The sustainability science – a challenge for an education for sustainable development

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Abstract: The paper refers to one of the most complex problems of the mankind - the responsibility for the sustainable development requirements, taking into consideration the worsening state of the environment and the dangers the future generations are exposed to.
The objective of this paper is to highlight the importance of sustainability science for education for sustainable development. Considering the general goal of the sustainability science regarding the evaluation, the reducing and the minimizing of the consequences of the human’s impact on the environment, we analyze the complexity and the possible contributions of this science to sustainable development. Thus, we introduce some arguments, interpretations and concerns for the promoting of the sustainability science within the education and management for a sustainable development.

Key-Words: - Sustainable development, sustainability science, education for sustainable development – ESD, academic curricula, environment, higher education.

1 Introduction

The three main aspects of sustainability - economy, society and environment have been integrated into a new science - the science of sustainability. The defining of this new science has led to confrontations between experts from different fields. This science has an important role in education for sustainable development process, in knowledge management and in achieving Triple Bottom Line.
The UN Decade of Education for Sustainable Development 2005 – 2014 is a substantially challenge on the rethinking and the renewal of the curricula and pedagogy in higher education based on the sustainability science. An enhanced understanding of the principles, values and ethics that underline sustainability is needed.

Among the numerous arguments that have been taken into account in our study in order to support the promotion of the sustainability science in education, there are four that can be considered more important:

- The decline of ecosystems A warning report - presented by the UN that highlights the disastrous state of the environment (The Economics of Ecosystems and Biodiversity – TEEB, 2010, teebweb.org);
- The need of interaction between people and the environment. Man is the cause of the environmental imbalance but also ... the solution. Recent events and studies show that the world’s population ignores the concept of sustainable development and the meaning of the Agenda 21’s theme (TEEB-2010). The population growth in general, but especially the growths of population in urban areas are problems that will aggravate the environment’s condition and will impose the integration of the sustainability science in the urban research. [18] [20]

The need of synthesizing and exploiting the knowledge that are integrated in the (educational, economic, technological, administrative, managerial, etc.) processes and systems which can influence the sustainable development on the bases of the new challenges of the sustainability science.

Recently, Professor Yoshikawa of Tokyo University has made a comparative analysis between sustainability science and traditional sciences (Table 1).

Table 1 Traditional science and Sustainability science [21]

<table>
<thead>
<tr>
<th>Traditional science / Sustainability science</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aim</strong></td>
<td>To understand everything</td>
</tr>
<tr>
<td><strong>Object</strong></td>
<td>Anything existing in the universe</td>
</tr>
<tr>
<td><strong>Result of research</strong></td>
<td>Knowledge for understanding</td>
</tr>
<tr>
<td><strong>Measure</strong></td>
<td>Additive</td>
</tr>
<tr>
<td><strong>Mode of change</strong></td>
<td>Unchangeable (Any change can be deduced from existence)</td>
</tr>
<tr>
<td><strong>Expected practical results</strong></td>
<td>Prosperity and safety of human beings</td>
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2 The sustainability science

The concept of sustainable development does not begin and does not end with economic development. Arima (2009) thinks that inside the concept of sustainable development, "development" includes both the development of science and technology as well as the development of society. This type of development should be understood as a new civilizing project based on values, ideas and dreams that mean for us a significant cultural resource. Here is where the universities must interfere.

"The sustainability science is an emerging discipline that seeks to understand the interactions between global human and social systems, the complex mechanism that led to the degradation of these systems and the concomitant risks of security and comfort of human beings” [15].

Sustainability science is partly defined as:

- “The comprehensive study on the multiple and complex interactions of the human, social, and global systems aiming to achieve a sustainable development of the human beings, the welfare and the development of the society.” [7].

- Improving society’s capacity to use the earth in ways that simultaneously meet the needs of a much larger but stabilizing human population, sustain the life support systems of planet, and substantially reduced hunger and poverty.” [6] [3].

In a recent paper referring to the post-crisis strategy on sustainable development [20] it is shown that “the overall goal of the sustainability science aims at the evaluation, reduction and minimization of the consequences of the human’s impact on planetary systems and human society, now and in the future, so that man should become a friendly user and the protector of the Earth”. This means fostering integrating and applying the knowledge about Earth’s systems gained especially from the holistic and historical sciences (such as geology, ecology, climatology, oceanography) and connecting to the knowledge about inter-human relations, knowledge gained from the humanities and social sciences.

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<tr>
<th>Mode of change</th>
<th>Unchangeable (Any change can be deduced from existence)</th>
<th>Slowly changing</th>
<th>Stable/unstable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected practical results</td>
<td>Prosperity and safety of human beings</td>
<td>Sustainability of the Earth</td>
<td>Prosperity/sustainability</td>
</tr>
</tbody>
</table>

Both the definitions and this analysis suggest the following:

- **Sustainability science seeks real world solutions to sustainability issues and aims to break down artificial and outdated disciplinary gaps between the natural and social sciences, through the creation of new knowledge and its practical application to decision making.** [4] [11] [18].

