.

Figure B4 provides four maps on distribution of support for innovation and environment, in percentage of GDP for the given country, as well, as selected indicators for these conditions in the 28 EU countries. Unfortunately, proportional support for environment is not known for Ireland, UK and Greece. Here the most interesting feature is, that the environmental investments compared to the GDP (lower right figure) have no east-west differences. This is connected with the fact that not only the wealth of a country but the condition of the environment determines this finance.

Figure B4. Illustrations for innovation and environmental conditions in the 28 EU countries: Percentages of R+D support compared to GDP and of renewable energy sources in the energy consumption (both in 2014, left side figures, upper, lower), percentages of households with broad-band Internet availability (2015) and of environmental investments (2012) compared to GDP (right, upper and lower) (CSO, 2016: Figs. 1.19, 1.24, 1.21 and 1.26)
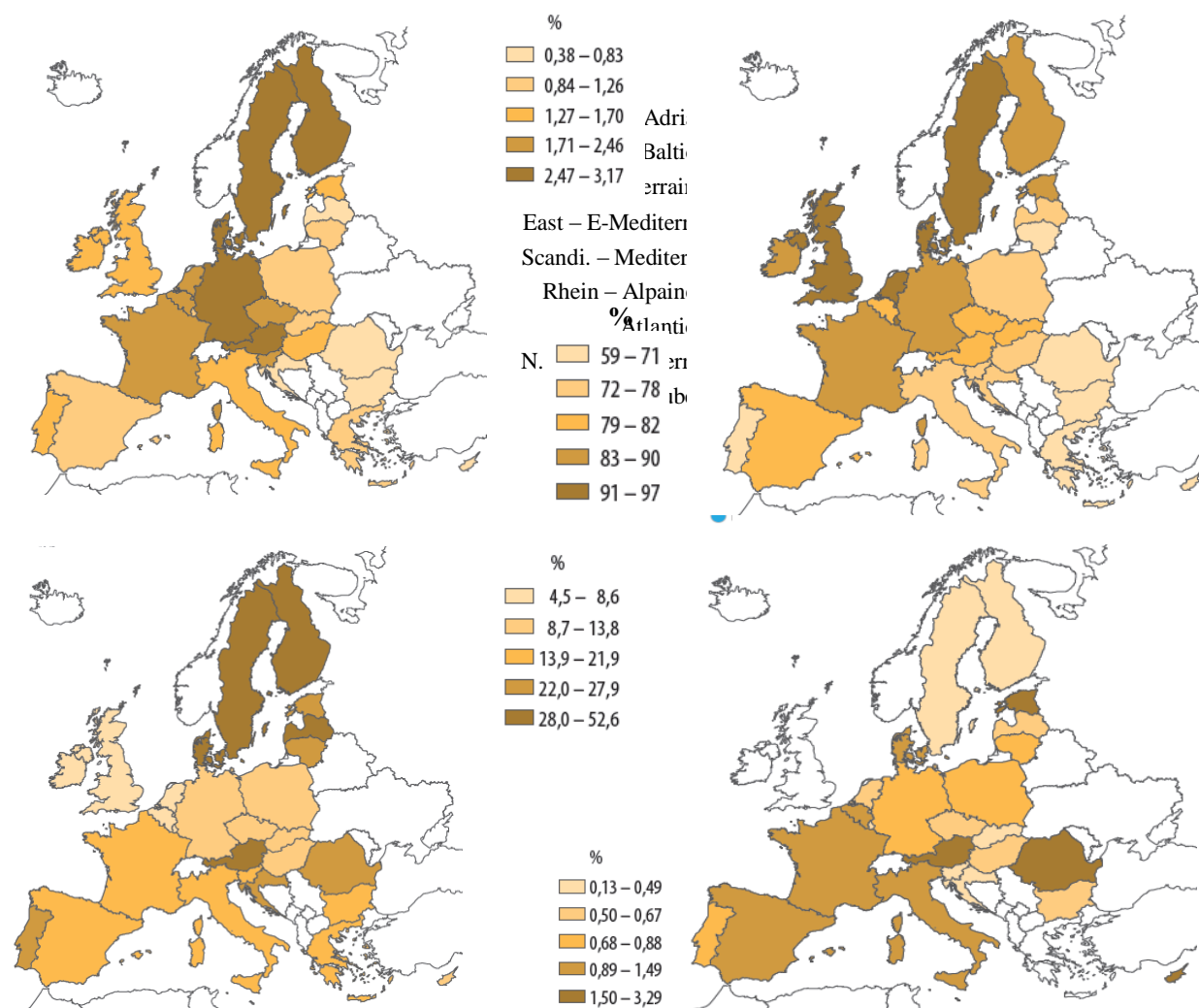
The above Figures of Appendix A and B are arbitrary selections. In our age, a teacher can find many other ones to illustrate any aspect of sustainability. Complexity of the figures, presented for the students, depends on the age (level of abstraction) and on the interest of the group we would deal with. The more complicated the given aspect is, the more key facts are requested.
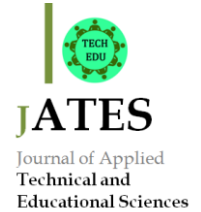
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The Comparative Analysis of the Biological Diversity in Schools

Éva Nagy

Doctoral School of Educational Sciences, Eszterhazy Karoly Univerity, H-3300 Eger, Eszterhazy sq. 1., Hungary

Abstract

The living nature is an incomparable treasure, an ever-changing unique world. Its priceless value lies in the appearance of its plant and animal species. Today newer and newer terrestrial and aquatic creatures are born and there is no such human mind that is able to memorise all of them existing in the world. However, what is directly perceptible from them exists only a short distance away. Could we see, or is it possible to show the real face of these remarkable aspects? Do we give or could we give the young generation enough to taste the real life of the actual world, attracting their attention to sustainability? Do we spend or are we able to spend enough time with our students getting acquainted with all animal and plant species, which appear directly around us? In other words, is there or to what extent does preservation of a considerably significant issue, the biodiversity exists factually in today's public education? The study summarizes methods that nowadays serve the teaching of species diversity and attempt to sum up the institutions where they are used.

Keywords:concept of biodiversity; biodiversity in public education; nursery schools; kindergarten; primary schools, biodiversity in secondary education, new methods

1. INTRODUCTION

The presence of the living organisms determines our inner world and affects the smallest resonances of the surrounding environment. The world, so the system of plants and animals is complex. Its structure is comparable to a web that spins over the whole planet. If only one yarn is accidentally touched, its shiver runs through all the other threads (Gerald Durrell). This thread could be the tropical rainforests, or the Earth's lungs, where the rate of oxygen production on Earth is the most intense and yet severely injured. But if we do it all because we do not know its nature, we can easily destroy it, without experiencing its beauty, knowing its practical benefit, allowing it to survive, leaving a deep impact on everything it has ever linked with. People do not only touch the net today, but often break strongly, and in many cases they are not aware of the seriousness of the damage they cause, for example, to the survival of the human race itself. We, Biologists must demonstrate not only the theory of what needs to be cared for what is beautifully

preserved from the beauties of the world (Albert Wass), but to create a unique experience for the youth about what surrounds them, so that it can become internal, and develop really durable information. The presentation of the biological diversity is an integral part of the environmental education. In this study, I want to summarise, how diversified the methodological repertoire, which can be used by the teachers nowadays in various institutions of public education and how closely the curriculum is matched to the current events in the recognition of species. Preserving the natural environment is a basic living condition of the present and the next generation. Biodiversity, also called biological diversity, is the basis of our existence.

It is very disappointing that this diversity is decreasing on an unprecedented scale. According to the latest press release by the European Parliament, 30 species of fish die each day and according to a UN study, there are still 17,000 species remaining at risk. The protection of diversity on Earth has therefore become extremely important. In order to keep pace with the innovative aspirations (such as the National Strategy for the Conservation of Biodiversity for the period 2015-2020), to meet the requirements and meet the goal for the specified time, it is appropriate to examine the student circles, strata, which can positively influence natural processes by their actions and attitudes, and so are able to save, which can be preserved in their original environment. For this purpose, it is worth summing up how biodiversity appears as educational material in different educational institutions, and thus how it can be developed.

Ever since the destruction of almost every subsystem could be seen in our immediate environment, we pay more attention to the protection of it than ever before. Many would like to act, but they do not really know how to do this. But we may only defend when we really know its nature, and if we know it well, maybe we love it, we will be able to take independent steps to keep it alive.

At first in my work, I outline the existing concepts of biodiversity, and the possibilities of the materials that can be used, and the concepts referring to biodiversity, and then I introduce the current status of the teaching of the nursery, kindergarten later education in primary and secondary education and biodiversity in detail. My goals are even to analyze curricula and textbooks in a sense that how profoundly educate the diversity of the living creatures and how up-to-date they are in relation to the current situation. Following the clarification of the conceptual background, each subchapter contains the biodiversity agents of the individual public education institutions.

1.   THE CONCEPT OF BIODIVERSITY

The concept of biodiversity is one of the most prominent concepts in the focus of today's environmental interest. It is very important because it involves all forms of life (either they are levels under the individual), that is, plants, animals (such as humans), as well as mushrooms or microorganisms (those tiny creatures that are often not seen with the naked eye). In other words, it appears at all levels of biological organization, either body, organ system (a combination of definite organs for a given purpose), organ (different cells and tissues for a given purpose), tissue (united identical cells that are the same in shape and function), cell (the smallest independent living entity of organisms) or (they are levels above the individual) population (in other words community), association (a community of plants and animals living together in a given place at the same time), biome (community of living communities), biosphere (the whole biomass of earth life). (*Gál B., 2016*)

Biodivers makes biologically rich and varied in terms of life forms.

