Handbook on Methods used in Environmental Education and Education for Sustainable Development

M. Scoullos, V. Malotidi

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Introduction

The need of formal, non-formal and informal education for environment and sustainable development

Education, in addition to being a human right, is a prerequisite for achieving sustainable development and an essential tool for good governance at both state/sub-state and international levels.[1]

From Tbilisi (1977) to Kiev (2003) education has been acknowledged worldwide as a fundamental tool for the environmental protection and sustainable development. To this end, formal educational systems have integrated environmental education (EE), education for environment and sustainability (EfES) and, very recently, education for sustainable development (ESD) in the school curricula, particularly at primary and secondary school level. The modalities by which EE or ESD are implemented in schools varies from country to country depending on a number of social, economic, cultural and institutional factors.

For instance, the model by which EE is implemented in primary schools in some Mediterranean countries (Greece, Spain, Jordan), is the one by which EE is included in the curriculum as a **separate subject area**.[2] However, the **"infusion"** model is also used in primary schools in many countries, such as: Malta, Syria, Portugal, Italy, France and partially in Greece, by which EE, as a cross-curricula topic is embedded in the curriculum disciplines.[2] The latter approach is prevalent in secondary schools. Another model based on transversal **thematic modules** (with topic such as: water, waste, energy, sustainable production and consumption, etc.) and implemented via interdisciplinary approaches is relatively new, not so frequently used, at least in the past, since it requires increased and efficient coordination, as well as a certain degree of expertise of the educators involved.[2]

Nevertheless, the role of non-formal and informal* education in achieving sustainable development has been recognised in all major international conferences and documents (Agenda 21[3], UN Decade of Education for Sustainable

[1] UNECE "Basic Elements for the UNECE Strategy for Education for Sustainable Development", Statement of Education for Sustainable Development by the UNECE Ministers of the Environment, UNECE 5th Ministerial Conference "Environment for Europe" Kiev, 21-23 May 2003

[2] Stokes et al. (2001) "Environmental education in the educational systems of the European Union", Synthesis Report, EC DG ENV; Ventura F. (1993) "Science & Environmental Education at the primary level in Malta: separate interests, different roles", International Journal of Science Education, 15, 5, 509-519; Madanat H. (1998) "Environmental Education in the Jordanian Education Curriculums" Report of the Second Jett Environment Workshop, Amman, 16-17/2/1998.

[3] "Promoting Education, Public Awareness and Training", Chapter 36, Agenda 21, UN Conference on Environment and Development, Rio de Janeiro, 1992.

* Non-formal education takes place in a systematic way, out of the established formal educational system and sometimes, in parallel with mainstream systems of education and training and, does not typically lead to formal certificates. Non-formal learning may be provided through the activities of civil society organizations and groups. It can also be provided through organizations or agencies, with specific objectives and specific target groups that have been set up to complement formal systems. Informal education is taking place as a natural accompaniment of everyday life. Unlike formal and non-formal, informal learning is not necessarily intentional learning, and as such may not even be recognised by individuals themselves as contributing to their knowledge and skills. It is "offered" or stimulated outside the schooling system and addresses the society at large or targeted groups other than students usually without any monitoring of its impact (UNECE, 2003; UNESCO, 2001).

Development[4], UNECE Strategy for Education for Sustainable Development[1]). On the other hand, educators cannot assume that several years of formal education ensure that students will gain and retain all the knowledge and skills needed for *environmental literacy***. Non-formal education could provide students with the means to maintain and reinforce the knowledge and skills that they have learned during their school years.

Furthermore, as both environment and sustainable development are complex issues dependent on local and time related characteristics and conditions, non-formal education and to some extent informal education, could provide opportunities and resources to help people retain and adapt their knowledge, skills and lifestyles.

Nevertheless, the goal of non-formal and informal education is not just the diffusion of information and knowledge. Enhanced awareness, expression of interest and behavioural changes are the initial signs of a successful process. It is when positive attitudinal changes occur that one of the most important objectives of education has been achieved. Eventually, when attitudes based on principles and moral dimensions are formed, then education has achieved its ultimate goal.
The contemporary problems related to natural resources management, particularly in the Mediterranean region call for the meaningful participation of the public and all concerned stakeholders. Education and public awareness are recognised as powerful management tools. In order to achieve an effective public engagement and involvement, participatory institutions should be established and/or strengthened and the public should be educated and develop the appropriate skills. Recent experience has shown that although formal education systems address these problems through traditional disciplines such as science (e.g. by including in the curricula issues related to water resources, waste, etc.), inadequate education has been provided to those who had the misfortune to not go to school or drop out. The latter is mainly a phenomenon of the rural and poorer parts of the Mediterranean region. To this end, non-formal education programmes have been developed and implemented aiming to, inter alia, develop the appropriate knowledge and skills and empower the young people. In brief, non-formal education could contribute to enhancing people's skills and willingness to behave and act more wisely, for themselves and the society, in the short and long-term, within the framework of sustainable development.

[4] UN Resolution 57/254, UN General Assembly, 57th Session, 2002.

** Environmental literacy is an individual's knowledge about and attitudes towards the environment and environmental issues, skills and motivation to work towards the environmental problems and active involvement in working toward the maintenance of a dynamic equilibrium between the quality of life and quality of the environment (Disinger & Roth, 1992).

INTRODUCTION

The purpose & structure of the present handbook

The present publication has been prepared within the MEdIES *(Mediterranean Initiative for Environment and Sustainability)* Programme* and it aims to provide an ensemble of elements, both theoretical and practical, for the implementation of educational materials for Education for Environment and Sustainability (EfES) and Education for Sustainable Development (ESD). This handbook is not exhaustive of all the educational methods and possible ways of their implementation, but it rather aims to introduce educators to the basic ideas relevant to the EE/EfES/ESD teaching methods, while trying to highlight some noteworthy or *"tricky"* points concerning their application and outcomes. Furthermore, the handbook does not intend to provide "pre-packaged recipes", but is designed to facilitate educators to plan, in cooperation with their students, their own working methods in the framework of EE/EfES/ESD programmes.

The handbook provides the necessary theoretical educational framework as well as the educational methodologies and methods, based on specific activities for students. The examples of activities derive almost entirely from the MEdIES educational material "Water in the Mediterranean"**. However, because of its structure, the present handbook could be used as a reference guide when implementing any other educational material relevant to EE, EfES and ESD.

More specifically, the handbook includes the following chapters:
Chapter A: In this chapter the necessary general theoretical framework is presented. It starts with an overview of the **evolution of environmental education towards education for sustainable development**, including its components and perspectives for the 21st century, as they emerge from the different, but closely related movements and initiatives. In addition, theoretical and research issues regarding the **responsible environmental behaviour** are presented. The **constructivism theory** is analysed as the contemporary context for the better interpretation of the learning processes, its links with EE and ESD, as well as the educator's role in students' learning within the above contexts (constructivist and ESD learning approaches). The chapter closes with a brief presentation of the **general teaching model,** which is compatible to all educational levels.

* MEdIES is a Type II initiative on Education for Environment and Sustainability (EfES), aiming at the facilitation of the educational community and students to contribute in a systematic and concrete way to the implementation of Agenda 21 and the Millennium Development Goals, through the successful application of innovative Educational Programmes in countries around the Mediterranean basin. The core of the initiative is a Network of Educators implementing the integrated educational programmes on water, waste, etc. as vehicles to sustainable development. The exchange of experiences and "know how" in educational matters of all partners involved - Ministries, IGOs, NGOs, educators, students- is one of MEdIES main activities (for more information visit the webpage: www.medies.net).

** Scoullos M., Alampei A., Boulouxi A., Malotidi V., Vazaiou S. "Water in the Mediterranean" Educational Package, MIO-ECSDE & GWP-Med, Athens, 2001.

Chapter B: It provides the necessary theoretical framework on the methods used in EE, EfES and ESD. Thus, the chapter presents various studies exploring: **which methods** teachers use and why; the **factors** that influence the choice of a method, with an emphasis on the **learning objectives.** The current **trends and characteristics** of the ESD methodological approaches are also presented. Reference is also made to cooperative learning and group work, since they are strongly recommended and commonly used within the implementation of EE, EfES and ESD programmes and activities.

Chapter C: It explores how the various teaching methods could be implemented, trying to highlight some "risky" points in each one rather than addressing all the possible ways for their implementation. The basic **theoretical** and **practical** characteristics of methods, as well as indicative ways of their implementation are elaborated, using as examples activities from the educational package "Water in the Mediterranean". The methods that are presented are, namely: various techniques of discussions, concept mapping, bibliographic research, experiments, analogies and models, simulation methods including case studies, role-playing games, computer simulation and other games; surveys, field teaching and field research. The last subchapter addresses the use of educational kits as important teaching and learning tools within ESD Programmes.

The last chapter, **Chapter D**, addresses the two widely used methodologies of EE, EfES and ESD: "problem-solving" and "projects", also known as "umbrella methods". These methodologies offer important frameworks that can include and integrate the various methods analysed in Part C. The chapter closes by presenting the ways by which a particular topic, the one of the "water cycle", could be implemented using the different methods elaborated in the previous paragraphs.

CHAPTER A

This chapter attempts to familiarise educators and people interested in Education for Environment and Sustainable Development with the evolution of the related concepts and the variations in terminologies and philosophical approaches. It also looks into the contribution of Environmental Education in the development of a "responsible environmental behaviour". The theory of constructivism and the general teaching model are presented as basic background information for those who are engaged in educational practice.

A.1.a Environmental Education and Sustainable Development: Common origins, parallel paths, meeting points - What is the way forward?

In the early 1970s, the emerging environmental education movement was given a powerful boost by the United Nations Conference on the Human Environment held in Stockholm in 1972 which focused the attention on environmental concerns. It is considered as a milestone, as it led to the creation and promotion of many NGOs working to conserve the environment. It recommended that environmental education (EE) should be recognised and promoted in all countries. Three years later, the International Workshop of Experts on EE, organised by UNESCO in Belgrade (1975), formulated the concepts and visions, which were adopted by governments in Tbilisi, at the Intergovernmental Conference on EE, in 1977.

From the early '70s, the basic inter-related components of environmental education had been formulated, creating the well-known motto:
"*education **about** the environment, education **in** the environment, and, education **for** the environment*".

- *Education about the environment:* Education about the environment focuses mainly on cognitive aspects. It is concerned with the acquisition of skills, knowledge and understanding of the environment and the related issues. It is crucial to perception and judgment and is a necessary facet of environmental education.

- *Education in the environment:* Education in the environment refers to the processes of education conducted outside the classroom. It provides direct contact with the environment, gaining experiences, stimulating interest, as well as the relevant context for acquiring knowledge and developing skills.

- *Education for the environment:* Education for the environment aims at the development of an informed attitude and behaviour towards the environment. It goes beyond the acquisition of skills and knowledge, and involves values and attitudes that affect behaviour. It is concerned with the formation of attitudes that lead to a personal environmental ethic, in order for people to involve responsibly in actions for the sound management of the environment and the protection of natural resources.

Environmental education has a philosophical base of holism, sustainability, enhancement and stewardship. It is, by nature, committed and action-oriented, promoting its objectives and principles, not by imposing them, but conveying and indicating them, as it develops critical thinking and decision-making skills to individuals, in order to adopt conscientiously responsible attitudes and behaviour. As it was clearly defined in Tbilisi: "*The **goal** of Environmental Education is to aid citizens in becoming environmentally knowledgeable and above all, skilled and dedicated human beings, willing to work individually and collectively, towards achieving and maintaining a dynamic equilibrium between quality of life and quality of the environment*".

The Declaration and the Recommendations of the Tbilisi Conference made it possible to define the nature, objectives and guiding principles of EE programmes, establishing broad guidelines for implementation and action in the field at national and international level. The recommendations state clearly that: "*Special attention should be paid to understanding the complex relations between socio-economic development and the improvement of the environment*".[1] Since Tbilisi, environment is seen in a more holistic way, comprising natural aspects and those that result from human activity. EE was considered to be an integral part of the entire education process, towards the solution of practical environmental problems through an interdisciplinary approach and with the active participation of individuals and the community. The vision and objectives in the Tbilisi Declaration integrated a broad spectrum of environmental, social, ethical, economic and cultural outcomes of education, all of which are central to the subsequent notion of "*Education for Sustainable Development*" (ESD). Its basic principles were translated into educational policies around the world, and with greater difficulty, into classroom practices in many countries.[2]

However, ten years after Tbilisi, the increasing awareness of environmental problems and the efforts made by many countries did not achieve the reduction in the deterioration of the quality of the environment. Pollution problems at global and local level increased; environmental risks multiplied; the problem of poverty and the gap between developed and developing countries increasingly expanded. The new challenges were put forward in the "Moscow Congress on Environmental Education and Training" (1987), where the objectives and principles of EE as in Tbilisi, were adopted and reconfirmed, while a new problematic was shaped about "*a new kind of development*", "*new objectives for development*" or "*redefining the notion of development*".[3] Already from the mid '80s the term "sustainable development" had emerged and in the milestone report "Our Common Future" of the World Commission on Environment and Development it was defined as: "*Development that meets the needs of the present without compromising the ability of the future generations to meet their own needs*".

So, the roots of ESD were firmly planted in the EE efforts of various groups, from individual ministries to intergovernmental and non-governmental organizations. In the meantime, development education, peace & human rights education, citizenship education and cultural education emerged and developed, but environmental education has been particularly significant. In its brief thirty-year history, EE has steadily striven towards goals and outcomes similar and comparable to those inherent and compatible to the concept of sustainable development [2] (see also Thessaloniki Declaration: *"Environmental education as developed within the framework of the Tbilisi Recommendations and as it has*

[1] UNESCO (1980) "Environmental Education in the light of the Tbilisi Conference", Paris.
[2] UNESCO (2002) "Education for Sustainability, From Rio to Johannesburg: Lessons learnt from a decade of commitment", Paris.
[3] UNESCO-UNEP Congress (1987) "Environmental Education & Training", Moscow.

evolved since then, addressing the entire range of global issues included in Agenda 21 and the major UN Conferences, has also dealt with education for sustainability"). The basic objectives of EE with the new orientation of sustainable development are, more or less, still the same with the ones identified in Belgrade, Tbilisi, Moscow, Rio and Thessaloniki.[4]

In fact, in the UN Conference on Environment and Development (Rio, 1992) the main focus regarding education was the formulation and development of the vision and framework for the reorientation of education towards the challenges and demands of sustainable development. Chapter 36 of Agenda 21 clearly stressed the need for a new vision for education in order to be reoriented towards sustainable development: *"Education, including formal education, public awareness and training should be recognised as a process in which human beings and societies can reach their fullest potential. Education is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision making. Both formal and non-formal education are indispensable to changing people's attitudes, so that they have capacity to assess and address their sustainable development concerns".*[5]

To this end, the International Conference on "Environment and Society: Education and Public Awareness for Sustainability" was held in Thessaloniki (1997) aiming at highlighting the critical role of education in achieving sustainability and considering the important contribution of EE in order to provide elements for further development of the work programme of the Commission of Sustainable Development (CSD). The Conference brought education and public awareness to the centre of the interest of the international community on the eve of the third millennium.

It set the foundations for the context of Education for Environment and Sustainability (EfES) which was seen as an indispensable instrument for achieving a sustainable future, and not as an end itself, touching on and integrating the notions of population, poverty, environmental degradation, democracy, human rights and peace, development and interdependence. It was widely agreed that many lessons could be used from the experience of EE in developing the broader notion of EfES. Furthermore, it was made clear that sustainability requires more than harmonisation and balance among social, ecological and cultural factors as they exist today, dominated by global market economic regularity. It involves the construction of a new rationality where these processes stop being opposites, giving rise to a false dilemma between environmental requirements and development needs, but rather integrate as synergetic forces. To this end, education could serve as a bridge between economic and human development,

[4] "Environment and Society: Education and Public Awareness for Sustainability" Proceedings of the Thessaloniki International Conference, UNESCO & Government of Greece, (ed. M Scoullos), Athens, 1998.
[5] UNCSD, 1992 "Promoting Education, Public Awareness and Training", Chapter 36, Agenda 21, UN Conference on Environment and Development Rio de Janeiro.

establishing new links between educational and developmental policies, with a view to strengthening the bases of knowledge and skills, such as encouragement of team work, synergies with local resources, etc. Thus, strategies for promoting EfES must not relegate environmental concerns to one sphere and put development concerns in another; nor must they see decisions concerning economics or environment as being exclusively science-based and value-free. In essence EfES should put the pieces of life back together again, so that people may see development not as an economic puzzle or environmental danger but as a set of rational and moral choices guided by the vision of a sustainable future.[4]

In addition, crucial theoretical and research issues - not yet fully explored - relevant to the strategies for promotion of education for sustainability and its methodology were expressed, such as:

- *"What is the most appropriate time for launching the process of EfES during the pre-school years, in the sense of how soon should we intervene and in what way?"*

- *"The investigation of alternative curricula structures based on transdisciplinary approaches, using thematic modules instead of isolated disciplines" and,*

- *"The comprehension of the impact of particular environmental parameters and the ability of the human mind to confront the broader dimensions of the environment and universe (Scoullos & Psalidas, 1998)".*

UNESCO prepared the Report: "Education for Sustainability, From Rio to Johannesburg: Lessons learnt from a decade of commitment" (2002)[2] which explored the key lessons learned over the period between the two World Summits (Rio, 1992 and Johannesburg, 2002), and underlined the contribution of EE to the shifting of education towards sustainability. It came up with the following four "key-lessons" from the International experience:

*"**Sustainable development** is perhaps a **moral** concept rather than a scientific one, linked as much with notions of peace, human rights, and fairness as with ecology theories or global warning. While it involves natural sciences, economics and policies it is primarily a matter of **culture:** it is concerned with the values people cherish and with the ways in which people perceive their relationship with others and with the natural world. Furthermore, it requires the acknowledgement of the interdependent relationship between people and the natural environment, meaning that no single social or environmental objective be pursued to the detriment of others. For instance, the environment cannot be protected in a way that leaves half of humanity in poverty, and likewise, there cannot be any long-term development on depleted planet".[2]*

An education based on the aforementioned is frequently referred to as Education for Sustainable Development (ESD) and sometimes takes a "strategic" distance from Environmental Education (EE).

(a) Education for sustainable development (ESD) is still an emerging but dynamic concept that encompasses a new vision for education, seeking to empower people of all ages to assume responsibility for creating a sustainable future;

(b) There is a worldwide need to refocus many existing education policies, programmes and practices so that they build the concepts, skills, motivation and commitment needed for sustainability;

(c) Education is the key to rural transformation and is essential to ensuring the economic, cultural and environmental vitality of rural areas and communities;

(d) Lifelong learning, including adult and community education, technical and vocational education, higher education and teacher education are all vital ingredients of capacity building contributing to the reorientation of education towards sustainability. In essence, this last point was already raised in Thessaloniki, where it was made clear that *"Only an appropriate, life-long education can teach respect for the environment and at the same time guide people in how to survive and develop without jeopardising the future of their own children" (Scoullos M., 1998)*[‡].

The outcomes of the "World Summit on Sustainable Development" (Johannesburg, 2002) underpin the need to integrate sustainable development into education systems at all levels of education, in order to promote education as a key agent for change.[6] The need to develop, implement, monitor and review action plans at local, sub-national and national level was stressed, as appropriate to achieve the objectives of the Dakar Framework for Action[†]. The Summit also recommended the adoption of the Decade on Education for Sustainable Development by the UN General Assembly, starting by 2005.

The "First World Congress on Environmental Education" (Espinho, 2003) explored the links between EE and ESD, referring to sustainable development as one of the key concepts central to EE and as a driving force of contemporary environmental action. However, the congress stressed the need of further discussion, clarification and creation of a common base of work around the concept of sustainability, as many times this "magic label" is being misused, since the relevant concepts and practices are still in construction, locally dependent, not universally understood nor applied. At this point, it is worth mentioning that given the various discrepancies for setting the framework of the contemporary dimension of EE and the reorientation of education, in general, towards sustainability, the active participation of all concerned stakeholders is a prerequisite. Nevertheless, the definitions regarding the educational systems or movements is a controversial issue, since definitions usually

[6] "Plan of Implementation" World Summit on Sustainable Development, Johannesburg, 2002, 26/8-4/9.