- **Sustainability science is based on interdisciplinary and trans-disciplinary research methods combined with practical knowledge.** Sustainability science has customizations in all scientific disciplines (ecology, economics, physics, chemistry, sociology, medicine, earth sciences, etc.), which lead to new methods of integrative research. [20].

- **Sustainability science can be a challenge for the worldwide educational process and system. Most of the problems arising from the impact of human activities on the Earth’s life support systems come from complex, global, and social human interaction. “Unless we understand these interactions, we will not be able to design a path towards sustainable development. Sustainability science plays a key role in thin understanding”.** [17].

- **Sustainability science is radically different from the current fields of science in terms of structure, method and content. It is about new approaches on non-linearity, complexity, large time gaps between socio-economic actions and their consequences, the development of specific theories and semi-quantitative models.** [19]

- **The consensual definition of sustainability science is as elusive as the definition of "sustainability" or "sustainable development". Sustainability Science tends to advance the basic understanding of the dynamics of human-environment systems in order to facilitate the implementation of integrated management systems design, the evaluation of practical interventions that promote sustainability in particular contexts or places, the improvement of the links between relevant research and innovative communities on the one hand, and a relevant policy and the management of the communities on the other hand.**

The multidisciplinary, interdisciplinary, and trans-disciplinary characteristics [11 of sustainability have been emphasized repeatedly [7] [8] [20]; Rapport [13] noted that sustainability science is not a “science” by any usual definition - that is, it is not yet a set of principles by which knowledge of sustainability may be systematically built. Rather, it consists of a plethora of ideas and perspectives, sometimes conflicting, by which one might hope to achieve a viable future for humankind.

The ones, who characterized sustainability science as an applied science, stated that if sustainability science is to grow into a mature applied science, we must use the scientific knowledge acquired in the separate disciplines of anthropology, biology, ecology, economics, environmental science, geography, history, law, political science, psychology, and sociology to build diagnostic and analytical capabilities. But it is also claimed that sustainability science is neither “basic” nor “applied” research, but rather an enterprise centred on “use-inspired basic research”, where both the quest for fundamental understanding and considerations of use are important [3]. As pointed out by Clark and Dickson [4], “sustainability science is not yet an autonomous field or discipline, but rather a vibrant arena that is bringing together scholarship and practice, global and local perspectives, and various disciplines”.

**The Statement on Sustainability Science** was adopted in 2000, at Friibergh (Sweden) as a result of the growing importance and the pressing problems of the sustainable development, statement that aims to substantially improve, even if in a limited way, „the interactions between nature and society”. Addressing the challenges of sustainability science requires establishing a clearer accountability in governance, an improvement of democracy, a stronger awareness of the citizens, new styles of institutional organization in order to strengthen and support interdisciplinary research on a long term period, including the emergent countries, the involvement of the scientists, practitioners and citizens in setting priorities, in creating new scientific knowledge, in evaluating the possible consequences and testing them in practice. „Sustainability science has to play a major role in the integration of different styles of knowledge creation in order to bridge the gulf between science, practice, and politics.” [8].

The International Conferences on Sustainability Science (ICSS) from 2009 and 2010 were an opportunity to strengthen and promote the new science.
Sustainability science is not a discipline that can be defined simply by the subjects it deals with, it is an academic field characterized by core principles that include holistic thinking, transdisciplinarity, and respect for diversity.” [9]

The aim of the academic curricula is to determine students to: „understand the interactions within and between global, social, and human systems, the complex mechanisms that lead to the degradation of these systems, and concomitant risks to human well-being and security; to be able to propose visions and methods for protecting and/or restoring these systems and linkages”. [17].

3 Education for Sustainable Development

According to UNESCO Education for Sustainable Development (ESD) aims to help people to develop the attitudes, skills and knowledge to help them in taking informed decisions for the benefit of themselves and others, now and in the future, and to act upon these decisions. (http://www.unesco.org/education-for-sustainable-development/)

The message that was the basis of all international (scientific, political, etc) reunions regarding ESD was the same: tomorrow will be too late. „Now is the time for humanity to mobilize the sum total of its wisdom and knowledge, including the natural sciences, the humanities, and the social sciences”. [1].

Education for sustainable development is not just an extension of environmental education including additional social and economic aspects, but it must also be a strong element of connection between global education, environmental education, technical education and health education. The goal of sustainability education is „to equip the younger generation with leadership skills, management capabilities, and the broad knowledge needed to create the new systems that can lead to global sustainability” [15].