Let's look at the concept through simple everyday examples. If there were no creatures other than us, for example, a dog and only a Kommondor, then the appearance forms would be narrowed. We would not know the cattle and we would be deprived ourselves of the taste of the fresh milk it gives us. The same is true for the plants. Imagine a world where we could not see other plants just pine. We would never know what the flavor of the wild strawberry is like or what the chamomile is good for. Fortunately, the species of plants and animals are not just those living creatures, there are millions of them. The living organisms are very varied and there are also subtypes within species. Consider, for example, only the apples, and think about the number of their varieties we know.

There are about 1.8 million species on our planet, but the possible number of species is estimated at another 4-40 million. 11% of the well-known plant species (250,000) were endangered, and were near to the extinction. Out of the bird species, the cranes, parrots, open seabirds (e.g. albatrosses), and the singing birds are mostly endangered while the quarter of the mammal species is threatened with extinction (ungulates, insects, purse, cetaceans, carnivores). (*Dr. Horvath Papp, 2013*)

In the list of current protected species, mainly plants, animals, mushrooms, lichens and antlers are listed with different nature conservation values in terms of money. The protected and highly protected species can be seen numerically in the table below:

Table 1: Database of currently protected and highly protected plants and animals (following the data of www. Greenfo.hu)

Protected and endangered species				
	Protected	Specially Protected	EU	Total
Plant	652	63	577	1292
Animal	828	137	597	1562
Mushroom				
Lichen				
Total	1480	200	1174	2854

If this diversity decreases or ends, at first we lose species, which will not reborn, and then all of this affects the environment, completely transforms it, therefore it will not be the same. Globally sooner or later this will be equal to the impoverishment of the wildlife.

2.   THE IMPORTANCE OF BIODIVERSITY

According to the 2005 UN report on Biodiversity and Well-being, such a reduction in biodiversity is a serious threat to the whole of the wildlife, including humans. For wildlife because in a more varied ecosystem there are more likely to be individuals that can adapt to, or survive external events such as natural disasters, extreme weather or increased pollution. People need biodiversity primarily because of the food they provide (*Jakabffy, 2007*)

But let us not forget the additional benefit that contributes to our physical and mental well-being. The good quality of air results in healthy lungs, or stopping the climate change, eventually reversing it, and reducing CO2 emissions will restore the ups and downs of seasons and weather. Pure water is the basis of our existence, without it we cannot exist, diseases overflow consumers of unhealthy, even infected water, but the risk of dehydration also threatens the healthy person in the same way as in case of water shortages. Insects help to pollinate plants as well as feed for birds and reptiles. While we are still able to take some care of our natural values, and as long as this is reality and not just history, there is hope for knowledge, treasure in our possession, which can be passed on, in order to preserve the planet's current state of health. (*Erdei-Gulyás, 2008*)

The main consequences of the extinction of species can generally be summarized as follows:

Loss of energy: In developing countries, 50% of energy is derived from wood, e.g. by the destruction of the rainforests, the state of the poor countries will be even worse in Africa or Asia and the poorer populations are much more exposed to the loss of biodiversity, as many of them live in nature; from where they get food or the basic materials and their culture are closely related to nature.

Feedstocks: Approximately 7,000 plants and 100 animal species are used for eating purposes and 50% of the medicines are of plant origin, in addition, living organisms provide genetic resources, too.

Biogeochemical Processes: Water Circulation, Oxygen Circulation, Carbon Circulation, and Soil Processes - Consider how many species allow soil to be fertile, how many living things help water purification and how much wood species contributes to cleaner air.

Climate regulation: forests contribute to the climate, since they breathe in carbon dioxide, which is a greenhouse gas.

Culture and leisure: we all go walking, many of us love hiking. How boring would it be if habitats looked the same everywhere or we saw the same trees everywhere, the same dog barked in every garden? (*Zólyomi, 2009*)

As a result of the over-utilization of renewable resources, the deterioration of the various ecosystem services may lead to economic downturn, and the disruption of ecosystem stability may endanger our basic living conditions. Nowadays, typical species extinction means a more significant burden, which is much more complex than before, because its nature is different from what it was in each geological era, that was a natural phenomenon in its own way. The extinction accelerated by human activity is quite dangerous: the current rate of extinction is about 400 times higher than those from the time of catastrophes ending the great geological eras (e.g. at the end of the Cretaceous age, 65 million years ago) (*Wilson, 1986*).

In my short theoretical approach, my aim was to clarify the concept and also to support the relevance of the problem. In order to begin the concrete process of an attitude change younger and older members of the growing generation should be acquainted with the theoretical background of one of the most serious environmental problems, biodiversity and the destruction of it too, through the means of education and later bring them close to nature.

In order to achieve radical change, it would be worthwhile to influence the thought processes of the smallest. Much depends on the world in which they are placed and where the world is moving them. The sooner we expose the small ones to biodiversity education, the more likely they will be more effective later on in this area. Therefore, for a few words, I will first deal with the aspects of environmental education and biodiversity in early childhood.

3.   STAGES AND OPPORTUNITIES FOR BIODIVERSITY EDUCATION

1.   **Preparing school environmental education, nursery education and biodiversity**

Tamás Vekerdy, the head of the Hungarian Waldorf Teacher Training and the sociologist György Simó said this year in November in his 168-hour interview, that there was no effective learning without pleasure and we have to write love formulas for the kid's mind. (*Ónody-Molnár, 2017*) One of the most prominent drivers of these formulas can be the channel of nursery education in the nursery school, where the central topic is often how they get to know the animals and plants and this early socialization is a life-long determinant.

The National Fundamental Pedagogical Nursing Care Act stipulates that nursing care and nursing activities should also be organized and carried out according to the sustainability criteria. This approach has to appear in all areas. Environmentally-behaved staff must also show themselves in a variety of activities, in the use of natural materials, in minimizing energy. Efforts must be made to reduce chemicals (e.g. cleaning), to improve the quality of food, to place fruit and vegetables grown on the spot, taking into account the life cycle of the products.

The same is important when selecting games. From folk songs, their beauty and justice, traditions, folk games, organic food, herbs to the nature touring. The main activities of many environmental NGOs are the environmental attitude shaping. National Parks, Ornithological Associations visit small children groups, so they can directly meet living plants and animals.

The "greening" of the nursery is a reflection of educational practice. The color scheme of the decorative elements, the attachment to the local traditions, the proportion of wood and plastics are all important. With the guidance of parents, many of our educational tasks can be made easier, we may help them in gaming, game making, recalling the traditions of simple, inexpensive, traditional values that are still known even by grandparents.

In addition, there are many possibilities for creating an environmentally friendly, bird-friendly garden. It is important for plants, bushes, trees to be indigenous, and it is ideal to choose aromatic plants, herbs. Traditions are also relevant here. Herbs and herbs are suitable for tea or summer cooling (mint, lemongrass), but also for insect elimination. By developing sensory organs, children can learn to recognize the spice of the traditional gardens (rosemary, peppermint) by differentiating touch and smell. Acceptance of diversity as a basic ecological value can be justified in this way as well. (*Balogh et al., 2012*)

Preparing school environmental education, kindergarten education and biodiversity

Preschool education is also of great importance in the aspect of environmental education, in many institutions, the entire activity system of kindergarten is organized around this educational

area. (*Balogh et al., 2012*) Children between the ages of 3 and 7 are the age group where the principle of environmental education can be practiced the best, reaching the age where observations generate deeper thoughts, giving them a more lasting experience. At this age they are more cooperative and more open to the opportunities offered by the outside world, so they can be more easily involved in targeted environmental programs. Concerning the environmental activities of observed kindergartens, we may say that activities aimed at biodiversity and sustainability are all day-to-day.

We can have habits and behaviors practiced that will remain in their minds forever and become internal necessities. The susceptibility of the nature and man-friendly nature, as well as the harmony of nature is important both for the family and the child. Since parenting is the most important thing for a child, parents need to be educated, too. However, the views of families can be shaped through children as well. Close co-operation, everyday contact provides a distinctive opportunity for a kindergarten teacher. There is a great need for this at the present level of environmental awareness. By modifying consumer habits by modestly influencing wasting lifestyles and shaping attitude, a change in sustainability and quality of life could be noticeable in a relatively short period of time. As families cover the whole society (parents, grandparents, siblings, relatives), the effect may be multiplied. (*Balogh et al., 2012*)

Kindergartens in Eger, for example, are characterized by constant observations in terms of changes in nature, they are constantly experimenting, planting sprouts of plants, participating in targeted exhibitions, for example On Forest Open Days, Earth Day, each year competing in competitions, they are visited by local members such as the Birds Association, regularly organizing excursions to nearby wildlife parks e.g. The Nyíregyháza Wildlife Park and they make local bird houses, then jointly set up them and refill them continuously, following the seasonal events from time to time.

As an additional proposal, quoting from the suggestions of the National Environmental Education Strategy can be summarized as follows:

1. When entering kindergarten, let the child achieve favorable emotional effects as this helps the development of his social sensitivity and the development of his self-consciousness; From the point of view of socialization – from the goal and task of environmental education - it is of particularly important to practice common activities based on common experiences.

2. Strive for co-operation between kindergarten and family; Strive for the children to "nurture" their parents, to bring home ecologic habits learnt in kindergarten.

3. Implementation of environmental education in kindergartens is a multifaceted activity with special regard to (non-substitutable) play.

4. It is desirable to organize such kindergarten life that promotes the development of the moral qualities of the child (sympathy, helpfulness, altruism, attention, etc.) and the will (self-discipline, endurance, sense of duty, rule of law, etc.) suggesting a nature-friendly, environmentally friendly approach.

5. When designing learning and environmental education, nursery schools strive to create and organize the following common activities:

(A) placement and care of plants and animals in kindergartens;

(B) establish or transform the nursery garden (e.g. floral, herbal, vegetable and orchard), to ensure the realization of the tasks of environmental education, carry out the corresponding age-appropriate activities;

(C) organization of walks, excursions to sites and habitats where observations of changes in nature, interactions between living and inanimate environmental factors can easily be seen;

(D) the content-methodological design and organization of museum visits; in the environmental education of children, and in shaping their ecological views museums can be important venues, too;

(E) organizing kindergartens' programs. They are recommended to arrange in a place other than kindergarten, away from local specialties. The experiences of the 5-6 days will help to know the values, love and protection of the homeland and the people living there, the local landscape, the local folk traditions, customs and tangible culture.