[†] *The World Education Forum in Dakar (2000) confirmed the World Declaration on Education for All (EfA), and agreed to six new goals, which were included in the Dakar Framework for Action. These goals made the links between basic education and sustainable development very clear. Indeed, the Dakar Framework for Action states, inter alia: "Education is a fundamental right. It is the key to sustainable development, peace and stability with and among countries, and thus, an indispensable means for effective participation in the societies and economies of the 21st century".*

tend to impose limitations rather than facilitate and expand the framework in which they are used. The dimension of sustainability in the education systems should be an open ground for systemic and concrete investigation with critical thinking and with perspectives for changes in the structures of society, especially of the value-systems which created the need for sustainable development, and with simultaneous changes in education itself, since, *"the problems in education cannot be solved with the same education that created them"*.[7]

Moving towards ESD, as the global developments demand and the relevant meetings indicate, many theorists focus the attention on the fact that ESD is not so much education about sustainable development but education **for** sustainable development, aiming not only at the understanding of the related issues by the teachers and learners, but also, focusing on how to cope with and act upon the interdisciplinarity of the issue. One of the trends that emerged, as concerns the approaches of ESD, is that its goals, processes and points of emphasis must be **locally defined,** meeting the particular environment, social and economic conditions in culturally appropriate ways.[4, 8, 9] Besides, the richness in diversity in all sectors of the natural, cultural and social environment is a basic component for a stable ecosystem and for safety and resilience of every community[10].

Seeing the Tbilisi objectives of EE through the view of reorienting education towards sustainability and considering the recommendations of the Thessaloniki International Conference (1997), the International Commission's work on Education for the 21st century (Delors Report)[11] and the Draft Framework for an "International Implementation Scheme for the Decade of Education for Sustainable Development"[8] we come up with the following content and characteristics of the domains of objectives for a reoriented EE:

Awareness: to help social groups and individuals to acquire awareness of the entirety of environmental and allied socio-economic issues, understanding the complexity and interconnectedness of problems such as environmental degradation, wasteful consumption, poverty, gender inequality, violation of human rights, etc. Furthermore, education should develop, in the long term, learners' cognitive skills of "*learning to know*" in order to recognise the challenges of the modern world in the environmental, social and economic sectors. Such an educational framework should "open" the pathway for life-long learning and adaptation to new knowledge related to the results of science and the applications of technology.

[7] Papadimitriou V. (1999) "Seeking the Identity and Perspectives of EE in the 21st century", Proceedings of 1st Pan-Hellenic Conference for Environmental Education, (ed. by Calaitzidis D.), Athens, pp. 97-100.
[8] UNESCO (2003) "Framework for a Draft International Implementation Scheme for the UN Decade of Education for Sustainable Development" (January 2005-December 2015), Draft.
[9] Basic Elements for the "UNECE Strategy for Education for Sustainable Development", (draft) Kiev, 2003.
[10] Scoullos M. in the 5th Ministerial Conference on Environment for Europe, NGO Session: "Education for Sustainable Development", Kiev, 21-23 May 2003.
[11] International Commission on Education for the 21st Century (1996) "Learning: The Treasure Within", Report to UNESCO

Behaviour, Attitudes & Values: to help social groups and individuals gain a variety of experiences, acquire and strengthen values and feelings of concern for the environment, society and the interdependent relationship between them, and achieve the necessary motivation to be actively involved in the protection and improvement of the quality of the environment and of the life of unprivileged people such as: the poor, women, victims of racism, cultural and ethnic minorities, etc. The latter was expressed in the Delors Report as *"learning to live together"*, a concept which reflects the development of understanding of other people and the appreciation of interdependence. The new vision for ESD cannot be concerned only with disciplines improving the understanding of nature –despite their undoubted values. It requires approaches that promote understanding and appreciating cultures and cultural diversity, and that strengthen moral values and sensitivities thus developing the corresponding attitudes and behaviours.

Skills: to help social groups and individuals acquire skills for identifying and addressing environmental and socio-economic problems through appropriate decision-making and action. Such skills include: critical thinking, reflection, communication skills, conflict management, etc. ESD has come to be seen as a process of learning how to take decisions and acting upon them, considering the long-term future of environment and society.

Participation: to provide social groups and individuals with the opportunity to be actively involved at all levels and encourage them in working collectively and efficiently towards addressing problems and issues of their community. In other words, encourage the process of *"learning to do"* by developing the competencies that enable people to deal with a variety of issues affecting their lives, working at personal and group level, as well as acting locally while thinking globally.

All the aforementioned could be integrated under the umbrella *"learning to be"*, which expresses the ultimate goal of education in general: to develop the appropriate skills for the empowerment and "protection" of the integrity of human beings. The above objectives cannot be met if education does not aim at the development of personalities able to act autonomously, but also collectively, with critical spirit and responsibility, towards the well-being of society within a healthy environment, both in the present and future timeframe.

A.1.b A Graphic Representation of the Evolution from Environmental Education to Education for Sustainable Development

The development of the present graphical representation intends to facilitate understanding of the scope of Education for Sustainable Development (ESD) not as an entirely new concept but as a result of the dialectic evolution of both the Environmental Education (EE) and the Education for All. To this end, in this subchapter an attempt is made to represent in a concise visual way the evolution of EE towards ESD and connect it with many of the relevant topics that are elaborated in other parts of the handbook.[1]

Starting from the Stockholm UN Conference on the Human Environment (1972) and continuing with its follow up for EE in Belgrade (1975) and Tbilisi (1977), throughout the process of setting the foundations of EE most of the critical issues of today were already recognised as "route causes" of the environmental problems necessary to be addressed. However, the political context was different then than today. Similarly our knowledge and understanding of the environmental issues and their interconnections with social, cultural, ethical and economic issues were considerably less developed than now.

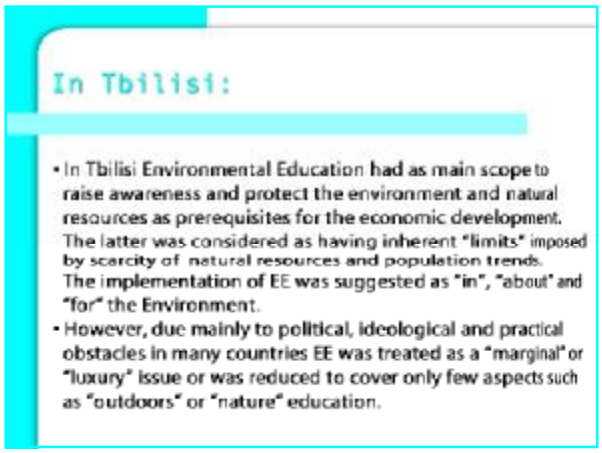


Fig. 1

Developing the concept of Sustainable Development (SD) (see the Brutland report "Our Common Future" -1987) and moving to the Rio UN Conference on Environment and Development (1992) and the adoption of Agenda 21 and Chapter 36 an appropriate kind of Education is needed which will be able to contribute substantially to sustainable development. The "famous" module of SD is based on three pillars: Environment - Ecology, Economy and Society (Fig.2).

[1] Based on a series of papers of Prof. M.Scoullos: University of Athens, 25-26 October 2003; University of Indiana USA, 30 November 2003; 12th Session of CSD, New York, 28 April 2004; Drafts submitted to UNESCO for the UN DESD (Scoullos correspondence, 2004).

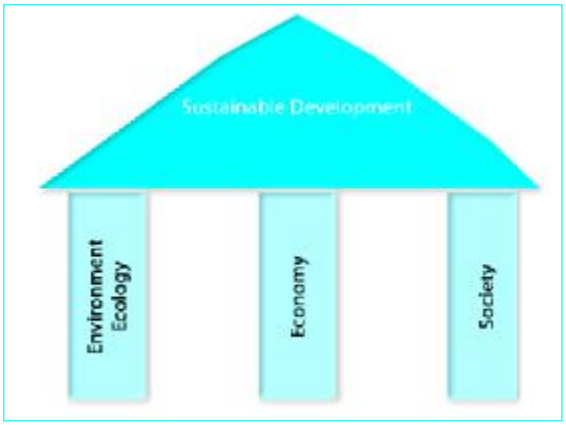


Fig. 2

…Which is the role and place of education in the above figure?
Is EE the kind of Education which could satisfy our new needs and contribute to the achievement of SD?

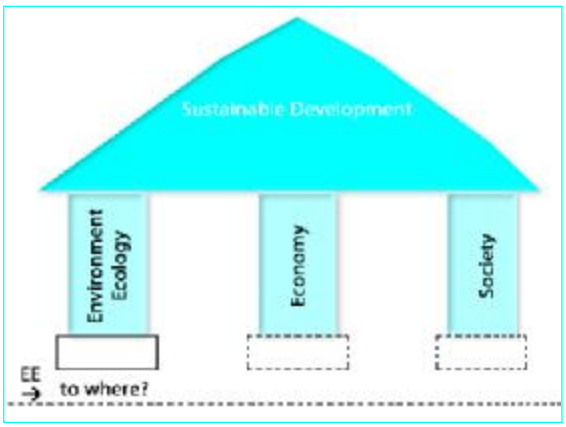


Fig. 3

Here we have two opposite views in the extremes and a wide spectrum in between: The one extreme suggests that EE serves only the one pillar (Environment) and therefore we need similar "balancing" educational components for Economy and Society. The other extreme claims that EE already from the beginning covered fully the economic and social concerns through the recognition of the complex relations between "socioeconomic development and the improvement of the environment" and the analysis of the route causes of global problems and their interdependence in which decisions and actions can have international repercussions.
Moving to the Thessaloniki Conference approach (1997) where the three pillars of SD remained independent and separate the EE was acknowledged as including in many cases many more elements of socioeconomic character and it was accepted as the extended basis of SD, expressed as "Education for Environment and Sustainability" (EfES).

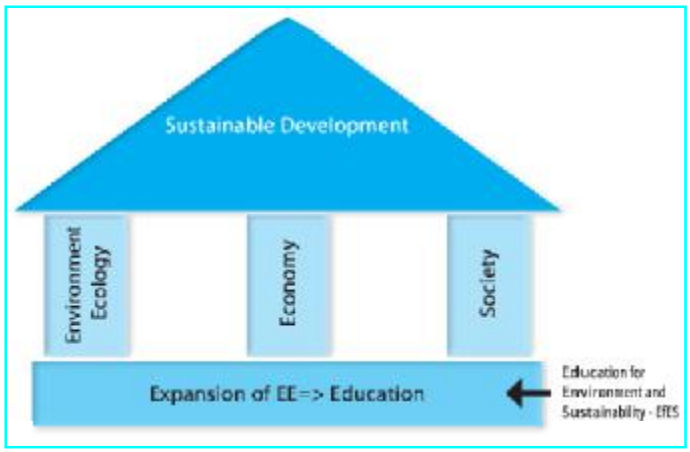


Fig. 4

The above scheme (Fig.4) still does not present the interdependence and interrelationships between the three pillars of SD while it recognises appropriate Education as the cross-cutting basis of it.

To this end the following representation for sustainable development is proposed (Fig.5) in which the SD module takes the three-dimensional shape of a pyramid as much closer to the reality. This pyramid has as facets Environment, Society and Economy and is based on Education that is the Education for Sustainable Development (ESD), an education which should combine specific components to enhance the learning about Environment, Society and Economy while it will permeate and change the entire Education for All towards sustainability.

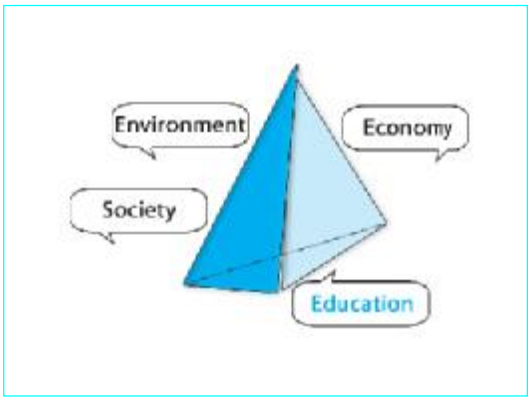


Fig. 5

Though for simplicity reasons the above representation could be sufficient for most educators, a further elaboration is needed in order to attribute to Education its true dimensions and responsibilities in approaching SD. This is necessary because, unfortunately, it is obvious that with Education alone it is impossible to transform the

current development patterns into sustainable development. In fact in Thessaloniki (1997) an attempt was made in order to address this problem by proposing other three components together with Education, namely Legislation, Economy and Technology. In other words Education is one of the components of the overall "Governance" needed. To this end, the basis of the SD pyramid has become now Governance instead of Education (Fig.6).

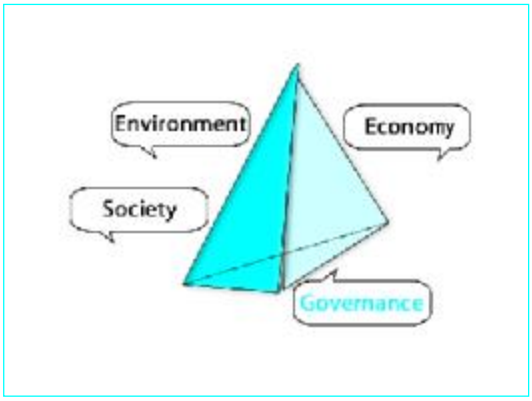


Fig. 6

If we simply "turn" the above pyramid we produce the scheme below (fig.7) where environment is the "natural basis" while all other three facets are "human over-structures". In this respect this scheme is very close to the original starting point of EE, though it is still different indicating both the proximity and the natural evolution of the relevant concepts and ideas.

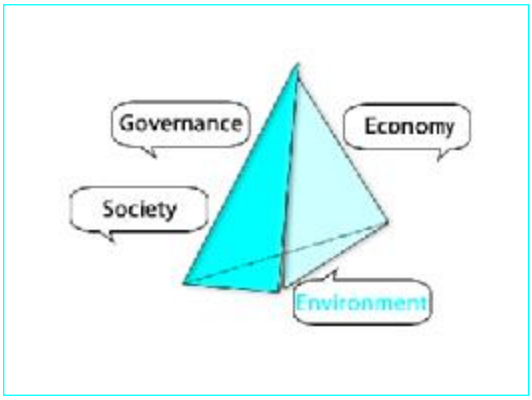


Fig. 7

Keeping in mind the results of Thessaloniki and in order to clearly indicate the place of Education in the system it is necessary to take a closer look into the analysis of the Governance concept.
Analysing the main components of Governance in the implementation of SD we need to use appropriate Institutions, Technology and Education (Fig.8).

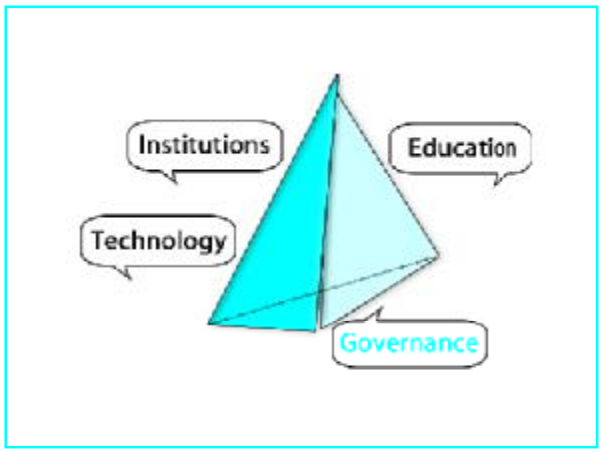


Fig. 8

If we now combine figures 6 and 8 we come up with the following scheme (Fig.9)…
… a model of SD as a double pyramid.

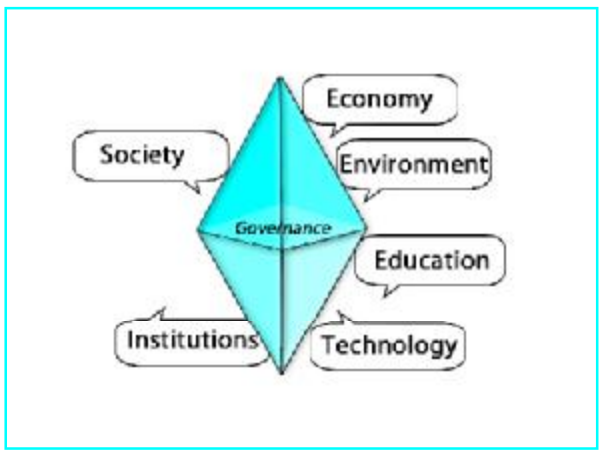


Fig. 9

The upper part of the double pyramid represents the three interlinked components of sustainable development (Economy, Environment, Society) while the lower part represents the prerequisites and tools for its implementation (Institutions, Education, Technology).

If we wish to explore a little bit more the facets of the double pyramid one could say that in order to obtain SD we need:

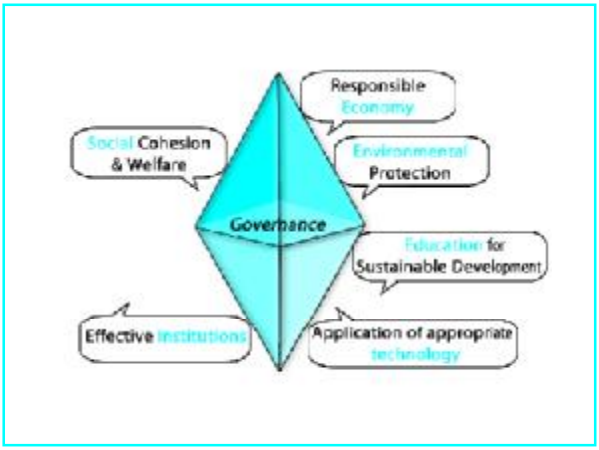


Fig. 10

social cohesion and welfare, responsible economy, environmental protection, effective institutions, application of innovative and appropriate technology, and Education for Sustainable Development.

On the other hand, the Delors Report (1996) and the Framework for a Draft International Implementation Scheme of the UN Decade on Education for Sustainable Development (DESD) (2003) rightly emphasise the importance of culture as a "fourth" pillar of sustainable development.
If we wish to best combine all the aforementioned elements to a concise whole we may propose that the components of Education for Sustainable Development (ESD) could be represented with the double pyramid of the following scheme (Fig.11) where the naming (position) of its facets is random and therefore all interlinkages are possible, real and important. The Education for Sustainable Development should enhance our knowledge and our ability and skills to understand them and act accordingly for the benefit not only of our generation but also for the unborn ones.

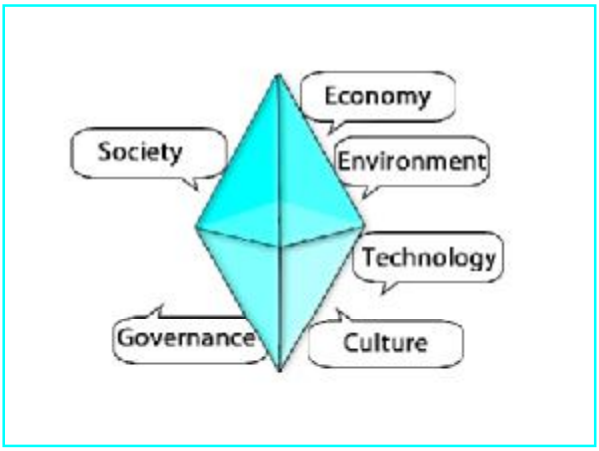


Fig. 11

A.2. Responsible Environmental Behaviour

A key function of EE in the attainment of sustainability is to develop responsible citizens who have appropriate knowledge and skills. To this end, the challenge for educators is to translate such EE objectives into instructional reality. It is obvious that the objectives focus on *environmental behaviour*. Most environmental psychologists and educators (Borden, 1984-85; Bowers, 1993; Cortese, 1992; Cowan & Stapp, 1982; Gigliotti, 1990; Gray, 1985; Milbrath, 1989; Olson, Lodwick & Dunlap, 1992; Smith, 1992) have identified in their studies that EE is closely linked to environmental behaviour.[1]

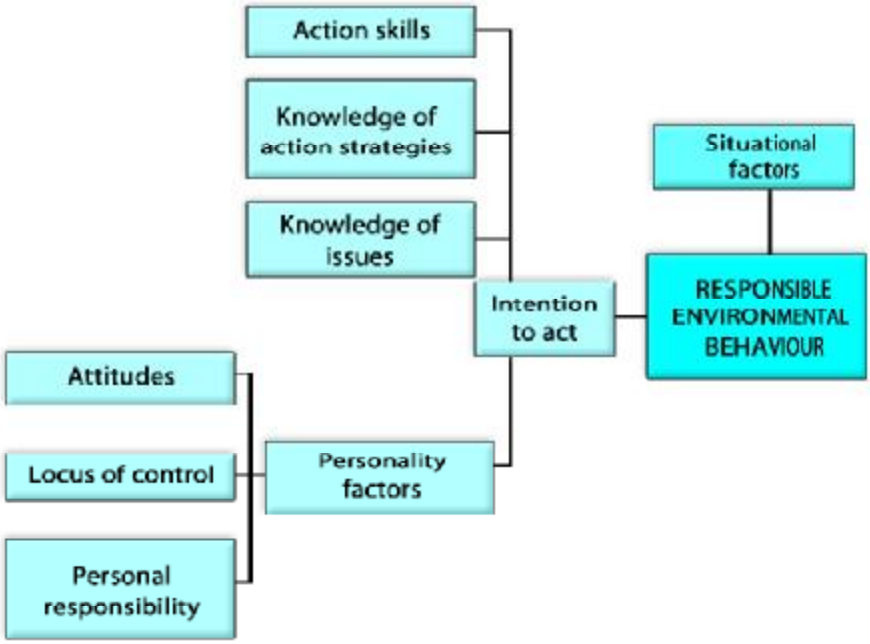
Traditional thought among educators and EE theorists illustrated a linear model for the relationship between environmental knowledge, attitudes and behaviour. In other words, it was widely acknowledged that a positive attitude towards the environment and the associated behaviour could be the result of increased environmental knowledge.