The environmental education policy in higher education can be divided into two parts: one is the policy for the environmental major, which is to foster the specific personnel; the other is for the non-environmental major, which is to popularize the environmental education.

Sustainability science can contribute to the improvement of the quality management, the environment management etc. Thus, it is more correct to talk about integrating into a single global management system of all operational components of the organization: quality, safety, environment, social, financial and not to talk about an "integrated management". By integrating all these components and issues we came to the interaction of these three spheres: economy, society and environment, therefore, to sustainability. In fact, many quality specialists agree with the definition of total quality as an integrated and mobilizing policy of energies and knowledge, which means the complexity of the relations between the three areas and a strategy of participatory management and empowerment [12].

4 Involvement of Universities

The Talloires and Kyoto Declarations, the Copernicus University Charter for Sustainable Development and other international statements have gathered global consensus on higher education for sustainability. This consensus is based on the promotion of sustainability towards all disciplines; research on sustainability issues; the greening of university operations; engaging in academic cooperation; forming partnerships with government, NGOs and industry; and the moral obligation of universities towards sustainability.

An education on sustainability increases the awareness of the complexity and interrelationships of environmental, economic, social, political and technical systems and also increases respect for the diversity of voice that exists among cultures, races, religions, ethnic groups, geographic and intergenerational populations. This complexity and diversity around the world requires knowledge and skills by citizens, professionals and leaders that cross the boundaries of disciplines and institutions, cultures and realities of society. Transdisciplinarity is a growing field of education and research that holds great potential in order to bring an important contribution to a sustainable change.

If higher education is responsible for developing leaders who are able to create a sustainable society, then "students must understand how the lessons they learn - in art, philosophy, history, economics, engineering and any other discipline - can contribute to a more sustainable society” [10].

Compared with ESD in basic education, higher education has the following characteristics:

- Higher education tends to be more initiative and spontaneous in the promotion of ESD, the construction of resource-efficient and sustainable development campus.
Higher education has great academic strength, which leading the construction of the resource-efficient campus. It could offer much more support in science and technology to energy saving and emission reduction for the society.

Higher education not only educates its own students, it also has the function of training the government leaders and teachers from basic education. Furthermore, its laboratories and demonstration projects can be the good practice bases for the public, not only the students on campus.

Being at the service of great ideals and supporting civic engagement, universities should promote the learning outcomes that go beyond specific knowledge of curricula and must produce good citizens, who are well prepared both in terms of competence and of character [21].

Today’s students will be the business leaders, scientific researchers, politicians, artists, and citizens of tomorrow. The extent to which they will be prepared to make decisions in favour of a sustainable future depends on the awareness, knowledge, expertise, and values they have acquired during their studies. For this reason, the concepts and themes of sustainability should be integrated into all levels of education. Curricula must be revised so that sustainable development forms a guiding principle throughout the entire period of their studies and afterwards too.

The university should be a key change, a place for training, preparation and specialization for sustainable development. Investing in knowledge helps to harmonize the strategy - cultural process, generating positive synergy and excellence [13] and the intellectual capital becomes more important than the financial capital for achieving sustainable gains [5].

Within the educational approach to sustainable development there can be delineated a series of competency based on:

- Knowledge and understanding: such as: world’s current situation, causes of un-sustainability, sustainability fundamentals, science, technology and society, instruments for sustainable technologies
- Skills and abilities such as: self-learning, cooperation and trans-disciplinarity, SD problem solving, systemic thinking, critical thinking, social participation
- Attitudes such as: responsibility, commitment in SD challenges, acknowledgement, respect, ethical sense, peace culture, risk awareness.

The definition of these skills is a learning process expected from all the EU universities. One of the reasons behind these efforts is the Decade of Education for Sustainable Development (DESD 2005-2014), initiated by UNESCO, which aims to integrate the principles, values and practices of sustainable development in all aspects of education and learning.

5 Conclusions

Sustainability science is a challenge to researchers, government officials, citizens, managers, the educational system in general and higher education in particular. An integrated approach of the “eco” phenomenon is being necessary: economy + technology + science + society based on "synthesiology" [21] and "consilience”.

The arguments which we rely on in supporting the importance of the sustainability science inside the eco-education are based on the numerous events and calls coming from international and regional organizations in the last 20 years, from the researcher’s and universities’ forums, as well as on examples of good practice of some important universities in the world. The message of the international meetings regarding ESD – tomorrow will be too late – is alarming. Conclusively, it is necessary to acknowledge the existing problems in the process of education for sustainable development and to review the contribution of higher education in the field of sustainability science regarding the different views, approaches and methodologies. The means of efficiency are: inter and cross-disciplinary communication, information, education, involvement, integration, empowerment. The expected result for sustainable development: a responsible attitude, commitment, action. The collaboration between educators, researchers, business, political, administrative and all actors of society is absolutely necessary.

References