6. In order to make these things realistic, the Local Programs for kindergartens must show these goals and tasks. Help nursery schools to develop environmental programs.

7. The condition of the realization of kindergarten teacher education is the continuous participation in further environmental training. These intentions should therefore be supported." (Vásárhelyi, 2010)

In this list, a special venue was also mentioned for toddlers who are particularly interested in direct insight into forest life. The forest kindergarten has become accepted in practice with the emergence of forest schools. Everything is organized according to all the age-specific features.

They do not start familiarization with nature in the nature kindergarten. Formerly they have been teaching a one-day study trail on a zoo program, practicing behavioral ways. In the forest kindergarten, there are plenty of fun for children. Traces of the presence of animals, the effects of weather on the soil, plants, and animals have already been experienced many times in the past. Nature has been accepted in many ways. Children living in the city have little experience especially in fungi and soil. A forest puddle might be a treasure for exploration or sensitization. Observing birds, watching birds and nests also stimulate their fantasy or imagination. The

richness of plants, leaves, flowers, fruits, helps experience biological diversity. Painting with herbal milk fluids, making tables from natural materials, naming things as an artist develop their mother tongue competence. The observation of the built environment, the characteristics of the harmony of houses and buildings in the landscape, help them to attach to the past, to experience the culture of the earlier era. (*Vásárhelyi, 2010*)

3. Primary School Environmental Education and Biodiversity

The knowledge required for evolutionary survival has been lost by some earlier generations. Children who grow up in artificial, comfortable, urban dwellings with constant temperature are not only aware of nature, but also of its changes. Because they often do not even meet their immediate surroundings, they travel by car. They consume the same foods and fruits all year round, buying the same goods with their parents, often spending their freetime in front of computers, TVs or even the smallest ones with their mobile phone regardless of the seasons. Observing the surrounding world, and adapting to it, the role of community education became decisive. (*Bennet 1993*)

All elementary school subjects offer opportunities for environmental education. However, with its curricular material, the environmental knowledge stands out. Walk as much as possible with our students in the place of residence, to see the major buildings, the names of the streets in the neighborhood. Take them to events of different institutions, museums, cultural homes, etc. Get to know their parents, grandparents' childhood and their surroundings. Introducing the ornamental elements of older dwellings and their equipment also helps to experience emotionally the links between generations. Children should often be brought to nature to know nature. The memory of phenomena observed in the city, in the woods, in the meadow develops their memory. The exploratory, cognitive abilities allow for orientation in other new environments. A lot of experience leads to the recognition of the order, logic, change and beauty of nature. Individual, even, small, or class-level games maintain curiosity and develop collaborative capabilities.

General tasks:

- Monitoring of natural phenomena and processes.
- Detecting the beauty and diversity of nature.
- Healthy environment.
- Recognizing environmental values

The knowledge of the material is the sensory knowledge of the living and lifeless materials of the environment. It is possible to group different materials according to a given criteria. Some pollutants (smoke, soot) are also known. They need to recognize the most common sources of household casualties. It is advisable to learn which foods maintain health. It is time to get acquainted with knowing the periodicity of nature (regular repetition of certain times) as well as showing that the living beings change over time as well. It helps to find space if they can experience the presence of other creatures in different places of the space. They should be familiar with the locality and its surroundings, to know the characteristics of the landscape and the wildlife. It is about getting acquainted with scientific knowledge if they realize that the stage of knowledge is the reading of nature and of nature-related descriptions. Among scientists exploring nature, we also need to introduce the work of the locals and locals. (*Horvath Papp, I., 2001*)

Color illustrations of the textbooks used today are complemented with animated short films trying to illustrate the structure and living conditions of all major plants and animals, but there are special stages that emphasize the importance of preserving biodiversity by specific methods. Let's look at some of these:

Understanding the school and non-school environment is essential for sustainability education. This can now happen with the help of the Internet. Two projects, BEAGLE and Carbon Dioxide Investigators are designed to activate children's emotions, responses, and system approaches through the science approach and cognition of reality. The two projects consist of similar elements: the collected data can be processed on a web interface and deducted conclusions. On international project websites, Hungarian (and foreign language) teaching materials are also available. (*Halácsy, 2011*)

There is a particular primary schooling method, the KIP method, to emphasize environmental education and biodiversity emphasis and public understanding. Recently, as a member of a professional methodology group, we have participated in a primary school environment classroom, where the so-called Constructive Instruction Programme was introduced with 6th grade students. The uniqueness of the educational method elaborated by the American Stanford University in 2001 and adapted by the Emese Kovácsné Nagy is that there is nothing special about it, but it is very effective for those students who, because of their disadvantaged position, need personalized education. We have witnessed a particular form of environmental education, the introduction of which can bring a lot of results in the future. The typical features of the KIP method are presented through the specific tasks organized around the topic of water and water

fauna. Each KIP hour, also the environment classroom can be characterized by the following aspects:

- Children work in multicultural and ethnically diverse groups
- There are roles within each group (the most important are the Teacher Assistant, the Writer, the Reporter, the Tool Correspondent, Silence and Ordering Correspondent and Time Correspondent) that change in KIP lessons, highlighting the role of the participants starting the lessons
- Heterogeneity is not a problem, it is an advantage
- It is the Teacher Assistant's duty to ask him or her and not the Teacher
- The Teacher's role is only to praise the students in the hearing of the others ("he searches for what he may praise for)", coordinates, motivates, gives a sense of accomplishment, strengthen self-confidence
- Time limit can be developed individually (2 tasks per lesson)
- There are open-ended tasks
- Enables more capabilities - 24 people 24 different tasks (differentiation) - everyone is good at something
- Every 6. lesson (Source 1-5) - Nat
- No hierarchy - no "status" problem – there is equality
- Group members are cooperate with each other - at the end of the lessons there is always an individual report
- Every lesson consists of a group task and an individual one and at the end they always report what they have achieved - the material is illuminated from several sides, it attaches more.
- Activates all students - thus providing a positive experience
- Involves existing skills and knowledge
- Harmonization of social and knowledge differences
- You can not differ from the syllabus, but you can save lessons
- Applicable to all subjects

A product has to be presented at the end of the lesson and the students are always asked questions like "Do you think you're doing it yourself?" Or "Did Teacher Assistant help understanding?" (My own observations)

This is somewhat different, but from the point of view of biodiversity, Waldorf pedagogy is also a valuable pedagogical method, one of which we might visit last year and we have had the following experiences:

The curriculum of the Waldorf schools is deeply ecological. The method of teaching from the whole to the parts itself reinforces this and encourages the children to keep the widest view of their studies during their development.

The topics in Biology fit organically into the whole school curriculum, underlying the sense of united inner feeling.

Classes 1, 2 and 3 penetrate all the topics of Biology. The stories selected during these stages of children's development reflect the ever-changing relationship between young children and wildlife.

In classes 1 and 2, the stories are about the subject of change, the frog changes to prince, the reindeer is made of reed. These stories allow children to understand the language of animals and get to know other beings - elves, fairies - who keep secrets and protect lives. Such fantasy elements are not from whimsical fad, they are based on the complexity of relationships between animals and plants, and by the maze of healthy emotional relationships. Moreover, the hidden features of the biosphere, which are later studied in the upper classes, with the help of clear thinking, are brought closer.

In class 3, the stories of creation portray the origins of Earth, plants, animals and humans in their entirety. Other stories are about a particular relationship with the animal world (Saint Francis) to certain persons, religious people or saints. In the agricultural epoch (Greek word, it means era or period) children learn how the peasant works with the forces of nature. In addition to plowing, sowing and harvesting, there is still a lot of work to be done: installing live hedges, setting up fences, lambing, landing out water and weeding the crop. All of these are an introduction to the more conscious study of the living world in the coming years and to the subconscious confirmation that the ethical basis of ecology is the moral development of people.

In the 5th year, the life-like description, painting and the related poems of the plant with unique features and characteristics lead to the children's own experiences to the accuracy of the observation.

In class 6, mineralogy, in the 7th health and nutrition, in the 8th the human body increasingly needs students' own observations. The focus is rather on the phenomenon they are experiencing, rather than on the latest theories of contemporary science.

In the upper classes, starting with class 6, horticulture must introduce the flora directly and practically to the children. Up to the upper level, regular sessions are needed to cultivate the

garden properly. The emphasis is on tillage, on the care of flowers and vegetables and on the harvesting of crops. The primary need is to maintain and improve the relationship between children and the flora. Over the years, they meet with the annual cycle of harvesting, composting, insecticide and winter storage and long-term tasks such as planting seedlings, where seedlings are grown from seeds and they might be planted in the upper section.

Each plant should be examined in the context of the landscape, the soil and the climate. A plant in pots, or, worse, a cut and microscopic plant under investigation reveals isolation and tear-off, such tests are performed only in the upper section. At this age, children should pay attention to many forms of vegetation covering the Earth, the specificities of each plant species, their relationship with insects and soil, and their growth and yield from the seeds to their flowers. While observing and identifying the plants is an important element, any systematic definition of the species will cut through the warm friendships that have come from the knowledge of the surrounding trees and flowers. They also teach the names of parts of the plants.

Horticulture is an activity that exits the general care of plants in the class: they cultivate a small piece of land where flowers and vegetable plants can be raised, compost can be made, and responsibility for land can be practiced practically. For all Biology epochs, weekly training classes can be linked up to 8th grade.

The Waldorf School Biology Curriculum also teaches specific species and teaches young people in a clear understanding of contemporary scientific theories, assessing the human and environmental issues and the consequences of technological progress, a vibrant, open mind-to-life development gives them a sense of preference. (Waldorf Framework Concept, 2004)

4. High school environmental education and biodiversity

Today, research into the field of textbooks and curriculum content, modernity and durability is not particularly the focus of research. The rapidly changing technical environment makes the emergence of new knowledge and information faster, and moreover, the acquisition of education, which is almost impossible to follow with textbooks.