However, research in environmental behaviour during the last two decades has provided evidence of a more complex relationship between behaviour and numerous variables. In 1986-87, Hines, Hungerford and Tomera published an important meta-analysis of existing research literature on environmental behaviour and from this scientific analysis emerged the so-called: "*model of responsible environmental behaviour*".[2] In this model, not only in-depth knowledge about issues but knowledge and skills relating to the intention to act and the locus of control[3] were also identified as important parameters of environmental behaviour.

The "heart" of the model – as displayed in the following figure - is that responsible environmental behaviour is correlated with "*situational factors*" and with the individual's "*intention to act*". The situational factors include variables such as: economic constrains, social pressures and opportunities to choose different actions that seem to have influence on the behaviour a person will perform. On the other hand, the "intention to act" includes personality factors, such as one's attitude towards the environment and environmental issues, locus of control and personal responsibility, as well as factors such as knowledge of issues and appropriate ways of action and, of course, action skills.

[1] Zelensky L. (1999) "Educational Interventions that improve environmental behaviours: A meta-analysis", The Journal of Environmental Education, 1999, 31, 1, pp. 5-14.
[2] Franson N., Garling T., (1999) «Environmental Concern: Conceptual definitions, measurements methods and research findings», Journal of Environmental Psychology, 1999, 19, 369-382.
[3] Locus of control refers to an individual's belief in being reinforced for certain behaviour. In simple words, an individual who believes that he/she has good skills for dealing with a particular issue is more likely to express a relevant behaviour, because there is an expectation of success or reinforcement for such a behaviour (Franson & Garling, 1999; Anastasi & Urbina, 1997).

The Model of Responsible Environmental Behaviour



However, the relationships between these variables and environmental behaviour are complex and not completely understood. Considerable uncertainty still exists in the prediction of environmental behaviour because of the complexity of the process which is based on many factors. Therefore, further research in responsible environmental behaviour and its instructional and curricular implications and effectiveness is needed.

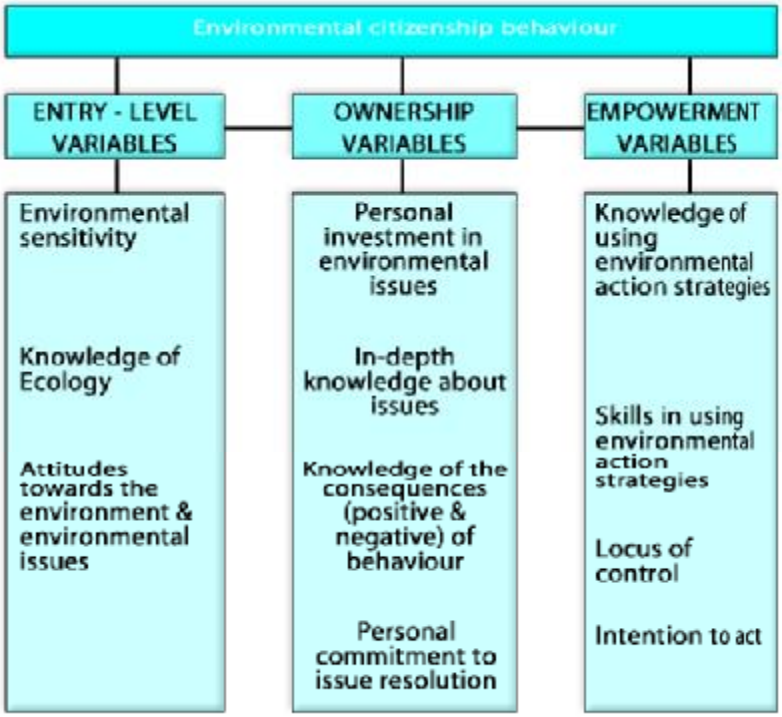
As it becomes obvious from the behavioural model, in order for EE programmes to contribute to a responsible environmental behaviour they should be planned in such a way so that on the one hand they change -when necessary, develop and empower the student's personality factors and, on the other, they strengthen their intention to act by developing the relevant factors.

A modified model for the prediction of responsible environmental behaviour was proposed by Hungerford and Volk in 1990 and it uses seven variables as key indicators.[4] These variables fall into three categories all of which contribute to shaping the individual's responsible environmental behaviour. "*Entry-level*" variables act as prerequisites for responsible environmental behaviour by **providing the foundation** for such an attitude. "*Ownership*" variables **personalise** environmental issues through expanded understanding and investment. "Empowerment" variables represent environmental **problem-solving skills.**

[4] Knapp D., Volk T. & Hungerford H. (1997) "The identification of empirically derived goals for programme development in environmental interpretation", The Journal of Environmental Education, 1997, 28, 3, 24-34.

According to the model, an individual who exhibits development of many of these variables is more likely to behave responsibly towards the environment. Therefore, an EE program that promotes such characteristics is expected to contribute to fostering environmentally responsible behaviour.

The Evolution of the Behavioural Model



All of the abovementioned indicate clearly that awareness and knowledge - from basic knowledge of ecology to knowledge of action strategies are key factors closely related to environmental behaviour. To this end, it is noteworthy to explore in the following subchapter, the *constructivism theory*, as a very important theoretical scheme of learning, its teaching implications, as well as its relation to EE.

A.3. Constructivism & Environmental Education

Dewey (1916) argued that education needs to emphasize knowledge worth understanding[1]. In other words, young learners should learn in depth and exercise learning skills related to inquiry, decision making and problem solving. The learning process must provide them with experiences that are real and meaningful to them. So, when planning learning experiences for students a core issue is "what kind of knowledge is taught" and "what kind of knowledge is expected to transfer from specific content to other meaningful situations".[1] By this it is assumed that our knowledge is a construction of many facets.

Understanding the learning process is a component that should not only affect teaching methodologies but should also be included in their content scheme. The learning process shapes the understandings held by students. Thus, without understanding how knowledge is generated and developed by learners, educators cannot adequately deliberate with them complex issues, such as the socio-cultural and economic dimensions of environmental issues. The explanation of a problem by the educator does not lead automatically to its comprehension by the learner, unless the learner's *concepts "already in his/her mind"* are compatible with the concepts that the educator refers to.

Furthermore, cognitive psychologists point out that "lasting" knowledge is not gained by simply reading phrases in a text or listening to words in a lecture. Instead, lasting knowledge occurs when the learner attempts to make sense of the new information by applying it to his/her already perceived notions about the topic. Once the new information is assimilated in the learner's established knowledge and "conceptual structure", comprehension takes place (Lord, 1999)[2] . During the assimilation process "perturbations" develop in the mind of the learner, as he/she tries to create the appropriate links between the new information and his/her conceptual structure. After this cognitive procedure the new information has been transformed into a new concept and has been "put" in the conceptual "building" (structure) of the individual. It is evident that during the learning process mental processes take place on both the part of the deliverer and the receiver. These processes constitute the framework of the constructivistic theory of learning (constructivism) that has as its main principles the building of knowledge by the learners and thus, their active involvement in the teaching and learning process.[3]

It is important to clarify that constructivism is not a teaching methodology but a framework for the interpretation of the learning process. Various learning and teaching methodological approaches have been based on this theoretical framework. In simple words, constructivism is a theory that interprets learning processes that are based on the "construction of knowledge" by the learners themselves.

[1] Basile C. (2000) "Environmental Education as a Catalyst for Transfer of Learning in young children" The Journal of Environmental Education, 2000, 32, 1, pp. 21-27.
[2] Lord T. (1999) "A comparison between traditional and constructivistic teaching in environmental science", The Journal of Environmental Education, 1999, 30, 3, pp. 22-28.
[3] "Tsaparlis G. (2000) "An introduction to the constructivism", in "Teaching Science & Chemistry" (ed) Tsaparlis G., ΔιΧηΝΕΤ, Ioannina, pp. 19-36.

It has been suggested that in a traditional, teacher-centred class the cognitive energy expended by the learner enabling him/her to resurrect new knowledge rarely exceeds 10-12 minutes, while in a student-directed teaching approach this process lasts a long time.[4] Research has revealed that students following an environmental course/programme based on the principles of constructivism had a better understanding of the concepts covered by the topics of the course/programme than did students in the "traditional", "teacher-centred" group. Furthermore, the majority of them ("constructivistic" group) stated that they found the course/programme interesting and enjoyable. They also claimed that the procedure helped them master the material given better and provided them with deeper insights into the topic than traditional instruction would have done.[2]

Klein and Marritt (1994) compared the goals of EE with the principles of constructivism. As already mentioned, constructivism comprises two basic ideas: *the learner actively constructs knowledge and does not passively receive information; and learning is an adaptive process that organises one's experiences of the world and does not involve discovering an independent pre-existing world outside the mind of the learner.* An educational methodology based on the principles of constructivism could involve:

a) introduction of a real-life problem by the students or educator for the students to resolve,

b) student-centred instruction facilitated by the educator,

c) productive group interaction during the learning process,

d) authentic assessment, in which educators determine whether students can use concepts and skills by requiring them to perform a task or create a "product"; and demonstration of student progress.

The compatibility between the main general elements of the constructivism approach and the ones of EE are obvious. Nevertheless, student involvement in their own cognitive procedure ("metacognition") and critical thinking are crucial elements for both EE and constructivism. Meaningful EE is envisioned as a teaching and learning approach with interdisciplinary, critical thinking, problem-solving and decision-making orientations, leading to the capacity of transfer beyond the specificity of each and every subject or discipline.[5] What is needed is not "programmed" students but students with the skill of autonomous thinking, as education should teach people to think for themselves, in the long term.

[4] Klein E.S. & Merritt E. (1994) "Environmental education as a model for constructivist teaching", The Journal of Environmental Education, 1994, 25, 3, pp. 14-21.
[5] Zoller U. (1999) "Interdisciplinary systemic HOCS development –the key for meaningful STES oriented Chemical Education", CERAPIE (Chemistry Education: Research & Practice in Europe), 2000, 1, 2, pp.189-200.

An example of the latter was given by Jickling (1994) who focused on the concept of sustainable development as a representative set of beliefs that many environmental educators are attempting to impose on their students. He criticised their tendency to teach a set of environmentally "correct" beliefs. Instead of being taught to think for themselves many students[2] are being taught to "believe that sustainable development constitutes a constellation of correct environmental views or that hidden beneath its current obscurity lies an environmental panacea". Learners should know that ideas could be criticised, even by themselves.[6]

Nevertheless, this should be perceived through the notion that EE and education for sustainable development (ESD) is not a finalised product, already prepared and pre-packaged; it involves learning processes on both sides: the educators and the learners.[7] In such a framework educators should think and act as "change agents", inspiring people and not imposing rules or ideas about being "green", but stimulating learners to regard themselves as a part of an entity, in which the factors and parameters are very closely interrelated. However, it is a fact that ESD has as "*a priori*" objectives the protection of the environment and the promotion of sustainable development as the pattern of development which is, as much as possible, the friendliest towards natural resources and the welfare of society, particularly of the most vulnerable social groups. To this end, it is important to highlight educators' commitment to the ideas they teach and their key-role in implementing ESD.

Firstly, it should be clear that what the new vision of EE towards sustainability requires of educators is not in contradiction with their role when implementing a teaching method based on constructivism. Constructivism provides the context for the interpretation of the ways by which students learn and perceive the "new messages and ideas", thus being an essential means for the educator and not an end in itself. Therefore, it is important for educators to be aware of and practice such methods, as they could be very useful and effective in order to achieve the educational objectives of the lesson, activity, etc. On the other hand, their role is crucial as they are the transmitters and "sparks" of stimuli and knowledge, the indispensable guides and facilitators of students. Even a simple lecture could be very important in EE as the educator conveys knowledge and inspiration, trying to provoke emotions and reflection by the learners. And when such a process involves "maieutics", exchanges of ideas and reflection, methods compatible to constructivism, it usually results in fruitful learning outcomes, making the lesson "interactive", involving both sides of educators and learners.

[6] Saul D. (2000) "Expanding environmental education: thinking critically, thinking culturally", The Journal of Environmental Education, 2000, 31, 2, pp. 9-15.

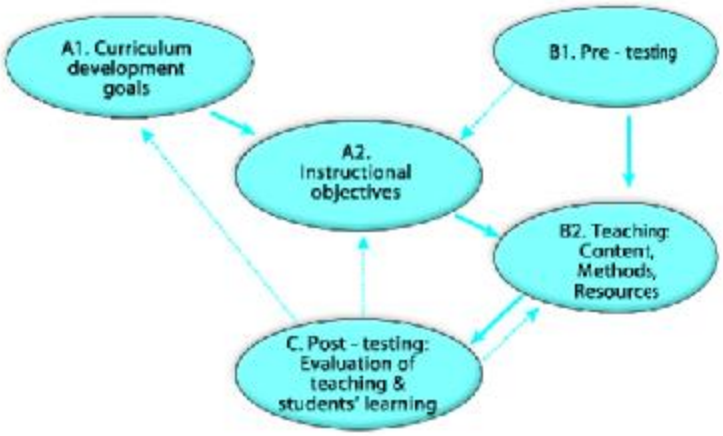
[7] "Basic Elements for the UNECE Strategy for Education for Sustainable Development", Statement of Education for Sustainable Development by the UNECE Ministers of the Environment, UNECE 5th Ministerial Conference "Environment for Europe" Kiev, 21-23 May 2003.

Furthermore, what is crucial for an environmental educator is to brave the honesty of placing the ethic of sustainability in the centre of his/her teaching and practice, whatever the approaches and methods followed. Seeking to educate for environment and sustainable development requires educators to inspire and encourage a commitment to the values of social justice and equity, peace and ecological integrity, democracy and respect to nature, promoting the adoption of new lifestyles and living patterns. Above all, educators should create a **realistic hope** in which the possibility of change and the real desire for change are accompanied by concerted and active participation.

Another important point is that in order to create understandings that are more integrated and contextualised, not only for their students but for themselves as well, it is important that educators encourage interdisciplinary approaches, the linking of knowledge and ideas within their local context as well as through partnerships between different institutions and eventually between different countries. Information sharing and experience exchange among educators, as well as being regularly informed on research findings and new technology applications are also responsibilities of educators, in the context of ESD, as such actions facilitate the revision of "traditional" teaching methods and the development of "new" ones (meaning the methods and strategies that integrate the concepts related to sustainable development).

A.4 The General Teaching Model

The so-called "General Teaching Model", based mainly on Hungerford et al. (1988), adapted from Miles & Robinson (1979) is a teaching model accepted widely from the educational community.[1] The model reflects the major components of the educational process and it can be applied to any grade level and content area. It provides an instructional framework that could result in organised, internally consistent and valid environmental education materials and programmes for any learner group. Its schematic representation is reflected in the following diagram:



Steps A1, A2, B2 and C constitute the core of teaching.
Step B1 of pre-testing should be included if the educator considers it necessary or useful.
Step A2 sets the objectives of the lesson/activity which are of high importance, since they establish the framework of what the learner is expected to learn, what skills to develop and what behaviour to express. These instructional objectives could be based on the general objectives of ESD, as they were described in sub-chapter A.1 and could be expressed according to Bloom's taxonomy, which comprises of the "cognitive", "psychomotor" and "affective" domains (see page 33). Drafting, revising, re-adjusting and re-writing the objectives constitute elements of an on-going process, necessary to keep the teaching interesting and "alive" and to follow the evolution of these rapidly developing issues.

Pre-testing should involve a kind of evaluation of the already gained knowledge and skills of students, relevant to the content of the activity that will be implemented. For instance, pre-testing could be conducted via a brainstorming or a concept mapping exercise (see also Chapter C).

Post-testing might include not only the evaluation of students' performance, according to the objectives of the lesson - activity, but the evaluation of the teaching method and of the educator's performance, as well.

[1] UNESCO, UNEP, IEEP Series No 30 (1994) "An environmental education approach to the training of middle level teachers: A Prototype Programme", Paris.

Bloom Taxonomy of educational objectives[2]

Benjamin Bloom is recognized as a leader in the pursuit of defining educational objectives. In 1956 he headed a group of educational psychologists, developing a classification system (taxonomy) of educational objectives, dividing his findings into three domains:

Cognitive: The cognitive domain involves knowledge and development of cognitive skills, such as *comprehension* (understanding the material being communicated, without necessarily relating it to anything else); *application* (using a general concept to solve a particular problem); *analysis* (breaking something down into its constituent parts); *synthesis* (creating something new by combining different ideas); and *evaluation* (judging the value of materials or methods, as they might be applied in a particular situation). For example, "*to describe the phenomenon of eutrofication & its main causes and impacts*"; "*to realise the importance of water in plant's growth*"; "*to relate the special characteristics of the Mediterranean region to desertification*"; "*to analyse the impacts of a dam on the local environment and society*"...

Affective: The affective domain includes the manner in which we deal with things emotionally and experientially, such as feelings, values, appreciation, enthusiasm, motivations and attitudes. It involves the processes of *receiving* and *responding; valuing* (showing some definite involvement or commitment); *values organisation* (integrating a new value into one's general set of personal values, giving it ranking among one's general priorities) and *internalisation* (acting consistently with the new value). For example, *"to value water as a strong link among Mediterranean traditions & customs"; "to be sensitised towards the aesthetic aspects of aquatic environment"; " to adopt an informed attitude towards conserving water"; "to adopt an informed attitude against overuse of cleaning products"; "to adopt a positive attitude towards the protection of wetlands"...*

Psychomotor: The psychomotor domain includes physical movement, coordination and use of the motor skills, as well as the skill of undertaking action. The included sub-categories are the following: *reflex movements* (actions that occur involuntarily in response to some stimulus); *basic fundamental movement* (innate movement patterns formed from a combination of reflex movements); *perceptual abilities* (translation of stimuli received through the senses into appropriate movements); *physical abilities* (basic movements and abilities which are essential to the development of more highly skilled movements); *skilled movements* (more complex movements requiring a certain degree of efficiency); and *non-discursive movements* (ability to communicate through body movement). For example, "*to obtain the skill of making simple constructions*"; "*to be able to organise and set up photo, paint, etc. exhibitions*"; "*to obtain the ability of conducting simple experiments*"; "*to take action for the conservation of the wetland*"; "*to take action in order to reduce water losses in the house, school, local community*", etc...

[2] Bloom B. S., Englehatt, M D., Furst E. J., Hill W. H., & Krathwohl D. R. (1956) "Taxonomy of educational objectives: Handbook I Cognitive domain" New York, Wiley.

Chapter B - Preamble

This chapter presents the role of the various teaching methods and methodologies and their use in the educational practice, based on relevant research findings. A number of educational approaches useful in implementing programmes on Environmental Education and Education for Sustainable Development, is briefly presented, as well as a thematic module for designing such programmes. The chapter tries also to address the need of easily choosing the appropriate method while avoiding the trap of offering ready made recipes. Finally, the last paragraph addresses cooperative learning and group work as an important educational framework for implementing activities and programmes on Environmental Education and Education for Sustainable Development and of other educational programmes, as well.

B.1. The Various Educational Methods Used in Environmental Education & Education for Sustainable Development

A review of the methodologies and methods used until now for teaching in Environmental Education (EE) or Education for Sustainable Development (ESD) is automatically based mainly on those dealing formally with EE. However, the analysis of the principles, objectives and practices of many of the so called "EE projects" in which these methodologies were applied were, at least, implicit about sustainable development and other issues, as well. The most commonly used of these methods are: problem-solving and projects; cooperative learning; discussions; field trips; experiments. All the above, with minor variations are useful and adaptable to the prevailing conditions. In many cases several of them could be used in combinations.

__Method__ is the way of doing something; a systematic procedure (Oxford Dictionary). In the present handbook the term "method" is used to express the ways by which educators implement the "instruction", as well as to express the ways by which students act in order to reach the learning objectives, e.g. lecture, bibliographic research, surveys, role playing games, etc.

__Methodology__ is the body of methods used in a particular activity (Oxford Dictionary).

In this book the term "methodology" is used to express the body of methods, as well as the context in which the methods are applied within an educational programme, e.g. the problem solving methodology, the project methodology and the cooperative learning. In this respect, the term "methodology" is used as synonymous to teaching and learning strategy.

It is obvious that the same method could be used in different methodologies according to the learning objectives, the available means, the characteristics of learners, etc. Furthermore, the didactic __tools__ refer to the delivery mechanisms through which the educators may promote the methods applied. They are used for assisting instruction and stimulating interest and they could be: audio-visuals (slides, video films, cassettes, etc.), computer facilities, educational kits, etc.

Despite the fact that some of the methods (e.g. lectures) are prerequisites for others, several attempts have been made to rank them according to their "impact", based on assessments through the educators' point of view and experience.

A research carried out in the USA [1], based on opinions of environmental educators, gave the following range of respondents' assessment of the "value" of methods and methodologies: problem solving; cooperative learning > independent or group projects> community resource use; outdoor teaching strategies; experiments> guided research; audiovisuals > data gathering/analysis; writing, arts, music > issue investigation; role playing; computer oriented activities > simulations > case studies > lectures. However, the methods that the same sample

[1] Smith-Sebasto N. (1998) "Environmental education in the University of Illinois Cooperative Extension Service: An Educator Survey", The Journal of Environmental Education, 1998, 29, 2, pp.21-30.

of educators frequently use, are: lectures> observations > audiovisuals > outdoor activities-strategies > problem solving > data collection & analysis > projects; community resource use > experiments; case studies > issue investigations > simulations, role playing games.

Another assessment of the effectiveness of various EE programmes conducted in Elementary and High School students gave the following main outcomes [2]:

- hands-on activities and experiments seem not only to be interesting and enjoyable but also, they seem to have a powerful influence on students' interest and awareness on environmental problems;

- projects and experiential learning, accompanied with the appropriate discussions, optimised students' comprehension; they also stimulated enthusiasm and commitment to the issues studied and helped students to integrate their understanding of environmental problems into their practical everyday experience.

- the great importance of activities organised at community level and/or in cooperation with the community was confirmed. Such activities included: conducting surveys and interviews to identify people's perceptions of environmental issues; presenting project reports and results of surveys and field studies to the wider public; having the actions reported in the local newspaper; asking local industries to demonstrate their environmental management strategies; involving local business and community groups in environmental projects.

During a study on the development of a programme on Education for Sustainability by teachers of lower and upper Secondary Schools in England, teachers determined, inter alia, that the teaching approach which they would follow should basically:

- *Use situations that students would easily identify;*
- *Be interactive and participatory, preferably of a problem-solving kind, in which students are required to find out information for themselves, and are encouraged to work in groups;*
- *Set the teacher in the role of facilitator and problem-setter and not as an authority and the main source of information. There should be a genuine sense in which the teacher is also a partner in learning. Teachers considered that this was the only honest way in which they could deal with inadequacies in their own knowledge.*[3]

[2] Ballantyne, et al. (2001) "Programme effectiveness in facilitating intergenerational influence in environmental education: lessons from the field", The Journal of Environmental Education, 2001, 32,4, pp.8-16.
[3] Gayford C. (2001) "Education for Sustainability: an approach to the professional development of teachers", European Journal of Teacher Education, 24, 3, pp. 313-327.

In Greece relevant research on educators showed that the methods preferred are those which supposedly enhance students' self-esteem and self-confidence. Furthermore, the research revealed that environmental educators prefer to implement mainly projects, field studies, surveys, as well as combinations of the various methods.[4]

It is noteworthy to mention the meta-analysis review of Zelensky (1999) on published studies from 1971 to 1996, relating to the impact of applied educational methods on the behaviour of young students and adults towards the environment.[5] The types of methods examined were included in two main categories: "*classroom settings*" such as lectures, simulation games, teaching on issue investigation and action, and "*non-traditional settings*" such as: workshops, nature camps and field studies. The study revealed that all practices in the "classroom settings" category reported improved environmental behaviour, while only 44% of the "non-traditional" settings, namely those of camps, gave such a result. Furthermore, the educational methods that involved learners in an active way were more effective in improving environmental behaviour than those that did not. In addition, the effectiveness of environmental education interventions, regarding the improvement of environmental behaviour was greater among the participants who were under the age of 18 years old; a common finding in other similar studies, indicating that younger people are influenced more by EE programmes.

At European level, the European Commission's Report "Environmental Education in the European Union" (1997) highlighted that educators demand from the school system a greater degree of freedom in choosing their teaching methods.[6] The latter was more evident in countries where the educational systems are decentralised, such as Germany, the UK, Ireland and the Netherlands. The majority of the educators expressed their preference and need for methods which "*evolve the students in the formulation of the problems and the planning of measures to be taken*". Thus, they indicated the value of EE programmes that promote the notions of "*learning to learn*" and "*learning by doing*" and cooperative learning, as well. In this context, the importance of research programmes and investigations, problem-solving activities and values education strategies was stressed.

In general, the teaching strategies that educators throughout Europe consider meaningful and effective (in terms of achieving the learning objectives) and which they also try to use within EE programmes and school curricula subjects are methods based on constructivism, characterised as:

[4] Vachtsevanou M. "Educators' Attitudes Towards Environmental Education", in the Proceedings of the 1st Hellenic Conference on Environmental Education, 8-10 October 1999, Athens.
[5] Zelensky L. (1999) "Educational Interventions that improve environmental behaviours: A meta-analysis", The Journal of Environmental Education, 1999, 31, 1, pp. 5-14.
[6] Giolitto P. (ed.) (1997) "Environmental Education in the European Union", Office of the Official Publications of the European Communities, Luxembourg.

"*student-directed*", providing students with opportunities for active involvement and cooperation, and "*experiential in orientation*", including, *inter alia*, values education and issue investigation.[7]

Generally, the educational systems have gradually changed the view through which they have been dealing with environmental issues: from a knowledge deficiency problem in the early years, to a conflict and reconciliation issue between the interests of humans and nature, to today's resolution of conflicts between different human interests. This evolution had a direct effect in the approaches and practices that have been used. In the early years of EE the transmission of scientific fact was the most common method. This was further developed and combined with elements such as the active involvement of students and problem-solving approaches. Nowadays, the conflict-oriented perspective of ESD implies a focus on participatory and democratic processes, seeking consensus and mutual understanding. All these developments are well reflected in the "Basic Elements for the UNECE Strategy for Education for Sustainable Development".[8] The document stresses the importance of methodologies involving active learning, creative discussion and critical reflection. It calls, *inter alia*, for the following characteristics of the **methodological approaches** within ESD:

- **Action-oriented teaching & learning:** Action-oriented teaching and learning approaches emphasise that ESD has the overall aim of contributing to changes in society towards sustainability. Students are considered not only as learners but also as "doers"; they are actors of a force for change. Thus, it is recommended that ESD approaches should involve concrete environmental actions taken by students and other interlinked target groups (parents, community, youth clubs, various NGOs, etc.) as integral parts of teaching and learning processes. Such an action-oriented approach has two main goals: to contribute to the development of students' competences to undertake action and to facilitate sustainable changes in the short and long-run. To this end, the widening of the activities' objectives is imperative, from narrow content-focusing to an awareness of learning and exploration of the dynamics, actors and parameters involved, as well as of the relations between them.

- **Approaches developing critical thinking:** Critical in the context of ESD means that ESD should be ideologically aware and socially critical. In general, critical thinking can be defined as how individuals consciously and freely adapt information into their own understanding within their existing values system, interests and knowledge. "Freely" here does not imply "without facilitation".

[7] Kapyla M. and R. Wahkstrom (2000) "An environmental education programme for teacher trainers in Finland", The Journal of Environmental Education, 2000, 31, 2, pp. 31-37 ; May T.S. (2000) "Elements of Success in Environmental Education through practitioner eyes", The Journal of Environmental Education, 2000, 31, 3, pp. 4-11.
[8] "Basic Elements for the UNECE Strategy for Education for Sustainable Development", Statement of Education for Sustainable Development by the UNECE Ministers of the Environment, UNECE 5th Ministerial Conference "Environment for Europe" Kiev, 21-23 May 2003.

However, such facilitation should not go beyond what the learner requests. This general definition applies to critical thinking in learning processes, but it is important to emphasise the importance of implementing approaches that promote an open mind in both learners and teachers, particularly for the sustainable development issues that involve a number of views and dimensions (cultural, economic, ecological, political, social, etc.). Critical thinking presupposes the development of cognitive skills, such as the ones of: logical elaboration of information and conduction of logical conclusions, making judgements, ascertaining, decision making, logical reasoning, inquiry, etc.[9] It is obvious that the educator's role in such an educational approach is crucial. Critical thinking, after all, should be "creative thinking" leading to deeper understanding and willingness to undertake action.

- **Democratic principles & processes:** It is imperative that youths participate actively in all relevant levels of decision-making processes. In addition to their intellectual contribution and their ability to mobilise support, young people frequently bring unique original contributions and perspectives that need to be taken into account (Agenda 21; Chapter 25, Children and Youth in Sustainable Development). To this end, the ESD programmes and activities should be based on and promote democratic principles, as well as require participatory processes for their implementation.

- **Holistic:** *the belief that anything natural is in some way connected to everything else and that each thing, is apart of whole which is more important than the parts that make it up* (Cambridge International Dictionary of English). In the context of ESD the term "holism" refers to an understanding where learners and learning processes are seen in a holistic and coherent way. Learners are seen as "whole" personalities including not only their skills and knowledge but also their needs, motivation, emotional and other characteristics.

- **Interdisciplinary & Multidisciplinary approaches:** These emphasise the interconnections between different perspectives. However, there are some basic differences in their methods.

  Multidisciplinarity refers to looking at an issue from different disciplinary perspectives but not necessarily integrating them into one single framework. The multidisciplinary approach involves different subjects of study or different "angles of approach" in one topic-activity, without changes in the structures of the contributing disciplines or their tools. At the end, there could be two or more visions and opinions of the issue from the different perspectives, provided that

[9] Matsagouras E. and Helmis S. "Production of educational material: Theoretical assumptions and technical standards" in the "Designing and production of pedagogic material for Environmental Education" Proceedings of the Pan-Hellenic Symposium organized by "ELLINIKI ETAIREIA for the Protection of Nature and Cultural Heritage and the Piraeus University (21-23 February 2003). Ed. by V. Psallidas, Athens, 2003.

these views are complementary and not in contradiction. In practice, quite often the two approaches are unavoidably intermixed.

Interdisciplinary approaches involve two or more different scientific disciplines and imply their cooperation and integration. This is the main difference between multidisciplinary and interdisciplinary approaches: the latter involve multidisciplinarity but they somehow go "beyond". They seek to create a common and adequate single framework shared by the disciplines involved. The disciplines "bend" and deviate from departure, to "meet" or even "merge", through an "osmosis" procedure, in order to examine the specific issue and obtain a common vision or shared opinion about it.

Using an analogy with visual arts for indicating the difference between multidisciplinarity and interdisciplinarity, one could say that multidisciplinarity corresponds to a mosaic in which many different colored stones have been used (or a painting of "pointillism") while interidisciplinarity corresponds to the mixing of appropriate colors in order to obtain the right shades needed for the particular view.

- **Use of modern Information Communication Technologies (ICTs)** refers to the application of information technologies in the learning processes, in order to have access to information, learning materials and best educational practices across all sectors and disciplines. This is considered more as a tool rather than an independent method.

- **Problem based learning (PBL) or Problem solving:** This means organising teaching and learning around a concrete issue and/or problem (preferably a local one), the solution of which is the ultimate goal, instead of a topic deriving from one of the usual disciplines. Thus, it is characterised by learning via contextualised problem setting, based on opportunities offered by real conditions. Problems or cases from the real world are used as a means to motivate and initiate students' learning processes e.g. acquiring a predetermined content and at the same time develop personal competencies (skills, critical thinking, etc.) (see also subchapter D.1.).

- **Project work,** which is characterised by students' initiatives, action-orientation, interdisciplinarity, group work and joint planning (teachers and students). The project's theme should be derived from the local community's reality and according to the particular issue relevant knowledge and information should be chosen (see also subchapter D.2.).

B.2. Choosing the Method

It is obvious that the spectrum of methodologies and methods available for EE and ESD is very wide. In principle, they are the same with those being used in other teaching–learning situations. However, the exceptional feature of EE and ESD is the "personal" involvement. This involvement requires not only knowledge and comprehension, but also individual and collective commitment to "*earth and human care*" and, of course, it should first of all genuinely exist in the teachers themselves. Therefore, the methodologies to be applied are primarily those which better suit the educator; the ones better delivering his/her own "commitment". Additionally, as mentioned in the previous paragraph (B.1.), in most cases experience shows that the methodologies mostly preferred are those promoting interdisciplinarity; developing skills of analysis and problem-solving; involving students in the learning process; stimulating and facilitating undertaking of action, based on change of behaviour and attitudes (in the long-term).[1]

There are several factors influencing the choice of the method and didactic tools to be applied.[2] The ones considered as the most important are given in the following box.

- BASIC FACTORS FOR CHOOSING THE METHOD-

- *the **characteristics of the activity,** such as its goals & objectives, content & topic, the framework in which it is implemented (formal, non-formal);*
- *the **attributes & style of the educators,** including their mastery & experience, willingness to experiment and be learners themselves;*
- *the "**limitation factors**", such as curriculum, time-table, space, availability of resources, number of students, etc. (in some countries the limitation extends also to the political framework);*
- *the **attributes of the learners involved:** age, mentality, needs, interests, skills;*
- *the **geographic (urban, rural, coastal), socioeconomic, cultural and local context.***

[1] Giolitto P. (ed.) (1997) "Environmental Education in the European Union", Office of the Official Publications of the European Communities, Luxembourg.
[2] UNESCO-UNEP, IEEP Series, No 39 (1998) "Environmental Education: Curriculum guide for pre-service teacher education in the Caribbean", Paris.

When the educator is to decide on a teaching method he/she should keep in mind, that, in general:

- *One method most probably may not achieve all the learning objectives.* A combination of two or more methods may be required. Nevertheless, many of them are innately closely related or interlinked, since the implementation of a particular methodology, e.g. problem solving, needs the combination of some methods, e.g. bibliographic research, surveys, experiments, etc.

- *All students may not respond equally, in terms of learning and developing skills, to a particular method.* For example, younger students (primary school pupils) may gain more from a game or a simple demonstration, e.g. using models or exploration of concrete situations around them. On the contrary, middle and secondary school students would benefit more through first-hand investigation activities or conduction of experimentations by themselves.[3]

In the following subchapter the way by which learning objectives influence the choice of the method is briefly presented.

B.3. Educational Goals, Learners' Objectives & Suggested Methods

The "educational goals" are the essential framework to be used when preparing curricula and making teaching decisions in education. They serve as an important set of guidelines for identifying what the desirable learning outcomes are. Thus, there is an imperative need for an intermediate step between setting goals and preparing for teaching, in which the intentions of the goals are translated to more specific statements of desirable learning outcomes, traditionally referred to as "learner objectives". Further on, these objectives guide the educator to choose the method and also the content which he/she will implement.

Hungerford, Volk et al. (1989) have recommended a set of teaching methods for implementing programmes in environmental education and teaching, in general[4]. In the following table a goal-oriented framework for choosing the teaching method within a programme of ESD is presented based on Hungerford's scheme and also including and integrating the challenges of ESD in the contemporary global community.

[3] UNESCO-UNEP, IEEP Series, No 26 (1988) "A process for pre-service teacher training curriculum development", Paris
[4] UNESCO-UNEP, IEEP Series 30 (1994) "An environmental education approach to the training of middle level teachers: a prototype programme", Paris.

Goal Domain	Suggested Methods
Awareness & Knowledge *…to help students acquire awareness of the environment, social & economic systems and the interdependence among them, as well as of the allied issues; and understand the complexity and interconnectedness of problems, such as environmental degradation, poverty, unsustainable patterns of production & consumption, gender inequality, violation of human rights, at local, national and global level.*	Lecture & discussions Bibliographic research & use of modern ICTs Experiments Field visits & trips Case study Surveys
Behaviour, Attitudes & Values *…to help students develop feelings of concern for the environment, society and the relationship between them; develop and strengthen values of respect of nature, equality, peace, tolerance and democracy; and develop motivation to be actively involved in protection and improvement of the quality of environment and of life, in particular of the unprivileged people, such as: poor, women, victims of racism, culture and ethnic minorities, etc.*	Panel discussions & debates Surveys Role play Case study Field work & research Projects carried out in cooperation with schools from other communities, or even from other countries*
Skills *…to help students acquire skills for investigating and identifying environmental, social and economic problems and addressing them through appropriate decision-making and action.*	Panel discussions & debates Role play & simulation Surveys Problem solving approaches Projects
Involvement in creative action *…to provide students with opportunities, encouraging them to be actively involved in working collectively and individually towards addressing problems and issues in their community.*	Workshops with community resource people Problem solving approaches Projects carried out in cooperation with other schools, local institutions (e.g. environmental education centres, non-governmental organisations), and community stakeholders.

* Cooperation while carrying out common projects could take place between schools likely from developed & developing countries, confronting the same issue but eventually from different perspectives.

B.4. The Use of a Thematic Module for Building Programmes of Education for Sustainable Development

The general scheme herewith describes very briefly a methodology for the implementation of ESD programmes that have as a "core", "foundation" or "vehicle" for the entire programme a particular theme -frequently referred to, by some professionals working in the field, as "*thematic modules*".

In all these steps various methods and their combination could be used according to the objectives of the programme, the particularities of the theme, the characteristics of the group of students, the educator's experience and imagination, etc. (see also paragraph B.2.)

It is also very important that the introductory remarks of the teacher are "genuine". Even if his/her analysis of the problems is pessimistic, his/her message about conducting policies to address the problem should be optimistic. Hope should be visible for the possibility of action that could successfully address the issue. It is also important to include:

- *prototype techniques, as frequently as possible, stimulating students' creativity and their willingness for action*
- *participatory procedures, encouraging the active involvement of all (team and individual work) within and outside the school (community work);*
- *provision of knowledge on communication techniques and action strategies, as well as options in order to implement ideas in the field, addressing the issue under study.*

a. Starting with the subject -"vehicle"

The need for an integrated, holistic approach to educational systems with a focus on concepts that allow people to understand their environment better is evident. To this end, concepts that can be used to bridge or combine the so-called traditional disciplines are needed. "Water", "waste", etc. provide such cases. Other more "narrow" subjects such as an endangered species (e.g. monk seal) or an essential substance (e.g. salt) or topics of particular local interest could also be used as an appropriate "vehicle". Such an educational programme may combine and integrate all relevant disciplines from science (chemistry, physics, biology, geology) as well as from social sciences, history, literature and arts. Since the teacher knows the main issues that should be explored, the vehicle could be used appropriately in order to guide students' work on the various relevant aspects, such as:

physicochemical properties and biological characteristics of the substance, habitats of a species, the bio-geological cycle of a substance - integrating its use; usefulness and problems of exploration; cultural aspects, history and related traditions (connection with religious, artistic, ethnic references); social importance of groups of people involved in e.g. its use, management, etc., "friends and enemies"; the need to reconcile various interests, etc.

Pre-testing should be conducted in order to identify students' background and eventual misconceptions. It may be carried out by various methods e.g. brainstorming or by briefly introducing the key components and then asking students to draw their own concept maps (see paragraphs C.1.4, C.2.).

b. Investigating whether the problems related to the issue are old or new
At this step the causes & impacts of problems related to the particular issue should be identified, in the past and the present situation. The educator could introduce the "old" and the current dimensions of the issue to students. He/she may invite students to elaborate short oral or written contributions (e.g. papers prepared by small groups as homework) integrating the additional elements e.g. social and economic parameters to the study, the impacts of human activities (economic, cultural, etc.) to the environmental aspects of the issue and vice versa, the changes through the time that passed, etc. The educator, depending on the class, the background of the students, as well as on his/her experience could summarise new elements that have emerged e.g. from the economic globalisation or the primary causes of the problem e.g. overpopulation, over-consumption, mismanagement of resources, inadequate education, etc. So, the questions that should be answered at this phase are: What are the differences and similarities between the past and present situation? What remains the same & what has been changed? What are the reasons for this? These questions lead in a logical way to a new set of questions such as: What are the ways out? What could be our role? How do we exercise our rights and obligations? Which are the foundations for tackling the related problems?

c. Finding the ways of tackling the issue
Work in this step should start with the exploration of solutions at the global level and further on, move to national and local strategies for action for both the short and long term. The concept of management should be investigated accordingly, at the individual and community level. Particular actions should be identified and certain suitable ones selected for the learners to apply.

d. Implementation of the selected actions
These could be simple and straightforward, such as beach clean-ups, campaigns for water saving, etc., or more "sophisticated" such as advertisements in the press, cartoons in local journals, writing letters to the local Member of the Parliament or the Mayor, visits, interviews, or even a peaceful demonstration at the offices of local authorities, etc.

e. Monitoring of the impact of the actions undertaken and, if possible, assessment of the educational procedure and feedback.

B.5. Cooperative Learning & Group Work

The previous paragraphs highlighted the importance of cooperative learning and group work for almost every educational methodology, in the framework of ESD. The relative superiority of cooperative learning over "*competitive*" and/or "*individualistic*" learning in improving students' performance in parallel to their cognitive and social development has been demonstrated by hundreds of research studies.[1,2] It is generally recognised that any topic and discipline can be taught using cooperative methods.

The basic elements of cooperative learning that educators should take into account and develop systematically, when designing such learning activities are, basically: collective responsibility, coupled with individual accountability, interdependence and interaction, and of course, collaborative skills. The collaborative skills are required in order for students to work together in an effective way and these include the skills of decision-making, trust-building, communication and conflict management skills. Thus, the activities within the framework of cooperative learning should aim to the development and enhancement of such skills.