István Lükő's research suggests that not all methodological possibilities are used by students and teachers when using textbooks at school and at home. Working with textbooks offers a huge range of methodological opportunities for students and teachers. Most of the textbooks are used to draw the attention of teachers to the use of various methods, but only a small proportion of them are used regularly by the colleagues in the teaching process. Usually, they ignore the tasks of dramatization, operation work, regular investigations, and usually those drills that need a lot of preparation or followed by "work noise". Teachers use the textbook mainly for illustration and

motivation or for raising awareness. The explanation and the method of verbal communication are the third in textbook use. Summary and practice are slightly fall behind. (Lükő, 2007)

Biology textbooks applied today can be used to demonstrate the flora and fauna of the Earth without exception, mainly through viewing the video material provided with the courses. It is much easier to teach young people concepts and figures through this channel, through which they are exposed to every day. Multidimensional footage and the associated tasks raise their interest, but often the question arises that is this really a good solution?

The beauty of a landscape, its characteristic nature, the plant and zoological values of a habitat can be said, but the essential content of the words becomes convinced only if there is personal experience. It is a moral duty of teachers teaching natural sciences in grammar schools to help their students to develop an integrated approach to their environment and to become convinced of environmentally conscious behavior, but to develop the environmentally conscious behavior in order to maintain the quality of human life, quoting Gábor Vida's academic thinking: „We should place more emphasis on nature's love and protection in education". It is understandable to the aspects of high school education, as despite the fact that the National Core Curriculum envisages environmental education as a top priority development and despite the fact that science teacher training is in the biggest crisis, most students do not have enough positive, inspirational science experiences during their high school years. (Kárász, 1996)

However, they would like to have it because the grammar school is able to see the beauty in nature, in the movement and in the arts, so it is extremely important to get acquainted with their narrower environment, natural and cultural history during their grammar school years. It would be worth noting that maintaining and protecting a habitat is only possible if we know and understand the history of its development. (Matthias, 1996)

As a natural science teacher, those work only as an enthusiastic instructor and educator who can give persuasive and persistent knowledge to his or her disciples in the light of the unity of theory and practice. (Berki, 2011) However, in most grammar schools, the use of field work is hardly or not apparent in practice. (Horváth, 2011) There is no time available for field surveys, cenological (association) and vegetation dynamic studies (that is, a specific place for all changes in plant cover time). Apart from the description of the associations, it is also necessary to investigate the factors behind them. To what extent the acquisition of knowledge in the new learning environment by using activity-oriented methods is more effective than within the classroom walls. (Kerber and Ranschburg, 2004)

As far as the part of the Biology curriculum with animal knowledge of some grammar schools is concerned, it is also incomplete as the so-called " Zootaxonomy, which subject should be the

phenomenon of the diversity of animals (at the level of individuals, at the level of populations), and which is similarly not related to the natural environment. Only the combination of theory and practice could be the only effective tool of attitude shaping. (Kováts, 2010)

One option is the faculty organization, which is given in the 11th and 12th years, three hours a week. From this, animal-taxonomy - depending on teacher - is five to twenty hours. In most places there is a definitive practice organized in the framework of practical training, museum visits, forest school (one or two days to one week). During this time, there is a good opportunity to develop, expand and deepen the species knowledge. (Dózsa-Farkas K. and 2007), but much more would be needed.

Alternative schools such as the Waldorf School are somewhat different. In classes 9 and 10, when the emphasis is placed on the human body and its processes within Biology, knowledge gaining at the same time covers field work and practical work with plants and animals, which gives the Biology curriculum a direct environmental and ecological focus.

During class 11 and 12, the adolescent's ability to think is strengthened and mature to accommodate ideas more deeply. The Biology curriculum supports this by studying botany and zoology, where the main role is the generally accepted cell theory, genetics and Darwinism. The historical approach of scientific theories and the technology can lead to the point of view where they can see: an important feature of healthy science is that new theories may emerge when discovering new phenomena and this can also lead to the disappearance of old ones. (*Waldorf Framework Concept, 2004*)

Knowledge is actively created by the learner, not only passively accepting it. (*Nahalka 2002*) Students create new scientific knowledge reflecting and integrating knowledge that they already possess. (*Nahalka 200*9) The prerequisite for creating an environmentally conscious thinking and approach is to provide students with new ecological, natural and environmental knowledge in their existing conceptual network and become persistent knowledge and conviction. To do this, you must activate the new conceptual structure and explore the relationships between the concepts already known and the new concept. If this does not happen, new knowledge will not be integrated into the conceptual system, it will remain isolated. Thus, students who are close not to natural sciences are familiar with only facts about their local environment and it is difficult to base on this.

But if we involve students in a specific project that we can test out on extracurricular (i.e. extra-curricular) occasions, we've done something to preserve biodiversity. There is a guide that can effectively activate the student through easy-to-understand tasks and illustrations:

We can all contribute to the preservation of biodiversity, and there is a need for everyone's help. Everyone can change their daily habits, without significantly affecting their lifestyle. The combined effect of such small changes can already be helpful. The Guide to Biodiversity with 52 Ideas (Janez P, 2011) can be an excellent tool for such things.

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Gamification on the edge of educational sciences and pedagogical methodologies

Rigóczki Csaba[a], Andrei Damsa[b], Györgyi-Ambró Kristóf[c]

[a] 1. Berzeviczy Gergely Szakgimnázium, Budapest 2. Doctoral School of Environmental Sciences Eszterhazy Karoly University of Eger, Eszterhazy sq. 1., Hungary
[b] Univeristy of Pécs, Institution of Psychology, Applied Psychology Doctoral Program, Pécs, Ifjúság street 6. Hungary
[c] NetCoGame GamefulLiving Research Center Nonprofit Ltd., Budapest, Gogol 16., Hungary

Abstract

The number of publications and best practices in the field of gamification are explosively growing, however, only a small percentage is linked to pedagogical methodologies. It is a well-known fact, that games are part of educational techniques since prehistorical times. In this paper we aim to explore the role of gamification in pedagogical methodologies, focusing on environmental education.

Keywords: environmental education, gamification

1. 1. A new point of view?

Many of the well-known scholars and researchers are publishing papers on how game-based worldview have evolved, and how games are getting a more powerful role in our society. Richárd Fromann introduced the expression of „Gameful Living", based on the fact that games, and game-like behavior are naturally integrated into human nature (Fromann, 2017).Damsa (Damsa&Damsa, 2014) created a model to link game research and gamified solution for a better understanding of the field.

The well-known publication of Jane McGonigal states that every passed minute what is spent on games without creating new values can be considered as a profit-loss (McGonigal, 2011). According to her, during playtime the player will start to feel free, to believe in himself, and identify with the epic (world-saving) quests. In one hand the player is developing his creative skills, on the other, he is acquiring a problem-solving attitude, which can be used in real-life problems (for example in environmental issues). We need to take only one step from this thinking to admit – gamification is a powerful tool to use in the field of environmental education.

One example of game-like concepts could be the statues on public spaces. In the last decades new statues in urban spaces started to look more game- and playful, some of them representing characters and scenes from tales (boys from „Pál utcai fiúk", „Bagaméri" the ice-cream seller, inspector Columbo; Bp. Práter street; Kisújszállás; Bp. Falk Miksa street).

The evangelist of gamification tries to harvest the potential underlying game mechanisms. The academic definition of gamification is constantly expanding (Németh, 2015), but most of the scholars agree with the principle derived from Nick Pelling. Pelling states that the goal of gamification is to integrate and use the elements, mechanics and dynamics of games (mostly video games) in non-gaming environment (Pelling, N. (2011).

The field of gamification is new enough to create different opinions. Those who are against the idea are questioning the scientific value of game based development. Those who are defending gamification are going further and describes this field not only as a methodology or tool, but as a new approach and point of view, which is required by a new informational era. In this era games are helping society to break through boundaries and think outside of the box (Fromann, 2018).

The hype cycle(often cited in academic publications) refers to the life stages of emerging new technological fields. In the first cycle the new paradigm gets a huge amount of attention, which is followed by a strong decrease, and after that a below-optimal state. Before sinking into oblivion, the paradigm occupies its deserved place within other technologies. As a new trend, gamification was also part of the hype cycle in 2015, now it starts to take its place as an established methodology.

Gamification-related publications are mostly appearing in the field of marketing and business management. This is understandable because gamification is based on a psychologically powerful and marketable trend (Rab, 2012; Gartner, 2015; Zichermann & Linder, 2013). In our daily life we are flooded with bonus coupons from supermarkets and petrol stations, frequent flyer programs from traveling companies, and other game-like advertisement campaigns. One of the best practices is the program developed by NIKE called NIKE+. The user can follow his achievement and goals related to running by using a gamified application.

2. MC Donald'smonopoly

Gamification, as a concept made its appearance in 2002, when Nick Pelling, a well-known video game designer decided to use his skills in non-gaming business environment. The difference between games and gamified solutions can be found within the setting of the goals. In the case of video games, the goal is mostly to generate profit for the developer, while gamified systems usually operate with different settings. Call of Duty and America's Army may seem

similar, but one is for commercial use, and the other was created by the American army to promote military carrier paths. America's Army hit more than 9 million downloads, and it was the most successful recruiting method in the history of the US army (Zichermann & Linder, 2013). These games are often labeled as serious games, referring to the aspects of simulation (Zichermann & Cunningham, 2011).

3. The chicken and theegg

While gamification was a brand new phenomena in the mindsets of marketing and human resource professionals, educators have been applying it for a long time. Teachers are using games and songs to engage children and young people since the first examples of school-like institutions. In our modern society games seems to overlap childhood and appear among adults too (for example in the case of the video game industry).

So, what was first? Learning or playing? We believe the two are somehow similar. As Pukánszky (Pukánszky & Németh, 1996) describes, in the prehistoric times children created toys in the form of adult weapons and tools.