Furthermore, in order to result in effective group processing, some regular discussions, among the teams are necessary for exchanging information on e.g. how well the groups are achieving their goals, whether the groups maintain effective working relationships among their members, etc. During such discussions, groups should describe which members' actions are helpful or not and make decisions on what behaviours to continue or change. It is claimed that such a process: [3]

- enables learning groups to focus on group maintenance;
- facilitates the development of cooperative skills;
- ensures that members receive feedback on their participation, and
- helps students to practice collaborative skills consistently.

Key components for effective cooperative learning require a grouping of students by heterogeneous abilities and skills and a component that ensures individual accountability of each member of the group.[2] Furthermore, it is very important for the educator: to allow sufficient time for the process to take place; to ensure that the procedure would be very specific rather than general; to maintain the active participation of all students, encouraging and stimulating them to practice collaborative skills; to monitor and facilitate students' work and; to ensure that

[1] Johnson D. and R. Johnson (1989) "Cooperative Learning", in "The Effective Teacher" Study Guide & Readings, L.W.Anderson (ed.), USA.
[2] Nichols J.D. (1996) "Cooperative learning: A motivational tool to enhance student persistence, self-regulation and efforts to please teachers & parents", Educational Research and Evaluation, 1996, 2, 3, 246-260.
[3] Matsagouras, E. (2000) "Cooperative Teaching & Learning", 2nd edition, Publ. Grigoris, Athens.

clear expectations deriving from the objectives of the activity are formulated and results are reached and communicated. To this end, the educator's role in such an educational practice should include among others the clear specification of the activity's objectives from the very beginning.

When summarising the "positive" and "negative" aspects of implementing such a methodology we come up with the following:

Cooperative learning	
"Positive" elements	***"Negative" elements***
Promotes sharing of ideas and stimulates discussion	*Difficult for teacher to prepare and coordinate*
Helps to maintain interest	*Need for clear guidelines to reduce irrelevant discussion/work*
Time-effective, in terms of content covered	*Risk of mere permitting some participants to be "passengers"*
Makes use & develops a variety of learners' skills, social and affective, especially when conducting field work	*Many times depends on the skills of the few "leaders" of the groups*

Preamble – Chapter C

CHAPTER C

In this chapter a series of methods are concisely presented. Several of them have been developed for teaching and learning of issues not necessarily linked to environment or sustainable development. The way they are used today or suggested or interpreted in this handbook may sometimes differ from their initial use and application. In the present handbook some selected aspects of these methods are presented so as to assist educators in using teaching manuals and educational kits. In each method, the basic theoretical and practical characteristics are developed, as well as suggested ways of their implementation, using activities and examples from the educational package "Water in the Mediterranean". The methods that are elaborated are: various techniques for discussions; concept mapping; bibliographic research; experiments; analogies and models; simulation methods such as case studies, role-playing games, computer simulation and other games; surveys, field teaching and field research. Finally, the last section addresses educational kits as important teaching and learning tools within EE/ESD programmes.

CHAPTER C

C.1. Discussion Methods

Discussions are necessary, critical and integral parts of all kinds of educational practices. A discussion may be used either to introduce a theme, e.g. brainstorming for some initial ideas, or to develop a lesson. The advantages of an effective discussion are obvious: it sharpens language and communication skills, it fosters sharing of information, analysis of situations and formulation of solutions to issues. It educates people to support their views with arguments, while having to respect the opinion of others, promoting tolerance and democratic processes.

The discussion may take a wide variety of forms, ranging from the teacher-centred lecture to less formal group or class discussion, from analysing and commenting on concept maps and brainstorming to formalisation at the highest level of a debate or a panel; each time aiming to clarify and represent positions and attitudes taken on a specific issue. Whatever the kind of discussion it might be, its success depends very heavily on the facilitator of the process, who usually is the educator and who should have skills to steer the situation in line to the objectives and educe the most important points in summary.

C.1.1. "Maieutics" & "Tell Each Other" Methods

Learners and young people in particular, learn not only from the content of the question but also from the way the educator formulates it. The educator should give students an opportunity to familiarize themselves with topics, materials and issues to be studied. Sometimes it is useful to prepare some questions that students could think about when they have spare time. The educator could also engage students in the process, training them in formulating questions by themselves, which can be answered by investigation and experimentation. In this way, students develop critical thinking and make hypotheses.

It sounds self-evident but, students need to be allowed enough time to answer a question: studies reveal that pupils need at least 3 seconds to "translate" thoughts into words and when pause for thought is extended the benefits are striking.[1]

The "Socrates questioning" or "maieutics" technique is an interrogative method of learning which involves the following:

- posing the question by the educator, creating an environment that persuades students that"there is no right answer"; and
- further successive questioning and discussion between educator-student.

At the end, the educator asks whether the student wants to change his/her initial opinion/statement. However, such a method of discussion involves only one student while the rest listen.

[1] Brunner W., et al. (2001) "Ecologicl Environmental education: Methods and examples", Keep Sweden Tidy Foundation, 2nd edition.

The "tell each other"[2] technique is another discussion method which provides the opportunity to involve all students in discussion. Usually, within such a practice, after making the question, the educator asks students to tell each other -in pairs- their answers within 15 seconds. Then he/she chooses some students to respond and after hearing each response, he/she asks those who agree to put their hands up and those who do not to express any other ideas. Although this method is no slower than the usual class questioning, it involves the whole class while allowing students to rehearse their ideas verbally before answering in front of the whole class.

C.1.2. Group Discussions

Group discussion is actually the extended version of the "tell each other" method. In such a method students split into groups and work on an issue that has been introduced by the educator. Therefore, the teacher could use an article or display slides or present a recent fact closely linked to the discussion's issue. He/she also should distribute relative printed material to each group. To this end, the members of all groups are given the opportunity to reflect, exchange opinions, arguments and feelings on the issue. The groups should choose one member to be the rapporteur, who will undertake to record the ideas and arguments expressed as well as the position that the group will decide upon concerning the issue. The educator could facilitate and coordinate the procedure and by the end of the activity he/she should, facilitated by the rapporteurs, summarise the main points of the groups and conclude.[3]

C.1.3. Panel Discussions

Panel discussions on issues are excellent mechanisms for permitting students to present conflicting viewpoints. In such a process students are offered a great opportunity to compare their personal "ideologies" and views to those of others on specific issues. Such a method usually involves from two to ten students and it could indirectly involve the entire class.

Another form of panel discussion is the debate, in which two participants, individuals or groups are involved representing two opposite viewpoints on the same issue. Usually each participant gets a few minutes to present his/her position and arguments. In the end, the educator could summarise the points raised.

An initial preparatory phase by the educator is absolutely necessary. Articles and other written information relevant to the topic of the discussion must be collected. Care should be taken so that the main positions involved in the issue are all well represented in the written material. In addition, it

[2] Ross K. (2002) "Teaching Secondary Science: Constructing Meaning & Developing Understanding", The Cromwell Press Ltd.
[3] UNESCO-UNEP, IEEP Series 39 (1994) "Curriculum guide for pre-service teacher education in the Caribbean-Upper Secondary Grades", Paris.

is recommended that a week before the scheduled panel discussion, the students select themselves or are assigned to represent a particular viewpoint, formulating enough groups for all the major tendencies or aspects involved in the issue. Thus, they should be prepared on the aspects and positions of their delegation on the issue, using the suggested material by the educator. However, it is useful to become acquainted also with the rest of the material related to the topic, which represents the viewpoints of the other panellists. Sometimes, students should be encouraged to seek additional information which might be useful in the panel, depending on the time available for the implementation of the activity, students' familiarity with the issue, etc.

- *In a panel discussion opportunities must be given so that the various different positions could be presented.*
- *The positions and their supporting arguments should be clarified, as needed.*
- *Questions and comments should be encouraged from the audience.*
- *As much time as it seems appropriate should be allowed for each panel's presentation.*
- *If necessary, the educator could help synthesize important information or viewpoints at the closing.*[3]

C.1.4. Brainstorming

Brainstorming is a discussion method, frequently used in the beginning, for the development of a lesson and/or for the investigation of students' spontaneous ideas and thoughts about the theme of the activity that will be implemented. Brainstorming stimulates interest and involves all students in the process. Within a brainstorming session students are given a few minutes, five or ten, depending on the complexity of the issue being examined, and are required to present their point of view briefly but precisely to the rest of the students and teacher. These points could also be written on a board, or a big piece of paper. The disadvantage of such a practice is eventually the formation and expression of premature judgements before the proper shifting of ideas. To avoid this, a simple variation of the "concept mapping" approach could be employed (see paragraph C.2.).

Alternatively, another method often applied before starting an activity, is the use of cards with words distributed to students and asking for their comments, as demonstrated in the following example:[4]

[4] UNESCO-UNEP, IEEP Series 26 (1998) "Environmental Education: A process for pre-service teacher training curriculum development", Paris.

Activity: "Germs are happy in water"

The specific activity is about the "detection" of microorganisms in untreated water, using the microscope. Before starting the activity, brainstorming could take place, as follows:

- The brainstorming session would include some numbered cards with words such as: "microorganisms", "pathogens", "waterborne diseases", "unsafe water", "disinfection", etc. which are distributed to the students.

- After a few minutes, the "carriers" of the cards are asked to speak about the word of their card. Viewpoints on each word are recorded on the board by the educator next to the word described and are arranged serially.

- After this short session the educator has supplementary information about students' ideas on the issue and thus, he/she manages the implementation of the rest of the activity accordingly.

C.2. Concept Mapping

Concept mapping is a very powerful and useful didactic method. Traditionally it is considered as a representational tool for showing the relationship between one entity, concept, etc. and another one, building relationships and links between them and representing them in a figure, schema or map. Variations of concept mapping could be used also for initiating brainstorming or any kind of discussion, game or study.

The philosophy behind the development of concept maps has its roots in the constructivist theory of learning and the cognitive operation of the human mind (cognitive psychology), according to which the basic elements of thinking are concepts built from the perceptual images of individuals.[1] The linking of perceptual images forms a perceptual mapping based on individuals' approaches to images of the world. The human mind creates fast abstract schemas which are ways of encoding regularities in categories: these are the "conceptual maps". The notion of a schema is useful as it integrates structural and functional aspects of human behaviour and reasoned action, which can be partly represented by graphic representations such "concept maps". Constructing concept maps promote "metacognition", as this tool is related to the structure of knowledge and helps students to understand the way they learn (metacognition).[2] This is very useful, if not a prerequisite, to meaningful learning, thinking and acting.

In simple words, concept maps could be a clear representation of the concepts that somebody has conceived, elaborated in his mind and developed. All this

[1] Novac J.D. and Gowin D.B. (1984) "Knowing how to learn", Cambridge University Press.
[2] Matsagouras E. (2003) "The interdisciplinarity in School Knowledge", 2nd edition, Publ. Gregoris, Athens.

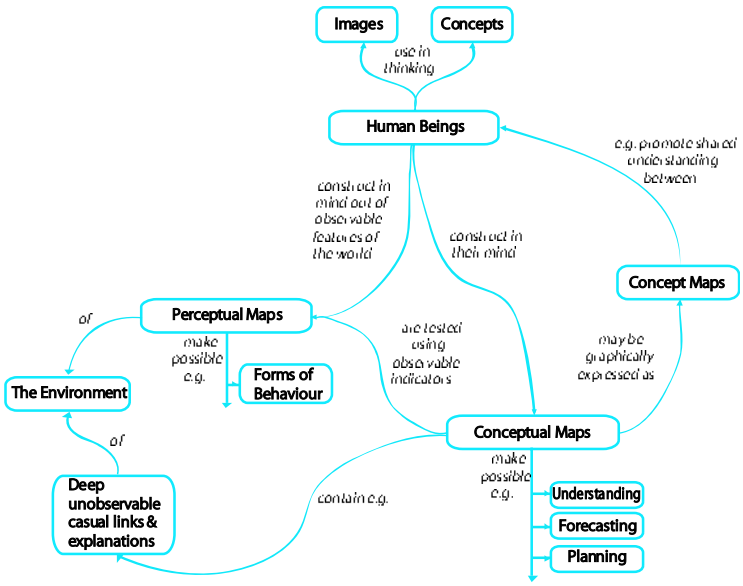
happens usually in a very short time in the human mind and through the mapping process individuals try to analyse, follow and reconstruct their conceptual schemas. Therefore, they could also be very useful tools for identifying students' misconceptions. This would be done by revealing either the failed linkage between two concepts leading to a wrong sentence or a sentence that misses the basic idea which links the two concepts or, finally, a logically unsuitable (or "forced") linkage between concepts. In brief, the main differential points between the abovementioned terms of "conceptual", "concept" and "perceptual" mapping are the following:[3]

- ***conceptual maps*** *refer to the abstract schemas that the human mind develops, in order to conceptualise, give meaning and include an "object" (regularity) into the individual's conceptual net, while*

- ***concept maps*** *are the concrete graphical expressions of such abstract schemas.*

However, even before the conceptualisation and creation of conceptual maps, the human mind firstly constructs a schema when experiencing, capturing images and perceiving the observable features of the world, as well as the links between them. The latter is usually called ***perceptual mapping.***

The following concept map attempts to show the relationships between perceptual mapping, conceptual mapping and concept mapping, trying to clear up the differences between them.[3]



[3] Source: The Telematics Centre, University of Exeter, School of Education and Lifelong Learning http://telematics.ex.ac.uk

-How Concept Maps Could be Used in the Teaching & Learning Process-

The simplest way to introduce concept maps to students is perhaps to use the analogy of "islands and bridges": concepts are like "islands" and links are like "bridges". Attention must be given to the fact that a meaningful proposition is possible only by **naming the link** to go from "island" to "island", from concept to concept.

Directional arrowheads are also very useful, since they indicate in which direction the particular propositions are to be read, showing the way in which the relationship is developing between the concepts.

Relevant research has underlined that the more the links are, the more important the concept is in the individual's thinking.

The initial maps made by students may not have an obvious symmetry or the majority of the concepts may be gathered in one part of the map. Therefore, it might be necessary to reconstruct them; sometimes it is necessary to construct the same map two or more times.

In general, it is recommended that young pupils be taught concept mapping at an early stage. A simple and simplified way to do so is by *asking pupils to write a word that describes how two words (it could be concepts, ideas, etc.) are linked.* Once the basic idea of linking ideas is established, additional concepts can be added to produce the completed map.[4] Another way is to show students the evident or expected link through a sequence or the least expected link or the critical link. For instance, in the case where a teacher asks students to link the numbers: 1, 2, 10, 15, 25, 7, 35, 85, 20 and 100, most of them will link them in increasing order. This is a logical, expected or evident "link". Some others would link them in more complex combinations e.g. 1-10-100 or 15-25-35-85 and several more. If then the teacher asks them to correlate words they would understand better what linking concepts will require. In some cases students could be encouraged not only to link words but also to add and complement the set.

In the following paragraphs some basic steps of the methods developed regarding concept mapping are presented, taking as an example the topic of "dams".

Activity: Concept mapping of a …dam …

1. Identifying the basic concept(s) of the document

Usually it is recommended that the educator starts by choosing some paragraphs (one or two) of a text, rich in meaningful concepts and ideas. The educator should ask students to carefully read the document and select the notions they consider as necessary for understanding the text and then write them down in a table.

[4] Ross K. (2002) "Teaching Secondary Science: Constructing Meaning & Developing Understanding" The Cromwell Press Ltd.

Using the paragraph in the box as an example, taken from a text about dams, students might choose as the most important concepts some of the following: dams, water demand, water supply, policies, water capture, irrigation, hydroelectric energy, floods, recreation, fisheries, purposes, consequences, problems, alternatives. Next thing is to discuss which of the notions is the most important and most comprehensive one.

Dams are primarily designed to balance water supply and demand. Usually this means capturing water in the wet season for use during summer, when demand, especially for irrigation and tourism, is at its peak. Dam building policies are widespread in the Mediterranean region. Nowadays, their main function is for irrigation and water supply of cities as opposed to hydroelectric production, their primary purpose in the first half of the 20th century. Dams have been frequently seen as modern symbols of power, fertility and high technology. The multi-purpose uses of the waters they impound (irrigation, power generation, flood control, urban water supply, fisheries, transportation, recreation) appear to offer solutions to a variety of problems in one splendid construction of high visibility. Yet, experience has shown that dams often create more problems than they solve. No doubt many of them, particularly the small-scale ones, can be justified in certain circumstances, if planned with care, but those who would undertake such enormous investments should weigh all likely negative consequences and thoroughly assess the alternatives.

(taken from the educational package "Water in the Mediterranean")

2. Ranking concepts

In the next step students should rank the words in order, starting from the word that expresses the most general concept to the less general ones.

3. Constructing the map

Using the list from the previous step as a guide, the educator and students together can start constructing the map. It is very important to stimulate and encourage students to identify on their own the appropriate words-links between the concepts through appropriate questions and discussions (brainstorming, "maieutics").

4. Making cross-links

An advanced task is asking students to find cross-links between different parts of the map. This is considered as an indicator for the successful construction of a concept map.

5. Constructing the map

At this step, students practise concept mapping. They should base their work on another text, full of notions, and work in small groups of two or three students. The constructed maps should be presented by the groups in class and the educator should encourage them to reflect on the way each group perceived the basic idea. To this end, the groups should explain to the rest the "philosophy" behind their map and discuss about the eventual similarities and differences between the designed maps.

CONCEPT MAPS AS A STIMULUS FOR BRAINSTORMING AND DISCUSSION

The educator may ask every student to describe with a few key-words the most important aspects of a selected issue e.g. potable water or rainwater and link these words in a logical sequence. Then he/she may collect the papers and make comments or identify misconceptions which he/she may correct, or encourage each one of the students to explain his/her concept schema. He/she may allow students to re-work their schemas and ask them to explain the eventual differences between the old and new ones. All these options offer excellent opportunities and stimulus for brainstorming and constructive discussions which may be followed by other methods.

C.3. Bibliographic Research

Bibliographic research constitutes a method on its own, which is also very often used in the framework of implementing other educational activities. Thus, it is necessary when conducting surveys, field research, problem solving programmes, projects, etc. Such a method contributes to the development of cognitive skills and, in particular, language skills, analysis and synthesis of information and critical thinking.

Some points that are noteworthy when conducting bibliographic research are the following[1]:

The students are encouraged to:

- Focus on the research questions which guide their work.
- Never forget to write down the "ID" of every piece of information (article extract of book) they use, such as: title, writer, publisher, date of publication.
- Note the basic elements (e.g. subject, basic points and findings, etc.) of every article or other piece of information in order to index their bibliography and facilitate the further elaboration of the research findings.
- Cross-check the information on the same theme deriving from different sources, if possible.

The educator is expected to:

- Clarify, from the very beginning, the theme and the objectives of the research in a way that they can be understood by all students, in order to avoid misunderstandings and lack of orientation during the research.
- Assist students to identify key-words for their research.
- Indicate the most appropriate sources of information, according to the characteristics and requirements of the specific research. Such sources could be not only the school or municipal library, but also the libraries of institutions and organisations, e.g. research institutions, statistics services, UN Bodies, universities, environmental and/or sustainable development NGOs (Non-Governmental Organisations), etc. Sometimes it might be recommended to join students during their visits.

[1] Kamarinou D., (1998) "Experiential learning in school", 3rd edition, Paper Graph, Greece.

Of course, bibliographic research does not end when the required information is collected. The most important part is the elaboration of the information that should follow, as well as its synthesis and presentation in reports, tables and diagrams, schemes, slides, etc. according to the objectives of the activity.

Nowadays, not only printed material could be used within a bibliographic research, but all that is available from audiovisual means: videotapes, slides, photos, CD-ROMs, and the Internet. The latter has evolved into a very common tool for information gathering. Research on the Internet has in the last years raised many questions related to the way it is conducted, as well as to its educational results. Such work contributes to the familiarity of students and teachers with modern information and communication technologies (ICTs), which is particularly important for our society at the dawn of the 21st century (see also paragraph C.6.3c.)

C.4. Experiments

Experiments are important teaching tools for introducing and involving learners to scientific methods of work. Experimentation is a learning method suitable for dealing with a number of environmental issues and facilitating comprehension on basic concepts. The method involves a set of steps, such as formulation of the hypothesis, experimentation, observation, findings recording, data analysis and elaboration, deducing conclusions. Such a process provides the opportunity for observing a single process and appreciating its complexity, importance and its manifestation in the natural environment, in combination with its socio-economic implications.