The pedagogical use of games is not a new invention. At younger age it is a natural part of learning, and ultimately many of the table-top games are also created with pedagogical purposes (for example: Activity, Barchoba, or „Gazdálkodj okosan"). Szászné Eszlényi Judit (2004) highlights those games which are used in the case of older children (referring to creativity, emotional induction, motion, drawing, memory, association, etc.). She also refers to the storyline method, which is a good example in environmental education.

According to the book of Pukánszky Béla – Németh Tamás („Neveléstörténet", Pukánszky & Németh, 1996), in every single era there were individuals who looked at games as powerful learning tools (one exception: there are no citations from the middle ages). We can define three major traits (independent of historical events or eras), which repeat in the context of games: the first one is

- motivation (Marcus Fabius Quantilianus (when) Decroly jeux educatifs,

- learning by doing, (Petersen, Alexander Sutherlan Neill, Kerschensteiner 1908[„the so called book-school should be transformed to work-school, which is based on children's games"]Percy Nunn, 1920, Rosa és Carolina Agazzi, Nemesné Müller Márta

- preparation for adulthood (Karl Groos, 1899, Stanley Hall, Eduard Claparede, Paul Bergemann)

4. Games and Gamification

The definition of gamification is even harder because of the differentiated state of games. We cannot use one determination to categorize such game-related concepts as sports, music, video games, riddles, or gambling. In the Hungarian language there is another difficulty arising from the poor linguistic description of games (same word for a wide variety of activities), while in English there are similar expressions for game-related concepts (game, toy, play, etc.). One of the well-known definition of games is written by Johan Huizinga, in his book „Homo Ludens". The author describes games as a free and voluntary activity, which is happening in a previously specified time and space, by following strict rules. The usual goal of games is to acquire positive emotions and lower tension levels, while creating an alternate reality for the player.

We believe that games (not only video games, but riddles, table-top games, sports, and other game-like activities) should have three major attributes: volunteering, motivation, and self-existence. This is view is reinforced by the studies of Zoltán Aczél (Aczél, 2015), define game-based behavior as a key competency, among other features like goals, symbolism, and idea. The author states that games do not have the goal to create values outside of an alternate reality, even if that happens. If there is no particular experience during playing (only learning), we cannot define the activity as a game. From another perspective: solving a puzzle, collecting stamps, or going for a run in the park can be considered a game, but playing poker for money, running on the Olympics, or playing chess in a championship are another concept.

5. Game elements and game mechanisms

The gamification of in-class and other pedagogical processes does not mean that the given activity would be considered as a whole game. Rather it would mean that the teacher engages the students in the educational process with game elements and mechanisms. The professionals divide the tools of gamification into two categories – game elements and game mechanisms -, however, the two categories are not filled equally. Often an expression is considered an element, while sometimes it becomes a mechanism. In our mind-set: game mechanisms are process theories (rules and principals) and the game elements are tools for the same process. We distinguish the game elements as game process serving and process supporting, also known as motivating elements.

Game mechanisms – process theories – in this sense are the following:

•   The game is self-serving. The publications regarding this reach back to Mihaly Csikszentmihalyi's (Csikszentmihalyi 1997) flow theory. He regarded this activity as self-serving where we do a task for the sake of the task, fully immersed without external reward. The activity

is without wondering, by closing off the outside world and losing one's sense of time – well, can a student ever feel this way in school? This is the aim of gamification.

• The game is voluntary. From the previous statement, it naturally derives: the gamers cannot be demanded to enjoy themselves. It is equally true for educational and extracurricular games. Then one of the game's unavoidable attributes is volunteering which requires motivation. (Could this opposition be relieved by the fact that school is mandatory?)

• The game offers success. If there are too many or too difficult tasks the gamer will lose motivation and if they are too simple, it will end up dull.

• The game is relieving. Csikszentmihalyi also mentions closing off the outside world, „the lack of anxiety" as the attributes of flow. His modern followers describe filter negative stress. The attributes of computer and video games that there are only positive and rewarding mechanisms within them. Recognising these benefits many teachers – including the author of this article – apply this as grading method where there is no failing mark, only plus points. Those who perform better get more, those who do worse get less plus points.

• The game has guaranteed/provided time. The time frames are pre-set and in many cases, they must happen in previously arranged times (e.g. Multiple role games, battles, football games).

• The game is transparent. The results can be seen ahead of time, the rules are always obvious and they do not change in progress. The gamer can continuously see how they are doing.

• The game is a social space. Online communities arrange around games where the gamers communicate, can get ranked, exchange and help each other with advice and resources. In many games co-operation with other members is the basic key of success.

The gamified processes can reach their goal by achieving the aforementioned game mechanisms. And the tools of these achievements are the game elements.

The elements representing the process of the game are the following:

• Epic story – this is the main storyline, character or avatar that proceeds on their own path towards their aim. The game has to have an attractive, well-understandable and reachable final aim. („Free the princess"). The field uses the expression of storyline, however, they rather understand it as the learning process (such as the knowledge elements) organised around one tale.

• Visualisation – during its lifeline the character walks through a path that can be followed-up and which will be the of transparency.

• Atomization, or modularization (where the task is always small and never consists of too difficult or simple elements. All the solution of task particles provides individual success experiences. This requires a point system and to the final, summarised points the results can be

added (higher level or even school grades). The atomization of the tasks can mean that the individual testing of the acquirable knowledge in educational settings. It is easy to imagine that it can be used in the case of definitions, dates, topography but even with poem-analysis or country introduction bullet points. In all these examples knowledge atomization has previously been tested.

- Continuous and immediate feedback
- Quest – these are the side-lines, an action which will be rewarded but the character or avatar is not derived from its epic story. The quest provides added bonus points. Bonus can be given to the individual for the community's achieved and shared good result of which pedagogical result does not require further explanation (although we can mention that in the world of workforce such as trades teams this motivational, inspirational element also exist).
- Points, rewards (points, badges, leader boards; the literature often uses them as PBL)
- Levels - where the accumulated number of points take the gamer to a higher quality level. Its aim is to provide that point collection does not become inadequate, therefore, dull. In many cases, this quality jump is not number but visual-based such as a badge, trophy or other symbols.
- Leader boards (display of success)

6. Theory and practice

We present three examples from the aforementioned theory.

1. In 1998, there were different coloured, funny cows on the streets of Zurich. On the same shapes, they painted different funny, surreal shapes those who deserved them. The idea was adopted by many other cities, in 2006 the cows arrived in Budapest. (In reality, the innovation arrived not the original statues, because they were made and auctioned locally.) The activity surrounding the playful statues – where all the civilians could apply to paint then the statues were auctioned as performance piece. This still was not interactive and the object sent a one-sided message. Therefore, we could call it playful, however, definitely not gamified.

In 2015, one level higher/up, a truly gamified statue group appeared in London which activated the civilians. In this performance, there were 120 performers dressed in funny costumes as lost sheep. One of these performers, Shaun was the character of the silly sheep. They (him, in 120 copies) were standing in an 8 km long path on the streets of London. Their whereabouts could be found by the help of an app which led and motivated everyone to move and find the next one, "hunt down" the whole herd. Whole families followed. The download of the app cost a small amount of charitable donation. This activity made the whole family move, provided

charitable profit and physical exercise. The city walks as undervalued tools of the environmental education. Their popularity is on the rise (Rigoczki 2015,2016) and they can be gamified really well (Rigoczki 2015, 2016).

2.   Parts of the environmental education are biological, internal, personal (mental-hygiene) environments as well (Magyar, Sandor, Gaal, Mogyorosi, 2008). Our following example offers an international practice. In 2013, a Utah elementary school created a game for the fruit and vegetable intake of children where they experimented with 251 students. They have gathered the children to whom they introduced FIT GAME. According to the story line, a hero is trying with all their might to stop the intergalactic evil, but they require some help. The support points can be collected if the children will eat fruit or vegetables. More precisely, if they eat more than they have in the previous ten days, they will receive the points. Firstly, the groups had to be accredited and they had to race to be the supporters, as other schools were in the competition to become the support team of the hero. These "other schools" were fictional, therefore with difficulty, they always won the competition. Every day they read the previous day's results in one minute.

The competition lasted for seven days when they have received a funny badge for the victory, but what is more, they became the support team of the hero. In the following 22 days, before lunch the teachers – if the children have reached the set amount – read a chapter of the story in three minutes. This always began that the hero congratulated and thanked their previous achievements. Then the hero with the strength of their support team reached victories over the evil power. If the children did not reach the given amount, then instead of the next chapter they received a motivating and support requesting letter in the envelope of the teacher in which they explained that there is great danger ahead and they need their help. According to the results, the children ate 38.7% more fruit and 33.3% vegetables.

3.   The love of collecting is in the genetic programme of almost all humans. Its subject can be anything there is only one condition it needs to bring joy to the collector and to involve them (referencing the above-mentioned flow-attributes) in order to create personal connection to the object. This is not far from the gaming attitude (Bernstein 2011; Harvey 2007; Ritchie 2013). The professionals of the science of marketing know this very well. In Hungary, the most successful (the most authentic from the perspective of the environmental education) collecting mission is the Spaar Company's at least quarterly offered sticker-collecting loyalty promotion. The aim is to collect stickers into a colourful album that the parents and grandparents can get after a certain amount of shopping (they can be bought separately as well). In the album, Garfield himself presents, for example, one creature's habitat alongside interesting educational sentences. According to Spaar's release, hundreds of thousands albums and millions of stickers about the

ocean reached the collectors and even though the results of the research of their success are not public, there were many families collecting the stickers, on the internet exchange-clubs were organised and on the flea-markets separate sticker stalls were installed. This promotion definitely increased the customers' loyalty and connection. The collecting game fits into the area of gamification and the expectations of environmental education.

7. Gamification and education

So far, we have moved from gamification to gamified education. Now lets see how much pedagogical relevance it has got.