Experiments develop critical thinking and cognitive skills and are good practice in using and developing a full range of manipulative skills (making apparatus, observing, taking measurements, recording data, etc.). Furthermore, they enhance learners' creativity and empowerment and stimulate their interest and enjoyment. Nevertheless, educators that use this method often fail to consider the socio-economic factors relevant to the issue studied and to clarify the associated values.[1]

However, experimentation requires good organisation and preparation by the educator. To this end, pre-planning is absolutely necessary for the effective use of experiments and for ensuring that the experiment is not just an application of a simple recipe. Furthermore, the content of the activity should be compatible with the students' age and level. Within the framework of ESD experiments should be simple, easy to conduct using everyday equipment and materials and, of course, closely linked to everyday phenomena and issues. At this point it must be stressed that experiments do not necessarily mean experimental activities based on laboratory conditions and/or rigorous physics or chemistry. Activities that follow the steps of the experimental method (hypothesis - activity - data elaboration - conclusion) may also be included in such a method.[2]

[1] Giolitto P. (ed.) (1997) "Environmental Education in the European Union", Office for Official Publications of the European Communities, Luxemburg.

[2] UNESCO-UNEP, IEEP Series 39 (1994) "Curriculum guide for pre-service teacher education in the Caribbean-Upper Secondary Grades", Paris.

Activity: "Filtration"

In the particular activity students experiment with the filtration of different kinds of water mixtures (or alternatively, groups of students could experiment with all mixtures). Students could work in small groups developing cooperative skills. The activity could be carried out with the following steps:

- *Presenting the theme of the activity & its objectives* to students. The presentation might include the explanation of the procedure of "filtration", its necessity and application, from everyday life activities e.g. making coffee, to activities of public services, e.g. water treatment.

- *Formulating the hypothesis* of the experiment, regarding what students expect to happen when they filtrate the various mixtures (e.g. which substance will get through the filter and which one will remain on it, as well as what the reasons for this are).

- *Experimenting.* Setting up the filtration apparatus and then experimenting with the different kinds of water mixtures , e.g. water and soil, water and detergent, water and watercolour, water and coffee beans, etc., following the instructions given.

- *Observing & recording* the process and outcomes on a piece of paper prepared by the educator or on their laboratory note-book.

- *Finding out* whether the initial hypothesis was right or wrong. This step requires allowing time for students to make sense of what they did, as well as of the new information that they have "extracted". Reflection on basic questions is needed in order to facilitate comprehension of the concepts related to the activity, such as: *"finally, how do the various mixtures "behave" during the filtration and why? "What could watercolour, detergent and coffee beans represent in a water solution or mixture in the environment"?, etc.*

- *Extension* Identifying the analogies of the phenomenon taking place during the experiment with an everyday-life process: students will be asked to find a phenomenon in nature similar to this experiment (in the particular case, it might be the phenomenon of percolation of water through the soil). They should also make the links between the activity to the environmental problems of pollution, as the soil, watercolour, detergent and coffee beans represent pollutants (e.g. solid waste, soluble pollutants, suspended particles).

The role of the educator in experiment activities is very important as he/she should coordinate students in an appropriate way, ensuring their active participation and their safety as well. In many cases, the educator, for obvious reasons, should "test" the experiments that will be conducted by the students beforehand. There are some general points that the educator pay special attention to, when preparing for and conducting experiments, such as:

- indicating the appropriate behaviour rules and other discipline issues;
- involving all students and assigning each one of them specific tasks;
- allowing time for reflection and for reviewing the objectives of the activity;
- preparing the work-sheet of the experiment;
- setting up follow-up work (homework, bibliographic research, etc.)[3]

C.5. Analogies & Models

Analogies are very commonly used in teaching, not only in environmental sciences but also in all other disciplines. In general terms, making an "analogy" means developing a system of relationships or "correspondences" that is valid for parts of the structures of two different "objects" (domains or areas).[1] The analogy between the solar system and the atom is one of the most well-known analogies, based on the similarities in the structures of the solar system and the atom: sun and planets - nucleus and electrons. Analogies are closely linked to "models". Models seek to re-create the main aspects of what occurs occasionally during an event (phenomenon) in nature or in the laboratory or even in society. Models are created based on multiple analogies which may function as the "building blocks" of the model.

The use of models should be based on the principles of constructivism. Nevertheless, the contemporary theories of learning indicate that learning of concepts and phenomena is a process which involves the construction of mental models by assimilating bits of new information. As the model construction process requires cognitive skills, it contributes to the mental development of students who are expected to develop such skills. Models may provide students with "experiencing" visually or intellectually a concept. It acts as an explanation to an abstract knowledge, leading to in-depth comprehension of concepts, instead of simple memorising information or imagining abstract relationships. Furthermore, research underlines the following main points when it comes to the use of models:

- *students understand better through images & concrete representations;*
- *the construction of a model should be the result of multiple analogies, carefully chosen or designed;*
- *the educator with the students should elaborate on the common characteristics-analogies between model and reality, as well as on the uncommon ones; the latter helps to determine the limitations of the model.*

[3] Ross K. (2002) "Teaching Secondary Science: Constructing Meaning & Developing Understanding", The Cromwell Press Ltd.

[1] Sarantopoulos P. (2000) "Analogies as a didactic tool in teaching Science", in "Teaching Science & Chemistry", (ed. Tsaparlis G.), ΔιΧηΝΕΤ, Ioannina, Greece, pp. 211-245.

Additionally, there are some basic requirements for the analogies on which models are based on, in order to be "successful" and meet the objectives of the activity, including the following:

- The components of the model should be familiar to students and relevant to their everyday life activities.
- A structural consistency should exist between the model used and the phenomenon that it attempts to represent, and
- Meaningful similarities should exist between the elements of the model and those of the phenomenon.[2]

In fact, there should be a test for a "structural validity" between the model and the phenomenon. One way to test this "validity" could be obtained by presenting the model to various groups of students of different grades, as well as to educators, and measure the level of understanding of the model or compare the comprehension of the phenomenon with and without the use of the model.

Many researchers have drawn educators' attention to the fact that students may consider models as reality. Therefore a clear distinction between the model and the "reality" should be made from the beginning, and further on, when highlighting the analogies between them.

In the following paragraph an example of the use of a model is presented, according to the *"Teaching with Analogies (TWA) Model"*.[1]

Activity: "Create a mini water cycle"

In this activity students will construct a model of the water cycle. Using the "Teaching with Analogies Model –TWA" the activity could be implemented within the following scheme of work:

- *Introduction:* the objective of the first step is to find out whether the topic of the activity, in the particular case, the water cycle, is familiar to students and what their ideas about it are. The educator introduces the water cycle to students by displaying photos, films, slides, etc. showing parts of it (precipitation, evaporation, surface-underground flows, etc.) or even, showing extreme hydrological phenomena, such as floods, droughts, tropic cyclones, etc. Discussion follows about whether phenomena are linked somehow or what the water cycle means to them, etc., by e.g. brainstorming or concept mapping.

[2] Vazeou S. (2002) "Water Cycle: Guide-research for the development of an educational material for Environmental Education", Master Thesis in Teaching Chemistry, National & Kapodistrian University of Athens.

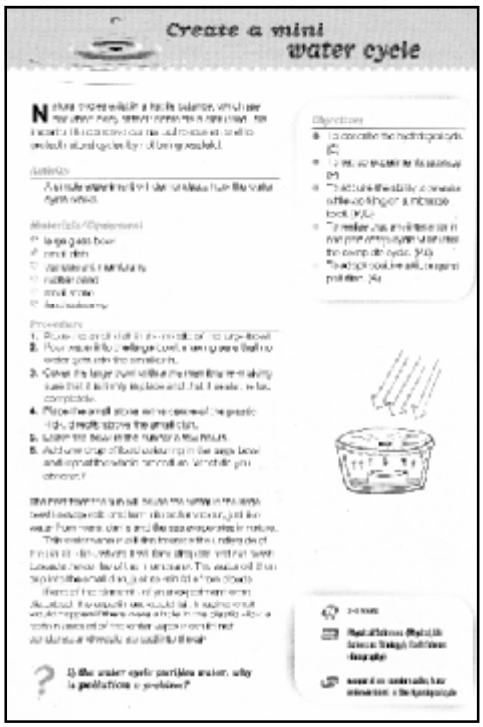
• ***Constructing*** the model of the water cycle, working in small groups and following the instructions given in the activity-sheet (see picture below).

• ***Identification*** & mapping of analogies between the model and the water cycle. Students identify the analogies between the elements of the model and those of the water cycle and sort them out in tables, such as the one following.

Model	*Water cycle*
Water in the big bowl →	*?*
Transparent membrane →	*?*
Drops on the membrane →	*?*
Food colouring →	*?*

In order to elaborate on the analogies, the educator should prepare appropriate questions, based on the objectives of the activity. Such questions might be: *"Where do the droplets on the plastic lid come from"? "What are the paths that the water follows in the apparatus"? "What is the "behaviour" of the food colouring and why"? "What could have happened if there was a small hole on the lid"? "In your opinion, what are the "limits" of the model you constructed?"*[2]

• ***Discussion-Conclusions:*** The next step includes students' reflection, expression of arguments and ideas, and discussion on the examined questions and issues. This part of the process is very important for clearing up students' misconceptions about the theme of the model (the water cycle in this case) and for observing how their initial ideas - from the introduction step- have evolved. At this point, the limitations of the use of the particular model should be discussed and examined as well.


Create a mini water cycle

In general, such a teaching method requires careful planning by the educator; although the educator is responsible for the choice of the analogy, students should participate actively in its completion and elaboration.
It should be clear that the use of models should not restrict the imagination of students and for this reason it is advisable to discuss with students the model and any improvements or alternatives they may think.

Taken from the educational package: "Water in the Mediterranean", Activity 3b.

C.6. Methods for Teaching Value-Laden Issues

In a world of limited and fragile resources, of conflicting values and competing interests of individuals and groups, an ethic of sustainability is necessary, since it is a moral concept rather than a scientific one, linked to the values of respect for nature, peace, tolerance, fairness, responsibility and human rights. Despite that sustainable development involves natural sciences, economics and policies, it is primarily a matter of culture: it is concerned with the values people cherish and their attitudes, as well as with the ways in which people perceive their relationship with others and with the natural world. Furthermore, sustainability requires the acknowledgement of the interdependent relationship between people and the natural environment, meaning that no single social or environmental objective should be pursued to the detriment of others. To this end, ESD can help the way human beings learn to co-operate, live in harmony with each other and with the rest of nature, developing the relevant values and attitudes.[1]

Values and attitudes towards the environment and environmental issues, according to considerable research of the last few decades, have been found to correlate significantly and positively with responsible environmental behaviour. Furthermore, research has demonstrated that values are related to the willingness to take environmental action.[2]

However, while values and attitudes are considered similar, they differ in many important ways. The differences between them are obvious even from the way they are defined:

> ***Values*** *are generally long-term standards or principles that are used to judge the worth of an idea or action. They provide the criteria according to which an individual decides whether something is good or bad, right or wrong,*
> *while,*
> ***Attitudes*** *predispose someone to respond in particular ways to an "object": an issue, a concept or a person. They are not so deeply felt as values and could change as a result of e.g. an experience.*

The main goal of teaching value-laden issues is not the strict teaching of a particular set of desired values aiming at their automatic and unconscious adoption by the students. Values must be developed by suitable teaching strategies. ESD should provide the opportunity for students to identify their own values, as well as those of others, to analyse their consequences and to change them, for the benefit of the environment, society and themselves, when they feel the need to do so.[3]

[1] UNESCO (2002) "Education for Sustainability, From Rio to Johannesburg: Lessons learnt from a decade of commitment", Paris.
[2] Franson N. and T. Garling (1999) "Environmental concern: conceptual definitions, measurement methods & and research findings", Journal of Environmental Psychology, 19, 369-382.
[3] UNESCO (2001) "Teaching and Learning for a Sustainable Future", Paris.

CHAPTER C

The challenge for the educators is to develop sound practices for dealing with value-related issues in an ethical and efficient way. Such practices would acknowledge the importance of values when teaching controversial issues in the framework of sustainable development. They would also provide guidance for adopting a positive and *optimistic* approach when dealing with controversial issues with an emphasis on using critical skills.

To this end, educational methods and approaches relevant to values should have as main objectives to help learners to:

- *identify and clarify their own values, as well as those of others;*
- *examine these values by using both rational thinking and emotional awareness;*
- *compare these values with those which seem most acceptable for the common good;*
- *recognise how values affect behaviour;*
- *communicate openly with others about their values.*[4]

It is interesting to note that the importance of including value-laden issues in the school curricula was stressed in the recent "EU Synthesis Report" regarding environmental education in the educational systems of the EU Member States. The Report suggests that general concerns about the environment and sustainability are taken seriously into account by education policy makers, in their attempt to integrate attitudes and values that would result in environmentally responsible behaviour by young citizens.[5]

Several methods for teaching value-laden issues have been developed and implemented. Among the most important ones are "*values clarification*" and "*values analysis*".

C.6.1. Values Clarification

Values clarification is a method aiming to encourage learners to clarify their thoughts, feelings and commitment, and thus enrich their awareness about their own values, clarifying the exact content and full meaning of them.

When planning values clarification activities it is very important to ensure that:

[4] UNESCO-UNEP, IEEP Series 39 (1994) "Environmental Education: Curriculum guide for pre-service teacher education in the Caribbean-Upper Secondary Grades", Paris.
[5] Stokes E., et al. (2001) "Environmental Education in the educational systems of the European Union" EC DG ENV.

- *everyone should think for him/herself,*
- *everyone should listen and respect other opinions,*
- *everyone should be able to express a personal viewpoint,*
- *questions in such educational practices usually have no simple "right" or wrong" answer.*

The latter is explained given that values clarification questions force students to ask themselves, e.g. "where do I stand?", as well as to accept their responsibility for their positions and defend or change them consciously in subsequent discussions about, e.g. "why do I think in such way?" [6] Within a values clarification method a "values grid" is often used, helping students to further explore their values and to define the degree of commitment to different ones. In the following paragraph a values clarification approach is given making use of a values grid.[3]

Activity: "Striving for water"

In the particular activity students are asked to express their ideas and feelings towards the issues of uneven water resources availability and consumption in various parts of the world. The educator, in order to assist them in clarifying their values on the issues, should prepare some relevant but more specific questions-statements, e.g.:

Statement A: *"All people should have access to adequate quantities of good quality drinking water".*

Statement B: *"The unequal distribution of water resources among regions on our planet is not the cause of water shortage in some countries but of mismanagement of water".*

Statement C: *"The developed countries should provide aid -financial, technical, etc.- to countries confronting water shortage problems for ever".**

It is obvious that statement A expresses the value of equality and addresses the "right for water", meaning the basic human need and right, as well as access to a critical amount of adequate quality water for human well-being. However, statement B refers to the value of equity and involves the value of sustainability, while statement C refers to solidarity and interdependence. However, statement C is kind of controversial, since it includes also the issue of the "limits" of assistance,

[6] Brunner W., et al. (2001) "Ecologic! Environmental Education: Methods and Examples", Keep Sweden Tidy Foundation.

* The suggested statements are indicative; the educators might use other, relevant to the issues of water availability, consumption and management.

reflecting the need of capacity building and creating the enabling environment in developing countries, in order to be, in the long term, self-reliable and self-sustained. Actually students could enrich their awareness on the values expressed in statement A, while B and C contribute to a further exploration and clarification of such values.

Students should be asked to carefully read the statements, to consider how strongly they agree with each one and explain the reasons why, writing their positions and arguments. Regarding statement A, they could express whether they are committed to contribute to actions in favour of this as well.

Furthermore, they should be asked to mark in the following table - "values grid", the box that mostly reflects their attitude.[3]

...about statement	1	2	3	4	5	6	7
A							
B							
C							

(1) *I have chosen my position freely.*
(2) *I have considered alternatives before deciding on one.*
(3) *I have thought carefully about positive and negative consequences.*
(4) *I am proud of my viewpoint.*
(5) *I have publicly stated my viewpoint to other people.*
(6) *I would undertake relevant action to support my viewpoint.*
(7) *I have taken actions to support my viewpoint.*

Each student should find out what his/her profile shows and means to him/her self. To this end, discussions in pairs or in small groups might follow, in order to present their profiles on the issues (based on the answers in the values grid). The educator could provide them with guiding questions, such as: "What does your profile reveal to you?" "How do your rankings differ from the ones of your classmates or from the average of the other students?", etc. It is very important that every student expresses him/herself. However, in a later step, they could make a list of actions to undertake themselves or in cooperation with other schools, with the local community (organisations, local groups, etc.), as well as with schools and groups from other communities (even from foreign countries) that could contribute to the endeavours for access of all people to enough and safe water.

C.6.2. Values Analysis

While values clarification could guide reflection on personal moral dilemmas, values analysis is commonly used when dealing with social issues that involve various people and viewpoints.

Values analysis is a method that facilitates students to examine other peoples' values, as well as their own. It requires the use of cognitive skills and especially those of critical thinking, in order to analyse diverse viewpoints on an issue.

Actually, values clarification and values analysis are strongly related methods, since both are implemented when teaching value-laden issues. Nevertheless, values analysis requires a kind of values clarification. However, they are different regarding the didactic objectives for which they are being used, as well as to the techniques they imply in general, e.g. values analysis requires getting students to make choices based on ranked values.[7]

Values analysis methods constitute mainly of the following activities:

1. Identifying the value question of the issue.
2. Gathering the facts relevant to the issue, assessing their relevance to the resolution of the issue.
3. Analysing the issue: exploring the causes and consequences of it, within the various stakeholders' perspectives.
4. Analysing involved stakeholders' interests and emotions.
5. Exploring the alternatives which exist for resolution.
6. Making a decision choice, based on the previous steps.
7. Adopt behaviour and action based on decision made.[2,3 8]

The previous could be implemented through a wide range of ESD methods. For instance, outdoor activities which are implemented very frequently in "environmental facilities" such as "nature" schools, protected sites, environmental centres, etc., provide students with access to values related to sustainability, such as social interaction, analysis of situations, study and research of alternative solutions, cooperation, fulfilling roles, etc.[6] Additionally, case studies, role-playing and theatrical games are often used for values clarification and analysis. These methods belong to the so-called "simulation" methods and they are presented in the next paragraphs.

[7] Giolitto P. (ed.) (1997) "Environmental Education in the European Union", Office of the Official Publications of the European Communities, Luxembourg.
[8] Kamarinou D. (1998) "Experiential learning in school", 3rd edition, Paper Graph, Greece.

C.6.3. Application of Values Analysis Through Simulation Methods

Simulation methods refer to cases in which a certain number of data are reproduced in another context. The simulated learning situation is provided to learners and the assumed "replica" usually reflects an issue and situation of the real world, linking the class with the environmental situations in reality. It has been found that simulation methods are quite compatible to the objectives of EE and ESD.[9] Studies have identified four types of simulation methods: role-playing, case studies, computer simulations and other games. The mode of presenting simulations is different in each of these methods, for example in case study activities the situation is presented mainly through selected information from printed materials, while role-playing requires improvisation on the role being played. Additionally, whereas case studies allow a look at the real world of immediate concern to the student, computer simulations allow various explorations into the world, answering questions such as *"what would happen if…"*.[3]

Case Study	Role-playing	Games	Computer Simulations
Observations on the real world & reflection	Structured group portrayal	Structured group representation	All data & decisions embedded in a mathematical representation

In general, these teaching methods stimulate students' interest and enjoyment, allowing for free expression and reflection. Simulation encourages a "look" at the real world in a structured setting, enquiring and promoting interdisciplinary treatment of the issue studied. Such learning practices provide opportunities for developing a wide range of mental skills, such as cognitive, language and communication skills -with an emphasis on the ones of decision making- and promote team work. Additionally, such educational practices involve the active participation of all students, and contribute to the understanding in depth of different social groups' values and perceptions.[7]

Nevertheless, there are some outstanding points that educators should be aware of when they implement such educational methods. For instance, very often the focus is shifted to the game itself, rather than to the activity's objectives and learning outcomes. Therefore, simulation methods demand adequate time and efforts by the

Educational researchers have proposed various techniques in order to have an effective students' involvement when implementing simulation methods, as far as the educator's attitude is concerned. The educators, inter alia, should:

- *move in class and stay away when students speak;*
- *be ready to accept to be silent for quite a while;*
- *act as the "devil's advocate", if needed;*
- *have a coordinating role, trying not to reveal their thoughts or judge values and decisions that students express.*[8]

[9] UNESCO, UNEP IEEP Series, No 26, (1988) "Environmental Education: a process for pre-service teacher training curriculum development", Paris.

educator in their preparation, implementation and follow-up as well. In general, the role of the educators in simulation methods is the role of the coordinator-moderator, keeping track of time, as well as encouraging students, since they have the "leading role" in the activity. However, the educator could also facilitate the students, at the end of the activity to elaborate and interpret their outcomes in order to reach the objectives of the activity (clarification, adoption of values, etc.).

C.6.3.a Case Study

In general terms, the case study method is a teacher-directed analysis of a given environmental issue. Such a method utilises mainly secondary sources of information, which are used by the teacher, at least initially, to aid students in developing awareness. The responsibility for finding and providing sources, such as printed material, guest speakers, films, video tapes, etc. in order to introduce students to the case, rests with the educator. Once students are informed about the issue, the educator leads them through its exploration, working in small groups.[10] The case study method provides the educator with a great amount of flexibility and control, since the extent to which the issue is dealt with is mainly decided by him/her. However, sometimes students could be involved in the selection of the topic of the case study or the selection of relevant information.

In the following text some basic tips for the implementation of the case study method are presented, using the theme "Water consumption & Water saving strategies".

Activity: "Water consumption & Water saving strategies"

- Initially, the educator could present the case of a town with water over-consumption and the resulting consequences, providing various sources of information: newspaper articles, reports of the responsible service, statistical data, etc. Such information could be about population statistics - decrease or increase, sources of water supply, water consumption in the various sectors - agriculture, tourism, domestic, etc. In addition, the educator could provide students with some general information e.g. about water-saving practices that have been followed in other towns, etc. but also about the driving forces leading to over-consumption versus the total lack of access to water for other groups of people. A short discussion could start about over-consumption and how it could be managed.

- Further on, students are asked to **work in small groups** on *"how the increased water consumption in the town could be reduced"*, identifying and proposing water saving practices for the particular case, using the information they were provided with. To this end, they should take into account the perspectives of the various types of consumers in town (e.g. middle-income inhabitants, high-income inhabitants, local authorities, hotel and golf course owners, schools, etc.) thinking about: *"what could they do about it"*, *"in which way"*, as well as "*what*

[10] UNESCO-UNEP, IEEP Series 29 (1994) "A prototype environmental education curriculum for the Middle School", Paris.

would be the implications (costs/benefits) of water savings to each of them".

- The groups should come up with a decision and propose a water saving strategy, after having exploring the potential alternatives. Groups are asked to present their decisions to the class, explaining their arguments.

- The educator facilitates the discussion in the groups, taking care that each group member expresses his/her opinion and feelings regarding the case.[7]

Such a method may involve students not only in the search of additional secondary sources of information, but also in elaborating ethical arguments for the reduction of over-consumption in the particular case. Moreover, if the teacher and students decide what primary information is needed, a kind of survey might be necessary, as well (see paragraph C.7.). For the particular topic, the survey would aim to obtain information about people's attitudes, experiences and values regarding water conservation.[8]

C.6.3.b Role Playing

While simulation methods, in general, provide opportunities for individuals to explore the various perspectives, attitudes and values regarding an issue, "role-playing" allows learners to "get inside" and "experience" the issue through the viewpoint of a particular "actor/player". Role-playing is traditionally based on asking the participants to portray certain well–defined persons (e.g. a local authority officer, a farmer, an ecologist, a consumer, etc.) in the context of a particular issue, a given situation with clearly defined values, seeking for a resolution. In some cases the characters to be portrayed could even be animals in the food chain or "spirits" of the forest, etc. and these cases are also known as "theatrical games", usually played by younger pupils.

The process involves multiple discussions, e.g. on the causes of the particular situation, the role of each character, the implications on the various stakeholders and the possible solutions. These discussions could provide excellent means of clarifying or even determining values and can offer opportunities for identifying appropriate activities in the field. The method allows and requires learners to explore the particular issue and the roles they assume and to interact with each other, in order to reach a decision.[8]

Role-playing can be implemented by using either small or large groups of students. In the small-group procedure, most of the students act as observers and their participation takes place after the players have come to a decision, for further discussion, comments and remarks. Large-group role-playing has, of course, the advantage of full involvement of all learners. Generally, this type of simulation requires research, good preparation by students as well as coordination by the educator.[9,10]

- It is very important for students to perceive in advance that role-playing is not a joke or a game for spare time. Specific guidelines or rules of procedure and a timetable are strongly recommended, to help students to keep on track.

- Once the role-playing session is underway no breach of rules is acceptable. To this end, the educator should not only encourage students to get involved but he/she should also clarify from the very beginning, and remind students, about the goals and the rules of the activity.

- Students should realise that they are to participate in the activity after having adequately prepared for it. To this end, information, statistical data, accounts, facts, etc. should be used by the role-players in order to appropriately represent the characters they portray, and not their personal opinions and attitudes.[11]

The following activity is given as an example of an organised role-playing game. It requires students to decide on and prepare a general plan of action for the integrated water resources management of their country. The suggested process presented in the next paragraphs includes the main parts of the implementation of the method, which are, namely:

- determining and addressing the **prerequisites** of the process;
- setting and clarifying the **objectives** of the activity;
- setting and clarifying the **scenario;**
- **roles assignment;**
- **processing;** and,
- **synthesis** and **summary** of the process.

Activity: "Integrated Water Resources Management"

The purpose of this role-playing game is the development of a national Strategy for Integrated Water Resources Management (IWRM) by a "National Commission" which could balance water demand and supply ensuring the sustainability of aquatic ecosystems and water resources.

- *Prerequisites:* Prior to the role-playing activity students should be familiar with the basic concepts linked to the topic. In the particular case these are concepts relevant to the principles of Integrated Water Resources Management (IWRM), including: water and land resources; the water cycle; management of natural resources; economic and social welfare; conservation of ecosystems; involvement of all parties concerned; public participation; dialogue; political will; sustainable development. To this end, the educator should prepare an "introductory" activity aiming to introduce students to the IWRM principles and practices, including a lecture (e.g. inviting guest experts), discussions (e.g. brainstorming), or even field visits (e.g. to institutions, centres, NGOs premises), etc. Students should also be provided with information relevant to water resources management, water demand and consumption.

[11] UNESCO-UNEP IEEP Series (15), "A Problem-Solving Approach to Environmental Education", Paris, 1985

- ***Objectives of the activity:*** The educator sets the objectives of the role-playing activity and discuss with the students about it. For example:
  - To identify the factors influencing water resources management;
  - To identify various involved groups;
  - To explore the variety of positions and interests of different stakeholders when it comes to water management;
  - To investigate the values behind human attitudes or activities;
  - To analyse and synthesise information;
  - To evaluate alternative options;
  - To participate in decision-making processes;
  - To be able to make and evaluate arguments;
  - To develop the skills of putting oneself in someone else's position;
  - To be able to compromise and settle on the most appropriate solution.

- ***Scenario:*** *A national "Commission on Sustainable Management of Water Resources" has been convened by the Government charged to identify, propose and develop strategies of water management to balance water demand and supply, ensuring the sustainability of aquatic ecosystems and conserving water resources. The Commission should organise a national public consultation involving various representatives. These representatives should come from the various key sectors such as: the Government (from Ministers to officers in the Ministries of Environment, Agriculture, Tourism, Development, etc.), local authorities, private enterprises (e.g. Industry, Tourism), utilities/water companies (public or private), associations (e.g. farmer associations), Academia, institutions, consumers, local community groups, ecological or environmental Non-Governmental Organisations (NGOs) active in the field, "pro-poor" groups, and, of course, individuals including local politicians, experts, professionals. By the end of the consultation a first draft Strategy or some guidelines of the Strategy should be developed.*

- ***Roles' assignment:*** students undertake the roles of the identified players. Furthermore, they are expected to conduct background research on the roles they have undertaken and eventually contact the relevant sector. They should develop their positions and statements based upon their research, reflecting accurate and up-to-date information. The educator should facilitate them, indicating and providing appropriate information sources.

> ***Farmers*** *might insist on more "rights" for using free or cheap water for irrigation;* ***ecologists*** *would demand measures to adequately secure the protection of wetlands; representatives from* ***tourism sector*** *would ask for more water in summer, the period when farmers need it most;* ***government representative*** *might not be willing/able to proceed with economic or legislation reforms;* ***pro-poor groups*** *will argue about the (in)ability of the poor to pay for the basics;* ***local politicians*** *will try for quick solutions in order to win in the upcoming elections, while* ***experts*** *may suggest too long term solutions or solutions that demand further capacity building, more economic and human resources, ….*

- *Activity process and rules:* in order to develop statements and arguments based on equal opportunities, mutual respect, etc. some guidelines and rules should be set up from the very beginning.

  For example, the chairperson/moderator of the consultation could determine the order in which representatives will present their testimony and he/she should communicate this order to all representatives prior to the process; each representative might have a specific time limit in order to present his/her position, along with supporting information, explanations, arguments, etc; following the testimony, the floor will be open to members of the Commission or observers for questions and discussions; during the working session other representatives should not interrupt the speaking representatives or they may intervene only if the Chairperson permits it, etc.

- *Synthesis/Summary:* the last part of the process involves a summing up of the various viewpoints and a conclusion with the final decisions.

  At the end of the activity the educator should stimulate a discussion towards topics which reflect the above mentioned objectives of the activity. Thus, students could reflect on questions such as:

  - *What are the characteristics and behaviour traits of the roles they enacted?*

  It is particularly important to focus not only on the way each role behaved, but on the basic characteristics and values that guided such an attitude.

  - *How did they feel, what did they understand and what do they think they learned from such an experience?*
  - *In case they wanted to repeat the role-playing game, what would they change?*
  - *In case they confront a similar but real situation in the future, would they behave and act in a different way and why?*

! In general, it is preferable to come up with a clear, positive and, as much as possible, realistic "solution" of the problem, taking all or most interests into account. The result should lead to hope; otherwise the role-playing activity leads to disappointment.

C.6.3.c ICT Packages, Computer Simulation Games and Other Games

The term "Information and Communication Technologies" (ICTs) means the application of information technologies (IT) in the learning process. It is evident that incorporating ICTs in teaching requires teachers to have the knowledge and skills to adapt accordingly the educational "package" that will be used as a teaching and learning tool. The educator should select the appropriate package to serve the didactic objectives of the lesson and to facilitate the learning process through interaction. ICTs basically include CDRoms with didactic material (games, simulations, models), as well as the Internet.

However, even though there are many advantages of ICT use there are also some "pitfalls" which educators should be aware of, such as:

- It can be counterproductive for the relationships between educator and students or even among students, especially when the activity is too difficult or too easy for students.
- Time can be wasted by students who are only interested in "decorating the title rather than completing the content". Such teaching tools are fascinating to students and can easily disorient them from the objectives of the activity.[12]

Educational games

A simulation could be provided to students with the use of an educational game, as well. A game is played with a predetermined set of rules and procedures, which are introduced by the educator. The game-playing method provides the educator with flexibility in terms of the fact that he/she could easily adapt it to the skills, needs and interests of a particular group of learners. Environmental games as tools of learning and acting could achieve learners' involvement with an enjoyable and memorable, most times, way. If they are adequately designed and played, these educational methods could stimulate interest and active participation, develop cognitive and communication skills, develop environmental attitudes and behaviours. Educational games are considered among the more "innovative" methods of learning and teaching.[13]

In any kind of game, there are rules to be followed, since its operational success in teaching and learning terms, demands that the educator ensures that all players have understood the content, the rules and objectives of the game. To this end, the teacher should clearly define the purpose and rules of the game from the beginning, as well as the roles and responsibilities of each player, individual or group, depending on the form of the game. In general, the role of the teachers might vary according to the type of the game e.g. table game, puppet show, etc. Generally, educators could be coordinators, co-organisers, time keepers and of course observers.
The general steps to be followed whenever a game method is implemented are given within the context of the following example of a puppet show.[3]

[12] Ross K. (2002) "Teaching Secondary Science: Constructing Meaning & Developing Understanding" The Cromwell Press Ltd.
[13] Vlastaris C. (2003) "The environmental games as tools for the Environmental Education in Elementary Schools", in "Designing and production of pedagogic material for the Environmental Education", Proceedings of the Pan-Hellenic Symposium organised by "Helleniki Etaireia for the Protection of the Environment and Cultural Heritage" and the Piraeus University (21-23 February 2003) Ed. by V. Psalidas.

Activity: The "living in water" performance

The activity calls for students to prepare a puppet or theatrical performance with the title: *"Living in water: how water creatures "feel" when water gets polluted"*.
The example presented below addresses Posidonia Oceanica populations (a seaweed).

1. Preparing: for deciding the scope and objectives of the activity, the procedure and rules of the game, the materials, time and space needed, etc. The teacher should explain the creatures that will be studied and "played" to the students, presenting them information about e.g. the *Posidonia*, its characteristics, habitat conditions, pollutants that affect *Posidonia* (deriving from factories, sewers, yachts or other activities), etc.

2. Defining and describing the rules and the procedure: the educator should explain to the students the objectives of the activity, how it will be done and decide jointly on the allocation of roles. Further on he/she should provide them with clear and more detailed guidelines, for example: some students will play the plants of *Posidonia*; others the marine animals which find shelter in the long leaves of *Posidonia*; others the toxic algae *Caulerpa taxifolia* (from the Caribbean) that kills *Posidonia*; others the pollutants that are discharged into the sea, etc. The students should focus their playing on how the lives of the plants and animals are affected if the pollutants continue to increase.

Furthermore, the game could be repeated using the case in which the local community and authorities take measures for the reduction of pollution in the particular water body.

The educator should ensure that the game provides the appropriate interactions between each player and the content as well as the appropriate interactions between the players. Some guiding questions that players should keep in mind when they prepare and play the game that might help are, e.g.: "why are the pollutants increasing?", *"what will happen if this growth is not controlled?" "how was life in the ecosystem before the appearance of the pollutants or before the toxic algae?" "how do the rest of the marine organisms in the ecosystem respond?" "why do they act in such a way?"*.

3. Assigning the tasks: in order to avoid too much input from the teacher, sometimes it is preferable that students undertake some of the responsibilities and tasks e.g. organisational arrangements or even finding further information about the Posidonia, Caulerpa, etc. themselves.

4. Playing the game…

5. Discussing: it is very important to allow sufficient time for the students to reflect and discuss about: the extent to which the objectives of the activity were achieved; how the different players felt after the play and why; what they believe they have gained or changed in terms of their knowledge and behaviour in the context of the topic of the game, etc.

6. Summarising the salient points from the activity by the educator in cooperation with the students.

C.7. Surveys

The survey method involves collection of primary data, data analysis, reaching conclusions and presentation. The survey is an "autonomous" learning method, though it could be conducted in the framework of a project or a problem solving process. In general, surveys are carried out through questionnaires, opinion sheets (opinionnaires) and interviews, to elicit information on individuals' opinions and attitudes towards the issue studied. Conducting survey research is a student-centred method, very effective for developing communication and investigation skills and raising awareness on a variety of issues.[1] Research has also shown that such an educational method contributes to the development of positive and responsible attitudes and behaviour towards the environment and environmental issues.[2,3]

Researchers agree on the importance of understanding the **theme** and the **objectives** of the survey in-depth before organising the activity. To this end, firstly, the educator should facilitate and prompt students to answer a number of questions, such as: "*What exactly is the theme of our research? What are the characteristics of the people that will be asked (the research "sample")? What could be the eventual factors of the theme? Which of these factors are we interested in investigating?*" [4] A survey usually requires communication and cooperation with experts, e.g. when formulating the questions or when conducting the statistical analysis of data, if needed. Group work is strongly recommended for the effective implementation of such a method, especially in the case of large samples or of a great amount of various data that should be collected and treated.

*Before implementing such a method it is useful to introduce students to the survey practice. A good starting point e.g. for an interview, could be the following: students in groups of four (interviewer, interviewee and two observers) perform an interview on the theme of the survey that they will conduct later on. Discussion will follow about the **order**, the **wording** of the questions, as well as the "**non-verbal communication**". The process could be repeated by the two observers in the "roles" of the interviewer and the interviewee and discussion will follow again on the same topics. In the end, two students could perform the interview process to the class and general remarks will be pointed out from all students.*[1]

In the following paragraph an example of conducting a survey is presented step by step, stressing the basic elements of the method.

[1] UNESCO-UNEP, IEEP Series 26 (1988) "Curriculum guide for pre-service teacher education in the Caribbean-Upper Secondary Grades", Paris.
[2] UNESCO-UNEP, IEEP Series 22 (1986) "Procedures for Developing an Environmental Education Curriculum", Paris.
[3] UNESCO-UNEP, IEEP Series 29 (1994) "A prototype environmental education curriculum for the Middle School", Paris.
[4] Kamarinou D. (1998) "Experiential learning in school", 3rd edition, Paper Graph, Greece.

Activity: "Interviewing the visitors of a beach"

This survey is part of a field-work activity, in which students investigate the characteristics of a coastal zone: flora, fauna, quality of water, presence of solid wastes, etc. as well as the "satisfaction" of people using the beach for recreation. To this end, students interview people at the beach to find out what visitors think about the quality of the water and the beach.

1. *Clarification of the survey's objectives*
The first step is the clarification of the survey's objectives to the students since these will guide the research e.g. the sample needed (age, place of residence, occupation, etc.) as well as the elaboration of the information collected. In the particular case, the objective is to collect information on the opinions of the visitors about the quality of water and about the status of the beach vis a vis their expectations. The questions should focus on relevant issues.

2. *Bibliographic research*
Bibliographic research is required in order to formulate the questions that will be posed to visitors. Articles of scientific or other journals, newspaper archives, etc. could be very useful. The bibliographic research could provide information not only on previous relevant research, but also on the environmental status and quality of the beach sometime ago and/or of other beaches with similar characteristics.

3. *Deciding and formulating the survey's tool*
At this point the educator and the students decide about the form that the research tool should have; in the particular activity the survey could be conducted through interviews. The bibliographic research could help in the formulation of the questions (also called items) used in the interview. The content validity* and reliability** of the items included should be taken into account as much as possible while expert advice (sociologists, psychologists, etc.) should be sought, if available.

It is important to make sure that the questions posed do not require a simple "yes" or "no" as an answer. More information could be obtained when answers have a **rating**, e.g. "*very much…", "very…", "almost…", "not so much…", "not at all…*" For example, in the specific survey instead of asking: "*are you satisfied with the status of cleanliness of the beach*" in which the answer might be "yes" or "no", students could ask: "*to what degree are you satisfied with the status of cleanliness of the beach: very much; very; almost; not so much; not at all?*"

* Content validity refers to the degree to which the survey's tool measures, precisely and sufficiently, what is going to be measured, in other words, it expresses the proximity between the expected result and the actual result we obtain through the construction of the survey's tool. The content validity of a questionnaire could be ensured if the items have been chosen in a systematic way, through the study of the relevant bibliography and after the judgment of experts in the field (Anastasi, 1997).
** The term reliability means "repeatability" or "consistency": a measurement is considered reliable if it would give us the same result over and over again, under the same conditions, each time (Anastasi, 1997).

4. *Data gathering*

This is the step where the interviews are conducted; students could record the conversations with the visitors using a tape recorder, in order to better elaborate the collected information in the next step. Firstly, they should note some special characteristics of the people interviewed, such as their age, nationality, occupation, etc. The latter is very useful in case they proceed in a more detailed and specific statistical analysis, in order to identify potential correlations between the opinions of the sample and its features (this kind of analysis is recommended to older students and it certainly requires the educator's expertise or facilitation by an expert).

5. *Data analysis*

The method used for the data elaboration (e.g. statistical analysis) depends heavily on the nature of the survey (interviews or various types of questionnaires). Usually, when conducting interviews, data elaboration involves sorting in tables and representation in diagrams, e.g. pie charts, histograms, etc. Finally, students make their conclusions based on their findings, e.g. to what extent people are satisfied by the condition of the beach; why; are there any differences between the opinions of older and younger people, etc.

6. *Presentation of survey findings*

It is very important to present the outcomes of the survey not only in class, but also beyond it, informing the wider public, as well as the public authorities. This could be done either by preparing and distributing a relevant brochure or report, or by organising appropriate events in which the survey will be also presented (usually when it happens to be part of a project, presenting it at the final phase of its implementation to the wider public, from school community to inhabitants and local authorities). Such an activity contributes to the raising of public awareness on the particular topic of the survey. Furthermore, students could mobilise the public, beginning with their classmates and families, to get involved in action for the protection of the beach from pollution and the maintenance or restoration of a good environmental status.