It is widely accepted, that pedagogy has both scientific and or profession-like meaning, "pedagogy is not only a science, but a kind of practice, that is connected to our everyday life". (M. Nádasi Mária; Ollé 2017). The first we call pedagogy the second is often called pedagogicum (practice-teach).

Kapp, Blair and Mesh (2014) differentiates two branches of gamified learning: the gamification of the content, or gamifying the curriculum (with a storyline for instance), and structural gamification, that assigns game elements and game mechanism to the curriculum. To see how this works, lets check out two examples from the realms of the practice-teach. Both of these examples gamify classical pedagogical content.

The first one is a well known educational practice, where the kids ask questions about a chapter of the book. If we make two teams, and the teams start asking each other questions while collecting points, the task becomes a game. New media tools like an online test creating platform (even as e-learning) or quiz making app can help make this process more appealing.

Our example for the second case is simple. Placing dots on an outline map is usually not the favorite task of students. The Seterra topographical game is still popular. Its pretty simple, the participant gets a random name for a location that they have to pin on the map. After every guess, they see their score in percentage and they create a ranking based on time and precision. On a digital board of smart board this is learning and playing at the same time. The whole class is excited (and of course wants to help), and the player is a hero.

So far we have seen a dozen of examples of gamification, that mostly connect to the pedagogicum. At the end of our article we can verbalize a question about the conclusion, how do we interpret this in a learning environment? To help us look for the answer, lets see two vital parts of pedagogical literature.

In the view of István Nahalka "The learning environment has become one of the main concept of pedagogy. The modern educational theories write about the student-environment relation as an interaction" (Nahalka 1998). In Benő Csapó's words, we find something similar: "only right interaction with our environment can help to learn efficiently. The forming of the learning environment has one the greatest impact on learning. If we follow this train of thought, we find "planning learning environment" as a direction for research and innovation" (Csapó, 2004, 32.o.)

The everyday life of kids is fast, colorful, challenging and playful. The classroom experience is the opposite of this. The difference between personal and work environment can cause a decrease in the efficiency of learning.

According to Zoltán Báthory "the essence of teaching is planning, organizing, regulating and rating or evaluating"(Báthory, 1987). If we accept this, when we speak about the gamification of the learning environment, we have to look past planning the activity, and start to put it in the context of learning and teaching. After planning and organizing, we do need to check the effectiveness of the activity.

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An innovative way in education for sustainable development: e-School4s – e-school for sustainability in the Danube region

Ferenc Mónus[a], Christine Lechner[b]

[a]*University of Nyíregyháza, Institute of Biology, Sóstói út 31/B, Nyíregyháza 4400, Hungary*
[b]*Pedagogical University Tirol, International Office, Pastorstraße 7, Innsbruck 6010, Austria*

Abstract

The importance of education for sustainable development and environmental sustainability was acknowledged decades ago. Consequently, by joining to several international conventions countries across the world agreed to effectively integrate and implement education for sustainable development (ESD). However, it soon became evident that ESD must be effectively integrated into public education and crucially developed, if we really want to reduce the environmental burden caused by human activities. One possibility for this is to develop modern, interactive, ICT based educational tools which may grab the attention of students today. In this paper we present an inspiring example, the e-School4S (E-School for Sustainability in the Danube Region) Comenius project in the framework of which teachers and NGOs across borders collaborated to build interactive e-learning courses for secondary school students.

Keywords: education for sustainability; interactive; e-learning;

1. Introduction

The concept of sustainability gained attention mainly during the early '90s, after the Brundtland Report of the World Commission in 1987 ("Our Common Future") and the Earth Summit UN conference at Rio de Janeiro in 1992. Participants of these events of worldwide importance drew the attention to education for sustainable development and environmental sustainability (ESD). Thereafter it became clearer and clearer that ESD must be propagated worldwide in different strata of societies in order to protect the environmental equilibrium of our planet or at least to slow down the negative impacts it is suffering due to present-day consumer habits and the intensification of industrial and agricultural production.

Accordingly, ESD has been anchored in various forms in training and education in both developed and developing countries (Ware, 1999; Neal & Palmer, 2003; Dillon, 2014). Nevertheless, the overall social attitude that would effectively enable the reduction of

environmental burdens is very slowly changing, even in the case of simplest, everyday-to-life solutions (Wals et al., 2014). Researches both at international (e.g. Palmer, 2002; Jickling & Wals, 2008; Lechner & Rauch, 2014) and national (Zsóka et al., 2011; Marjainé et al., 2012; Mónus & Császár, 2016) level emphasize that improving the efficiency of environmental education in public education is crucial. Thus, the importance of the new, creative, various forms of environmental education remains indisputable.

Nowadays, for example, the attention of youth of the new generations can be caught only with innovative, "personalized" approaches during their education. These may include interactive learning materials developed in the e-learning environment, the effectiveness of which is unquestionable (Zhang et al., 2006; Liaw, 2008). With this in mind, ten partners (see Fig. 1 and Table 1) from the Danube Region started to realize the e-School4S Comenius project in 2014. The aim of the project was to establish cross-country and multilevel cooperation between the participating educational institutions, schools, teachers and students who develop, test, implement and ultimately extend an e-learning platform for sustainability education and the innovative concept of interactive teaching in the secondary schools of the Danube Region.

This paper aims to shortly introduce the concept, content and some experiences made during implementation and dissemination of the e-School4S e-learning materials. The materials are openly available from the project's webpage www.eschool4s.eu (direct link to the e-courses: http://www.elearning-politik.de/eschool4s.html) for everyone who is intended to learn or teach about environmental sustainability.

Fig. 1   Geographic situation of the partner organizations implementing the e-School4s project.
See explanation of the codes (P1-P10) in Table 1.

Table 1. List of partner organizations implementing the e-School4s project

code	country	name of partner organization
P1	Germany	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
P2	Germany	Landesakademie für Fortbildung und Personalentwicklung an Schulen
P3	Austria	Pädagogische Hochschule Tirol
P4	Hungary	University of Nyíregyháza
P5	Slovakia	Academia Istropolitana Nova
P6	Slovakia	e-code
P7	Croatia	Aquilonis d.o.o.
P8	Serbia	University of Belgrade
P9	Bulgaria	73 SOU „Vladislav Gramatik"
P10	Romania	TERRA Mileniul III Foundation

1.1. Project information

The e-School4S is a transnational e-learning platform for collaborative learning on sustainability. It is a networking project in the Danube Region uniting ten partners from Germany, Austria, Hungary, Slovakia, Croatia, Serbia, Bulgaria, and Romania (Fig. 1; Table 1). Each partner is specialized in different relevant fields of expertise. They were brought together to pursue a common goal – bring sustainable development and European integration to schools.

E-School4S has designed an operational e-learning platform for cooperation and exchange of information and experiences in the field of Education for Sustainability and Sustainable Development (ESD). The consortium has developed interactive web-based teaching and learning concepts to cover cross-border issues in the fields of sustainable development and European integration. The approach brings together decision-makers, (in-service) teacher training institutions, schools, and students across the Danube Region to raise their ecological awareness and to promote inclusion of these issues into the school curricula of secondary schools. Through using the platform students and teachers learn to which extent there is interdependence between social, economic, environmental, and political development of a country. The learning objective is that students will understand why the balanced interplay of the development dimensions is a condition for sustainable development at national, regional and European level. They improve their cognitive competences, communication as well as soft skills.

The e-School4S was a project within the framework of the EU program "Lifelong Learning Programme" (LLP), Comenius-Multilateral Networks. It was recognized as an official project in the priority area nine "Investing in people and skills", within the framework of the EU Strategy for the Danube Region (EUSDR).

The e-School4S strategic objectives as follows, are in line with the Life Long Learning and the Comenius Programmes:

- raise awareness of decision makers, and other crucial stakeholders about the relevance of ESD;
- initiate and strengthen regional network cooperation on ESD topics and e-learning;
- motivate and enable teachers to use innovative teaching methods;
- raise students' and teachers' awareness about the importance of sustainability and EU integration as well as of the creative and critical use of Information and Communication Technology (ICT) and
- enable students to acquire further computer, communication and soft skills.

2. Results and discussions

The project implementation ran from 01.01.2014 to 31.12.206. Following initial network establishment a baseline study was compiled (finalized in May 2015), which gives a comprehensive overview of the current status of innovation in the fields of ESD and ICT in the Danube region.

The design of web-based classrooms and the development of e-learning courses on SD in the Danube region were implemented from December 2014 to December 2015 within the framework of the Moodle platform, which is a widely used open source course management system (Cole & Foster 2008). Considering the findings of the baseline study and technical insights of the project partners, the following relevant topics were identified for the e-learning courses:

- Danube – River of united Europe,
- What is Sustainable Development,
- Water,
- Climate Change,
- Sustainable Consumption,
- Social Inclusion.

The partners designed and elaborated, thus, six comprehensive courses including 22 diverse lessons on the aforementioned topics. Additionally, a teachers' corner was created within the e-School4S Moodle platform. This area was designed considering particular needs of educators.

Thereafter, Moodle platform and courses were steadily optimized in three steps: 1.) Based on the insights of the teachers participating in a training (June 2015) for teachers and tutors, 2.) after the first (from January to March 2016) and 3.) after the second (from March to October 2016) trialling phase of the e-School4S web-based classrooms all e-learning materials were tested by teachers and students in all partner countries, and then optimized based on their feedback. In total, 25 teachers and over 250 students participated in the testing phases and implemented the e-learning materials in their classrooms with great diligence resulting in a highly functional e-School4S e-learning platform.

The e-learning platform was then propagated in eight countries. Initial partners identified 30 associated partners who are committed to the project approach and the implementation of network activities beyond project end, and further 46 stakeholders (NGOs, teacher training organizations, school advisers, decision-makers at national/regional government institutions in the education sector) who are also expected to act as multipliers. All these organizations will spread the message of European integration and sustainable development and strengthen the network of stakeholders the e-School4S consortium has initiated. Press releases, several e-media, regular e-School4S newsletters, the project official home page (www.eschool4s.eu), Twitter and three annual conferences during the funded period were used to disseminate the idea and the freely available e-learning platform to the general public.

The official presentation and launch of the main project's contribution, namely the innovative e-School4S e-learning platform which addresses cross-border issues in the fields of sustainable development and European integration in the Danube Region took place at the 3rd Annual Conference on the 17th November 2016 in Stuttgart.

Project partners were strongly committed to support the sustainability of the network and further networking activities after the completion of the Comenius project. Accordingly, the e-School4S network consisting of founding project partners, associated partners and further interested stakeholders will continue to exist after lifetime of the project. In the framework of

future networking activities network members should discuss the further dissemination of the project approach, related lessons learnt or possibilities of implementing other related initiatives together.

A detailed manual on how to organise, implement and evaluate e-School4S web-based classrooms has also been prepared by the eSchool4S partners. It can be used by future operators of the e-School4S Moodle courses and other interested stakeholders. It will allow successful further implementation of web-based classrooms in different contexts in the future considering the lessons learnt during the testing phases and the implementation of the e-School4S.

2.1. Main innovative characters of the e-School4S web-based classrooms

The e-School4S Moodle platform, which can be found at http://www.elearning-politik.de/eschool4s.html, is an inspiring example of how teachers and colleagues working in NGOs can work together across borders to build e-learning courses together. There are six open courses available covering the following topics: ESD, Climate Change, The Danube, Social Inclusion, Sustainable Consumption and Water.

The courses are constructed upon a common framework and thus all provide a general overview of the topic on hand including basic information leading to further factual details and activities. The information is given in different formats from purpose-written texts to video sequences. The activities are also varied ranging from knowledge checks to opportunities for in-depth thought and communication with students in other countries. Each course opens with an explanation of the learning outcomes for teachers and students.

The courses can be used in a flexible way meaning that there is potential across the curriculum from Citizenship & Global Studies Education to Economics, Geography and Biology. Since all are in English as a lingua franca the courses are accessible to secondary school students in different countries and would be very useful material for CLIL (content and language integrated learning) lessons.

One fascinating aspect of the platform is that the courses were designed within one of the nine e-School4S partner countries and trialled in the other countries in the Danube region. We hope that there will now be interest in other regions.

2.2. *We encourage pupils and teachers to integrate e-School4S in their classrooms because*

- **Pupils** will learn to understand the interrelatedness of economics, social, cultural and environmental issues at national, regional and European level
- Intercultural exchange will make **pupils** aware of culture and language diversity and will help create a sense of European identity
- **Pupils** will acquire several communication and soft skills (commitment, tolerance, foreign language use, ability to give/receive criticism, teamwork), those which are necessary for their personal development, for future employment and for active European citizenship
- **Teachers** will learn basic competencies on how to use and integrate e-learning materials into their classrooms
- **Teachers** receive a ready-to-use tool which can enhance the transfer of knowledge, motivate and raise the attention of the pupils during their classrooms
- **Schools** will be encouraged to strengthen existing and to establish new partnerships and cooperation between schools.

2.3. *Our expectations*

The target groups for the project products are secondary school students in the Danube Region. The language of the e-learning material is English due to the international nature of the project, so it can be used primarily in secondary school classes where students have reached a B1 to B2 levels in English. The e-lessons thus allow and, for some tasks require, that students interactively share their impressions on the lessons with other students from remote secondary schools (preferentially students from different countries). Beside the interactivity of many parts of the e-lessons these social relationships may also motivate students and help them to receive a more complex image from environmental and social issues concerning sustainability.

In the secondary schools mainly dedicated teachers and pupils are expected to use the platform and profit from it. Study groups, and teachers interested in biology, geology and in environmental and social issues may be the ones profiting the most from the courses. The main intention was for the platform to be used in subject lessons; however, the lessons may also provide possibilities for English language teachers to make their classes more interesting and more diverse.

Finally, the e-lessons could be also used in higher education. Some teachers may profit from the e-School4S lessons as they are suitable to make a course more diverse, more colourful and more interesting. The e-lessons may be especially useful in B.Sc. and M.Sc. courses for teacher education, water engineering and civil engineering.

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Review of Ecosystem Services of Headwater Catchments by J. Křeček et. al.

Lívia Kürti

Eszterházy Károly University, Eger, Leányka 6, H-3300, Hungary
e-mail: kurti.livia@uni-eszterhazy.hu

Abstract

This new scientific book was published by Springer in this year 2017. It is not just a new work about headwater catchments in general, but a good summary of the different applications and methodology faces the stakeholders and attendants of catchment services around the world. As it is well known any changes in headwater and mountain watersheds have major impacts on not the development of its own region, but also those of downstream. As the climate change is already in reality, we feel this change regularly, it is important to stay for a minute and reconsider the eco-service practices. Do we get the best answer to the challenges of this changing environment?

Keywords: review; headwater; mountain watersheds

1. Review

The book contains 23 chapters, divided in 4 greater parts. Since the scope of this review does not allow for a detailed presentation of each chapter, I will mention some of the major sub-units without any completeness. Each part starts a general outlook of the title and also it gives some concept explications as well. The different international convention and programme are also shown in this part.

The first great session title is *Headwater environment and natural resources*. In this session there are five studies from *Japan, Poland, Turkey, Finland and Spain*. Different aspects of the forest management and water management are presented in different climate conditions.

The ecosystem services are defined as the functions and the products of ecosystems that benefits humans, or yield welfare to society. So it is a wide range of activities. This holistic point of view is crucial in all type of landscape management, but maybe the most important in headwater catchment as it is the source of water supplies, refugees for biodiversity, main life supports. As Springay says they are „foundation pillars of our planet". It is mentioned in its work that mountains provide freshwater to over 50 % of world population. Headwater catchments are

fragile ecosystems due to their slope, altitude etc. At Paris, In the frame of Agenda 2030 Sustainable Development Goals were accepted to push integrated management and increased recognition of ecosystem services. Also an action plan was also accepted by FAO regarding these efforts. It demands multi-disciplinary approach to the watershed catchments. These aspects and approaches can be found in every paper in this book.

As catchments are in mountainous, forestry regions the water resources are controlled by not only the precipitation and runoff, but also by the type of forest management. For example in Poland a very precise and interesting study was made in 2007-2015 period. In the frame of this work more than 3500 measures were realized by the „Counteracting the effects of rainwater runoff in mountainous areas" project. The aim was to apply technical and ecological techniques to increase retention capacity and reduce sheet, rill, gully- and stream channel erosion. Their experiences showed that the combination of ecological oriented and technical acquisitions had good evaluation. They used for example small-scale retention structures in forest areas used by local and natural materials (wood, stones, cohesive soils) to reduce risk of sheet erosion and direct flow acceleration.

In the study by Görücü simulation were shown in the Ceyhan watershed, 58 % forest covered catchment. The scenarios were calculated on long term (30, 40, 50 and 60 years) with different interest rates (4,5,6%) and different allowable cut levels at 85 000m^3, 105 000m^3, and 140000m^3. The paper concluded that there is a need at this side to widen water cost in the catchment, to develop integrated resource management between forest and water sectors, and strongly cooperation among stakeholders. This last one appears in almost all of the study presented in this book.

It is also important that such a responsible management needs also political and civil support, not only to green the legislation and economy, but also to form the civil green behaviour.

In Finland the long term effects of clear-cutting and side preparation were analyzed and shown, exactly in boreal zone. It was clearly proven that after clear-cutting in the following 4-5 years the nitrate concentration were growing to 500μg/l in groundwater and after 17 years is still higher than the pre-treatment values. It means also, that forest management can cause long term disturbances in groundwater quality.

In a research done at Tedori River basin in Japan shows an increasing trend during the winter period in temperature and river discharge, and decreasing trend in the early spring period. This analysis was mad by studying the long-term observation data of air temperature and water discharge also. They were used hydrological model simulations to estimate future trends in water cycle due to climate change.

In Spain the forest management's important question is to reduce the fire number in drought periods. Or, in Africa, the role of „dumbos" in water regime was clarified.

The *second part* is focusing on *enhancing environmental services in headwaters*. According to this title the 6 studies presented in this part try to ameliorate the quality and quantity of ecosystem services. For an effective future, some of them started to collect all the experience from the past and present.

E.g. in Israel, where the status of Kinneret lake is very complex and crucial in the country life. As it is the only fresh water lake of this country, it is very valuable, not only for agriculture and industry but for the ecosystem, as well. The anthropogenic pressure is very high on this region. Although several project and study were figured out and mentioned in this paper. The conclusion was that long-term investigations, learning from the past management are very important to reduce pollutant fluxes, to prepare the water scarcity, follow-up on mitigation of water and nutrients in ground- and soil-water environments.

For example in a Japan paper presented in this issue summarize, and analysed natural hazards (mainly landslides) phenomena in mountain watershed context. As Japan is a densely populated country, a significant part of the population lives in a dreary area. To mitigate their impacts the researchers, stake holders try to develop technologies to predict and avoid landslides. Although it is a very difficult task, and complex question, relatively wide knowledge were accumulated. The article concluded that it is urgent to develop more precise prediction methodology and also mentioned that *comprehensive watershed* management would be the only possible solution.

It was interesting to read the study about the agro-environmental sustainability of the Yuanyang Rice terraces in Yunnan Province. It shows very clearly the millennial traditions of rice cultivation and in this form a very positive example of sustainable agriculture and also land use. During this study soil samples were taken along to terrace's deeper section also, to see if the organic matter concentration was changed. It is important that the upslope rocks are mainly impervious gneiss and schist, and the main valley structure is syncline. So there is an important groundwater reservoir, which is greater than the physiographic catchment. Terraces are used not only for rice cultivation, but also ancillary food production e.g. ducks, fish, grogs and snails, mushrooms and bee cultures etc. This example might extend and encourage other agricultural managements to develop their own sustainable systems.

In the *third part* of the book (Environmental Services in the Changing World) we can read 6 studies. As in the earlier parts, this chapter is begins with a general overview to environmental services, mainly in mountainous regions, in which Schreier writes that mountain areas warming up faster than lowland areas, but there is a lot of uncertainty of this studies due to the many

microclimatic   effects in this environment. Also mentioned that mountain watersheds are the water towers of humanity and forests here moderate the hydrological cycle by evapotranspiring precipitation by 20-30%, and allows the intercepted rain to enter soil and groundwater, and trees can also moderate the summer temperature in the stream water. With climate change the new stress situations appeared such higher temperature, extended droughts and these can encouraged also pest and disease events in trees and forests. So in the future, environmental forest management will be essential to protect our watersheds in mountain areas.

That is what says also the next study about Alp. But it mentions also that environmental services have to be linked also with climate change adaptations. So there is a need to analyze environmental system relevance, sensitivity and impacts for specific regions. In this paper the author said that the environmental approach to adaption is valuable for communities, municipalities or regional governments as they have to know their possibilities and resources to give a good answer to changes. They also concluded that in water related services there is an urgent need to develop and implement adaptation methods in Alps.

But other European mountain region in Jizera Mountains (Czech Republic) faces also the long-term effects of acid atmospheric depositions. In this study the acidification has already economic consequences, for example the rising costs by the treatment of drinking water or the reconstruction of the water treatment plant in Bedřichov. J. Křeček and L. Palán clarify that "in Czech Republic water catchments, a system structured forestry practices should respect five main priorities: protection of surface waters, conservation of biodiversity, soil protection (slopes over 30%), fog drip maintenance and evapotranspiration control (the rest of the catchment)." They also concluded that more study needs to be taken to understand the role of the herbaceous vegetation or soil conditions in hydrology.

The next study was written about Serbia, where water and wind erosion affects huge part of the country, and lot of torrent event is registered. In the last decades increasing frequency of torrential events was observed. The authors advise to create a national strategy for erosion and torrent control, an erosion map, torrent cadastre, and also cadastre the erosion control works in the country. It helps to achieve better security of people living in the mountain region or in the lowland cities. Population needs to be adequately prepared for emerging emergencies and prevention, which places a significant educational burden on the topic's experts. This latter process can involve the various civic organizations and educational institutions.

The last part of the book is about the new challenges for Environmental education and active citizenship with five studies. In which we find a severe work about the European Union politics, ecosystem services and stakeholders' participation. As headwater catchments are drivers of key

ecological processes, but also natural places in the same time with natural and spiritual values." Since the early 2000 European Union started a process from the nature and water legislation to the biodiversity strategy towards the integrated management of natural resources, with and for people, with their cultural diversity, following the ecosystem approach" declare the authors. The European Union tries to develop its own MAES and CBD (Convention on Biological Diversity)projects, as well as EU Water Framework Directive, which help to introduce ecological services in management systems also. Some of them have been implemented at national level, but there is also a need for localization. It is similar in the case of Finnish firm, which produces energy and environmental peat, forest fuel and pellets for heat, steam and electricity customers in Finland and the Baltic countries. As peat production is related to in a certain way to water protection, the company has built several water treatment solutions. They started an environmental program in which they aim to use the BAT (Best available Technology advised by EU). They measures 14000 water samples in every year and the information get from this process is published on the website also. They also introduced a programme for sustainable, responsible peat production; include also the land use after the end of the production. They also have a unique know-how about water treatments, and they started a program "CLEAR-WATER" business line to offer natural water treatment solutions to different land users. Their example shows that it is possible to create new, ecologically sustainable business opportunities from a traditional business area.

The next studies show the active programmes in Austria and Canada to involve owners and educators in ecosystem services. In the last one Québec has been building a strategy for active environmental citizenship, with a programme named 'Action Research for Community Problem Solving". The method encourages learners to become actors in, for and with their communities. As it uses 13 steps for developing community projects that integrate social, physical, or biophysical environment. During this processes the students become partners of decision-makers, and gradually take all or part of the project management. Their teachers have a role as a guide, resource person, a mentor. During the project learners write journals, containing their feelings, new insight on their problems, their learning, understanding and experimentations with participation strategies. This programme offer benefits to all involved: teachers to discover their students, for example. This model could be widely applicable not only across USA and Canada, but also in the European, Asian, and African countries. It could be applied in different ages from 4-5 five years until adults sector.

Also can be adaptable in Hungary where environment education can be found in several levels of academic programmes. As E. Pénzesné Kónya mentions in her article, after completing a

certain academic programme, the student should know the basic biotic and abiotic components of watersheds, and how watershed structure and functions may vary in time and space. In this little country those who want to study about watersheds can choose studies at natural sciences, Engineering and Technology and Agriculture. But it also appears in teacher training programmes as there are a lot of eco-schools, and programmes for biodiversity conservation and environmental protection.

As you can see the attitudes and activities of residents will have key role in managing future changes in watershed region. In this book we find several good examples from which we can apply the good element in our watersheds.

The last chapter summarizes and presents international programs dealing with the management of river basins. It emphasizes the vital role these regions play in human life. E.g. headwaters supply society with water, peat, timber, grazing land, and locally aesthetic, cultural, recreational and educational benefits to local communities. It details also the results of the Nairobi declaration for the International Year of Freshwater (2003) also.

But declare also the effective headwater management should be to maximize the benefits of headwater catchments to their stakeholders. It requires also the best available technologies, better policy frameworks, changes is land husbandry patterns and direct engineering interventions. It is clear, in the future research on headwaters catchment will be used with long term data, and environmental monitoring is needed also. It is required to supervise our concept of sustainable watershed management with wider meaning and embodiments, too.

That is why this new collection of research and papers is very valuable. It can lead to better, holistic management in different watersheds in different regions.

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INTRODUCTION OF THE GUEST EDITORS, AUTHORS AND THE BOOK REVIEWER

Guest Editors:

ERIKA PÉNZESNÉ KÓNYA is the Head of Department of Botany in the Faculty of Eszterházy Károly University and one of her research area is the role of biodiversity knowledge in environmental education, including garden pedagogy. She is the head of the organizing committee of International Environmental Education Conference, IEEC. The first event was held in 2016 in Eger.

JÁNOS MIKA is full professor at the Eszterházy Károly University, head of the Department on Environmental Sciences and Landscape Ecology, responsible for the Environmental Pedagogy module of the Doctoral School on Educational Sciences. His main research fields are regional climate changes, their impacts, and education of and by climate change. For his earlier research he received the title Doctor of Academy in 2007, and the Norbert Gerbier - MUMM International Award of the World Meteorological Organization in 1999.

Authors:

MARTIN HAIGH is Professor of Geography and University Teaching Fellow in the School of Social Sciences and Law at Oxford Brookes University. In 2004 he was elected President of the World Association of Soil and Water Conservation. Martin Haigh is co-editor of the Journal of Geography in Higher Education. He carries out research in Indian Religions, Geomorphology and Gaia Hypothesis. Their current project is 'The Scholarship of Teaching & Learning.' He is the author of numerous book chapters and articles in professional and academic journals.

CLAUDE POUDRIER is the Director of the Program in Environmental Education & Citizenship (PEEC). Website: http://www.P2EC.ca He gives bilingual training sessions in citizenship education tailored to the needs of teachers in elementary and secondary schools, adult education and pre-school educators. He is also involved in joint research projects with academic researchers in Canada and abroad.

TÍMEA TALIGÁS is a PhD candidate at the University of West Hungary's Environmental Pedagogy Program, whose earlier research focused on the sources and emissions of nitrous oxide (N_2O). In her actual Doctoral Program, she develops studies for agricultural university students and brings the role of nitrous oxide in the environmental systems into their attention.

JÁNOS MIKA see above

ÉVA NAGY is a PhD candidate at the Eszterházy Károly University's Doctoral School. Her earlier research focused on the discovery of current stages, where biological diversity could be developed among school children, by either methods or institutions. In the Environmental

Pedagogy Module she studies how important the knowledge of animal and plant species is, and she drives the students' attention to the more effective way of studying, learning by personal experience.

CSABA RIGÓCZKI is a PhD candidate in the Doctoral School of Educational Sciences in the Eszterházy Károly University, Eger. His topic of research is urban environmental education. He works as a teacher in a secondary school of Budapest, where pedagogical science and practice meet.

ANDREI DAMSA is the lead researcher of the NetCoGame GamefulLiving Research Center. He is an expert in gamification and video game studies, focused on the field of motivation, positive psychology, and related IT solutions. He is also involved in the development of digital competencies among Hungarian citizens within the Digital Success Programme.

KRISTÓF GYÖRGYI-AMBRÓ is a gamification expert at NetCoGame GamefulLiving Research Center. His main areas of expertise are gamification in education and the motivational mechanics of games. He also works with other GOs and NGOs in the field of education mainly focused around alternative teaching methods and the new challenges of the 21st century.

FERENC MÓNUS is associate professor at the Institute of Environmental Sciences, University of Nyíregyháza, responsible for subjects related to Evolutionary Ecology and Environmental Pedagogy. He received his Ph.D. degree in 2011; his main research fields include foraging and antipredator strategies in birds, the role of spatial position in behavioural response of birds, human mate choice, and methods and efficacy of Environmental Education.

CHRISTINE LECHNER is currently a professor at the Pedagogical University in Innsbruck. Her courses include courses on English language competences, on Content and Language Integrated Learning (CLIL) and on the European Language Portfolio for Student Teachers of Languages. She is the co-ordinator of an action-research-based post-graduate course and of the Council of Europe project Action Research Communities for Language Teachers. Her publications include papers on CLIL, action research on Education for Sustainability, student mobility and international co-operations.

Book review:

LÍVIA KÜRTI is assistant lecturer at the Eszterházy Károly University (http://geonature.uni-eger.hu/). She has a research about karst springs with lukewarm water at the foothills of Bükk Mountain in Hungary. She also teaches physical geography, protection of environment and hydrology to students on geography teacher, geographers at bachelor level.