Suggested bibliography (for educators) for the development of a questionnaire and data statistical analysis:

- *Tuckman B.W. (1997), "Conducting Educational Research", Harcourt Brace College Publisher.*
- *Peers Ian S., (1996), "Statistical Analysis for Education & Psychology Researchers", The Palmer Press.*
- *Anastasi A. and S. Urbina, (1997) "Psychological Testing", Seventh edition, Prentice Hall.*

C.8. Working in the Field

Many educators link ESD, with the larger picture of educational reform and community development by designing programmes that combine research about real-life community issues with content-specific learning and citizenship action. Up to now, experience suggests that conducting outdoor activities, and further on, community, "real life" research, enhances in-depth understanding of science and concepts, learners' critical thinking, problem solving skills, as well as locus of control.[1] The latter is particularly significant as it refers to students' perception on being capable of doing something important in order to contribute in addressing a problem, protecting the integrity of the local environment or improving the quality of life of people or of a certain group. It is essential for students to be given the opportunity to develop such a sense of empowerment, so that they are prompted to become responsible and active. Thus, students' outdoors research can also be used as a vehicle for social transformation and environmental change. In other words, engaging learners in outdoor activities and "field work", contributes to the fulfilment of the fundamental goals of education for environment and sustainable development.[2]

Research has shown that pupils experienced in outdoor activities were found to have a stronger relationship with nature and exhibited better social behaviour and higher moral judgments than pupils who had not experienced such activities[3]. Additionally, research has shown the importance of educational activities that have a theme from and/or take place within the local environment of the students. Such a practice: a) stimulates students' interest and motivates their action, since it has a direct link to their lives and eventually, is more visible and it can be easily addressed by friends, neighbours and people of their immediate environment; b) facilitates the learning process, since the place of activity is familiar and provides opportunities for direct personal experiences. Researchers point out that EE programmes conducted in the field -and especially in the anthropogenic environment- had significant learning outcomes, in terms of developing research skills, critical thinking and students' empowerment.[4]

Outdoor activities could be field visits, trips, camps, etc. Working in the field offers the opportunity for direct experience with materials, phenomena, environmental and social problems. However, working with students outside the borders of a typical classroom requires careful planning of the activities and attention to avoid or adequately address any health and safety risks that might be faced. Several challenges have been identified by educators that need to be taken into consideration, such as:

[1] UNESCO (2001) "Teaching and Learning for a Sustainable Future", Paris.
[2] Mordock K. and M.E.Krasny (2001) "Participatory Action Research: A theoretical and practical framework for EE", The Journal of Environmental Education, 2001, 32, 3 pp.15-20.
[3] Palmberg I.E. and J. Kuru (2000) "Outdoor activities as a basis for environmental responsibility", The Journal of Environmental Education, 2000, 31, 4, 32-36.
[4] Kamarinou D. (1998) "Experiential learning in school", 3rd edition, Paper Graph, Greece.

- Organisational factors, e.g. the difficulty of supervising a large group of learners and providing them with assistance, whenever needed;

- Time needed to plan worthwhile field work;

- Cost of transport and accommodation, if required;

- Students' safety, e.g. working in a polluted/contaminated ecosystem.

Another outstanding point is that in order to be effective, field activities should be **task-oriented.** In other words, the purpose of the visit must be clearly defined from the very beginning and its content should be directly linked to community issues and/or problems. A simple excursion outside the classroom could be a waste of time and thus, the appropriate preparation by the teacher and students is absolutely necessary, including discussions about the nature and the scope of the visit –as to what to look for, the assignment of students' tasks, etc.[2] A field work activity is an ongoing process: it does not end upon returning to class. Follow-up work should be undertaken: compiling reports, setting up exhibitions and informing other students and parents, the local community, etc. about the findings and outcomes of the activity. In relevant research a high percentage of educators were found to use follow-up activities.[5]

The two commonly used methods for learning outside the classroom are the "*field teaching*" and "*field research*" methods. [1] The first approach is a more teacher-centred and expository method, while field research can be more enquiry-based and student-centred. The choice between these two approaches depends on the learning objectives and, to a large extent, on the characteristics of the students (e.g. age) and of the educators involved (e.g. background skills).[1]

C.8.1. Field Teaching

Field teaching is the traditional approach to teaching and learning outside the typical classroom. It involves taking learners to a field location and delivering a mini-lecture by an expert, a local authority officer, or the teacher himself. Students are expected to take notes, thus the opportunity for their input and reaction is limited. However, when field teaching is appropriately implemented it could contribute to developing observation and reporting skills. The latter could involve, among other skills such as: oral and written description based on notes, sketching, mapping, constructing, taking photos, etc. Such an approach is considered very useful, particularly when students are inexperienced or unfamiliar with a particular topic. The following activity is a typical case of field teaching.

[5] Farmer A.J and J.A. Wott (1995) "Field trips & follow-up activities: fourth graders in a public garden", The Journal of Environmental Education, (1995), 27, 1, 33-35.

Activity: Visit to the sewage treatment plant

In this activity students visit the sewage treatment plant of their area. This provides an excellent opportunity for teaching the wastewater treatment process, a sort of "difficult" topic in terms of learning outcomes and students' alternative ideas, as research points out. [6]

Before the visit

The educator should discuss with students and explain: the theme and the purpose of the visit; the tasks which students will undertake, and students' behaviour during the visit. Sometimes a preliminary visit by the educator himself at the particular place is recommended for obvious reasons, in terms of organisation.

During the activity

Students keep notes during the visit recording all of their observations. To this end, it is preferable for the educator to prepare a work-sheet, as a guide for the students, including some carefully chosen questions. The questions should derive from the objectives of the particular field teaching. For example, if the site of the visit is a man-made construction (e.g. factories, industrial plants, etc.) the questions might refer to the processes that are implemented in the plant, the purposes, the implications and demands of the function of the plant, etc. In the case of a visit to a site in the natural environment (e.g. forest, wetland, beach, etc.) the questions could be relevant to its fauna and flora, the particular characteristics of the landscape, its condition, eventual problems that occur (pollution, erosion, etc.), the relation between the particular site and the local community, etc.

An example of a work-sheet for the visit to the wastewater treatment plant is given on the next page.

Suggested follow-up work

Upon their return to school students should complete the work-sheet and elaborate the information collected. They could also present their work by making a poster or a model of the particular plant; by compiling a report or an article to be included in the school newspaper; by preparing a leaflet with the topic of the wastewater treatment plant in order to distribute it and inform the local community. Furthermore, they could display the outcomes of their activity in the framework of a school event, inviting their families, other schools, etc.

! Nevertheless, follow-up work is strongly dependent on the content and the objectives of the activity.

[6] Malotidi V. and M. J. Scoullos (2003) "Potable water & wastewater: a research-guide for the development of educational material for Environmental Education" International Symposium "Environment 2010, Situation & Perspectives for the European Union" Proceedings (Porto, 6-10 May, 2003) co-organised by UNESCO, EU DG ENV & University of Porto, 2003.

SEWAGE TREATMENT PLANT VISIT

1. How many major steps take place in the sewage treatment plant?

.....

2. What is the role and importance of each step?

.....

3. What is the objective of the final stage of the treatment, e.g. is it secondary or tertiary treatment? What is the intended degree of purification, e.g. 70% removal of BOD or of suspended solids and what is the actual result?

.....

.....

4. Is there any plan for further improvement of its performance? Why can it not reach 100% of purification?

.....

5. What is the geographic location of the plant? Can you explain why?

.....

6. What are the wastes produced by the function of the plant?

.....

7. What is the size of the population served by the plant?

.....

8. Does the treated water return to a fresh water body e.g. river or is it discharged to the sea?

.....

9. Is the treated water being used for a purpose, e.g. irrigation? If not, why? What is further needed (see answer in question 3)? At what cost? (students should seek for an expert's advice)

.....

10. What are the interactions/relationships between the function of the plant, the local natural environment and the life of the local community? Are there any reactions by neighbors, interest group, etc.? Why?

.....

11. ...

C.8.2. Field Research

The field research method is an inductive approach to learning, involving the tasks of observation, description and explanation with a problem-solving focus, which is actually the basic difference with the field teaching approach. When implementing a field research, students are required to use the skills of investigation, problem-solving and scientific explanation.

This approach comprises the following main steps: hypothesis on a question; field work to collect data in order to answer the question; hypothesis testing and accepting or rejecting the hypothesis; discussing and identifying possible ways to answer the questions using information gathered in the field.[7] An approach of field research is given below using the topic of *water use in industry and waste disposal systems used.*

Activity: Water & Industry

The activity includes a visit to a factory in the region where the school is located. The activity is **task-oriented**, since the students will investigate uses of water in the factory, as well as the waste disposal system and the eventual pollution problems in the surrounding area. Dividing the activity in three basic phases we come up with the following scheme of action:

Step 1, Pre-field work
Students should make hypotheses on *ways of water use* in the industrial unit that they will visit and on *the disposal of the factory's wastes,* e.g. whether the function of the factory and the ways that its wastes are discharged are compatible to the legislation in force. Furthermore, they should be prepared to investigate **eventual pollution problems** in the area caused by the factory's function. To this end, bibliographic research is very useful in order to obtain some background information on the research theme and objectives.

Step 2, Fieldwork
The specific field research could include activities for collection of data in order to answer the above mentioned queries of the research, by:

- observing the ways by which water is used in the various operations in the factory and recording observations;
- taking photos;
- interviewing: the workers on their assessments about eventual problems,
  the neighbours about eventual complaints,
  the authorities about e.g. eventual violation of rules or proposals for improvements,
  the experts working in the factory about the measures taken or needed to prevent pollution;

[7] Matsagouras E. (2003) "Interdisciplinarity in the School Knowledge", 2nd edition, Publ. Gregoris, Athens.

- observing the landscape where the factory is based, the flora and fauna in the areas where the plant wastes are disposed of or discharged;

- consulting environmentalists about the existing pollution problems in the area;

- taking measurements, if possible, of the water's temperature (and other parameters) upstream and downstream of the plant;

- taking samples of the area's flora and fauna for further examination in the laboratory, etc.

Step 3, Post- fieldwork

During this step students organise, classify and analyse the information collected. They should:

- fill in tables;

- make graphs;

- make comparisons between the state of the natural environment, regarding fauna and flora, upstream and downstream of the plant (i.e. far from and near the location where wastes are disposed of or discharged);

- testing initial hypotheses according to the findings of their fieldwork;

- compiling a report about the impacts of the factory's function on the local environment (or even on the life of the inhabitants of the neighbouring area), including proposals for measures to diminish these impacts. It is very important to present and underline also any positive aspects they have identified, such as efforts of the factory to clean-up its wastes, etc. in an objective manner.

More follow-up work

For instance, the organisation of a photography exhibition with the theme of "industrial pollution and ways to address it".

Students could ensure that not only their families and neighbours would be invited in the photo-exhibition, but also the people who work in the factory. This would be a great opportunity to stimulate a dialogue on what more could be done to protect the local environment and which could be the contribution of each group or stakeholder. Students could start the discussion presenting their report.

C.9. Educational Kits & Materials

Educational "kits" are acknowledged as a new tool for the implementation of programmes on environmental education, as well as on other interdisciplinary fields, such as intercultural programmes, human rights education, etc. Depending on their educational objectives and their target groups, they may include: booklets and activity sheets for students, multimedia and audiovisual tools, teacher curriculum guides (user's guides) and reference materials, objects and materials focussed on environmental issues or material of particular local and/or regional interest, etc. Educational kits could be produced by and found at Local Natural Resource Agency offices, Environmental Educational Centres, Environmental Non-Governmental Organisation premises. They can be shipped to interested educators and schools for a period of time.

Well-designed educational kits might be valuable resources for educators who wish to provide learners with an in-depth exposure to environmental issues critical for any environmental education programme designed to develop and enhance responsible environmental behaviour (Hungerford and Volk, 1990)[1]. Their use allows educators to have substantial flexibility, as well as control and opportunities for a variety of teaching methods. Teachers who responded to a relevant survey supported the view that educational kits are useful both as supplements to science curricula and as interdisciplinary teaching tools.[1]

An example of their use is the *"Nautilus Travels..."* project for environmental education, which is based on a network of infant and primary schools from coastal cities and towns, islands, etc. in the Mediterranean region.[2] The project aims at the development of knowledge on Mediterranean environmental and cultural issues, the development of skills and abilities and the adoption of positive behaviours and attitudes focusing on the protection of the marine environment. The network facilitates the collaboration among 2000 pupils from Greece, Turkey and Cyprus in 50 schools (as of 2002) and intends to gradually cover the entire Mediterranean. The "core" of the project is the *"Chest of Nautilus"*, which arrives to every school once or twice every year for a period of one or two weeks (depending on the number of students that participate in the Network). The chest contains a Teacher's Activity Guide, a Students' Activity Book, Educational Software, CD-Roms, a videotape, pamphlets and books about the Mediterranean Sea, a board game with a map of the Mediterranean, a camera, binoculars and many other objects, including a glass bottle for sea messages that are transported from one school to another…

In general, the educational materials for Education for Environment & Sustainability (EfES) and Education for Sustainable Development (ESD) usually include a theoretical part and a part on proposed activities for students. What ever their topics and methods are, in order to achieve the objectives of EfES/ESD and

[1] Roy M., Petty R. and R. Durgin. (1997) "Travelling boxes: A new tool for Environmental Education", The Journal of Environmental Education, 1997, 28, 4, 9-17.
[2] Psallidas V. et al. "Nautilus Travels…A Network for the Environment, Culture and Peace in the Mediterranean Sea for Children who are 4 to 12 years old" in the Proceedings of "Environmental Education: the Mediterranean Perspective-Workshop on Environmental Education", Athens, 15 December 2002, MIO-ECSDE, Athens, 2003.

deliver the desired learning outcomes, the educational materials as well as the educational kits for EfES/ESD, should be designed, prepared and implemented in a way consistent with EfES/ESD principles. In other words, they should not be "teaching" but "learning materials" aiming to facilitate the development of learners' creative and critical thinking, the development of responsible environmental behaviour and skills and stimulate learners' active participation in the endeavours for conservation of the environment and social welfare. Therefore, educational materials should not simply serve as "databases" or "sinks of knowledge", but as learning tools facilitating students' involvement in the learning process; promoting innovative teaching methodologies and methods; and using interdisciplinary and holistic approaches for the elaboration of the issues, emphasising the complex interrelationships between the environmental, social and economical dimensions of the issues.[3] Another outstanding point regarding the quality of the educational materials is that they should be designed and developed based on the principles of constructivism. However, this does not mean total independence of students within their activities (see also paragraph A.3.). The materials should provide an explicit framework for the elaboration and conceptualisation of students' activities. They should provide opportunities for learning experiences creating an enabling environment for students to perceive the framework or basic concept within which they act, as well as the impact of their activities.[3] To this end, the appropriate teaching methodology and the educator's initiative and action is undoubtedly of crucial importance.

[3] Matsagouras E. and S. Helmis "Production of educational material: Theoretical assumptions and technical standards" in the "Designing and production of pedagogic material for Environmental Education" Proceedings of the Pan-Hellenic Symposium organized by "ELLINIKI ETAIREIA for the Protection of Nature and Cultural Heritage and the Piraeus University (21-23 February 2003). Ed. by V.Psallidas, Athens, 2003.

Chapter D – Preamble

This last chapter addresses two methodologies widely used within EE and ESD: "problem-solving" and "projects", also known as "umbrella methods". These methodologies offer important frameworks that can include and integrate the various methods analysed in the previous pages.

The chapter closes by presenting the ways by which a single topic, the "water cycle", could be implemented using the different methods explored previously.

CHAPTER D

D.1. The Problem-Solving Approach

The problem-solving approach has its roots in the 70s. The development of environmental education (EE) during the 70's was closely linked to the overall demand of raising public awareness on environmental issues (pollution, overpopulation, etc.). The importance given to finding solutions to these problems was reflected in the EE field mainly through the "problem-solving" learning and teaching approach.[1] The problem-solving approach is not restricted only to environmental issues. It is based on a wider educational objective of preparing citizens to be able to address and solve problems.

It is widely recognised that problem-solving learning is used to engage students in their own learning process. This is based on several cognitive theory concepts, among which the following two are the most prominent: firstly, learners should work on "real" problems perceived as meaningful or relevant and secondly, people try to fill gaps when presented with a situation they do not readily understand. Engaging people in working on real-life problems is also linked to the transition from a traditional educator/school-centred teaching approach to more learner/society-centred educational approaches. The problem solving method is very commonly referred to as *"umbrella-method"* as it involves various teaching methods and techniques, such as lectures and discussions, cooperative learning, outdoor activities: experiencing and investigating, surveys, and eventually, others.

The educator's role:

Not a commentator or director!
The educator should:

- *ensure that students acquire valid and updated information on their own initiative & facilitate them in finding appropriate sources,*
- *encourage students' initiatives and facilitate group-work,*
- *assist in the implementation of the various activities,*
- *create a positive and open group atmosphere,*
- *explore his/her own practice on how to organize educational experiences, enabling a problem solving approach.*[3]

Using problem-solving as a context of learning is also known as: "*Problem Based Learning-PBL*" and is characterised by three basic elements: problem-solving, self-directed learning and students' cooperation (usually in small working groups).[2]

Psychologists and education researchers argue that PBL promotes mental procedures, such as cognitive development, contributes to the development of a variety of skills and stimulates students in order to undertake initiatives and actions.

[1] Papadimitiou V. (2002) "Problem solving in Environmental Education", in "Environmental Education: the Mediterranean Perspective, Workshop on Environmental Education", Athens, 15 December 2002; Proceedings of the meeting", MIO-ECSDE, Athens.
[2] Brunner W., et al (2001) "Ecologic! «Environmental Education: Methods and examples", Keep Sweden Tidy Foundation, 2nd edition.

Such an educational methodology engages them in dealing with real life problems.[3] More specifically, PBL seems to facilitate learners to:

- handle information and knowledge in a meaningful context and broaden their understanding of concepts;
- develop problem-solving skills;
- enhance self- empowerment;
- develop the skill of cooperation and cooperative working; and,
- understand and control their own learning process.[3]

In the following paragraph a general framework for a problem-solving strategy is presented, with orientation towards action, including the steps of: exploring our knowledge on the problem; investigating the problem through time; identifying possible solutions; assessing the alternative solutions; and acting. [4, 5, 6]

What is an Environmental Problem?

Every change in the environment is not necessarily an environmental problem. A change in the environment might be good, bad or neutral and it might result from natural or man induced phenomena.

An environmental problem is a change that threatens, or there is evidence that it may threaten in the future, the environment, its quality and its integrity, including humans.

Most environmental problems have multiple solutions. The best of all solutions is their prevention!

[3] "Teaching about environmental issues", Module 3, The Essentials of Environmental Education for Pennsylvania, (ed. by Johnson P., Rosenberg L.), Pennsylvania Centre for Environmental Education.
[4] UNESCO, UNEP, IEEP (1989) Series, 29, "A prototype Environmental Education Curriculum for the Middle School", Paris.
[5] Flogaitis E. (1998) "Environmental Education", Ellinika Gramata, Athens.
[6] UNESCO (2001) "Teaching and Learning for a Sustainable Future", Paris.

CHAPTER D

A Framework for the Problem-Solving Methology – An "Action–Oriented" Approach

1. What do we know?

1. Students discuss and define the topic which could be introduced by the educator or chosen by themselves. The students exchange relevant information and experiences among themselves and with their educator or even an invited "expert". Questions that should be answered at this step might be: *"Does everybody know/understand what the problem is? What do we know about it?"*

2. Exploring the problem

2. At a second stage, all the possible causes and eventual impacts of the problematic situation are explored. Questions that should be answered are: *"What causes the problem? By whom? At the expense of whom? In what way? What are the various (environmental, economical, social) consequences of the problem? Is it a new or an old problem?* Causes and impacts should be investigated **through time,** examining what caused the situation some years, or even decades, ago and what causes it nowadays, as well as what was its impact in the past and what is it now. If more that one problem occur, it is preferable to divide them into sub-groups, which will be studied separately by different students or teams of students, in close cooperation and communication with each other.

3. Identifying solutions

3. Identifying possible solutions comes next. All possible solutions and alternatives are identified and proposed, taking into account their "positive" (advantages) and "negative" (disadvantages) aspects.

4. Assessing the alternative solutions

4. The solutions proposed by the students' teams or by students individually, are gathered and presented (e.g. on a flip chart). Students should decide jointly which option they would follow. To this end, they should assess all alternative options, considering the importance, attainability, advantages/disadvantages, involvement of parties, etc.

Acting!

5. The students act upon the solution they decide in the previous step, as well as on the plan and guidelines that this involves, trying to stimulate the participation of the parties needed to be involved.

The Action Process

Step 5, the "action" stage, is probably the most important one, since it is the one that differentiates the "problem-solving" approach from that of "field research". The core and key-feature of problem-solving learning is the action undertaken, to the extent possible, by the students for the confrontation and solution of the problem, in cooperation with other "partners" like schools, families, local community, NGOs, social groups, etc.

At this point, it is perhaps useful to refer also to the psychological models for interpretation of people's *intention to act* (Hines et al., 1986/87) and *environmental* and/or *citizenship responsible behaviour* (Hungerford & Volk, 1990) (see Chapter A.2.). These models indicate that in order to stimulate students' intention to act, as well as to facilitate them during the action process, they should know in depth the problem and the possible action strategies. Furthermore, they should be encouraged to develop their potential and skills (locus of control and self-efficacy). Thus, students that participated in problem-solving activities, after the completion of the programme, stated that they *"believed they learnt about action strategies", "can contribute to decision-making in their local community", "are responsible about the issues of their community"* and *"could act more effectively when they work jointly"*.[7] Therefore, it is of high importance for students to be introduced to the various action strategies and, in particular, it is very critical for them to act cooperatively. For instance, an action strategy at the local community level could include the following three basic objectives of action: *awareness raising, lobbying,* and *events' organisation.*

a. Awareness raising

This may include a series of actions such as:

- Informing parents, other schools, the local community, etc. about the problem.
- Contacting local newspapers, journals, radio stations, local TV Channels presenting the problem.
- Preparing a comprehensive and "attractive" leaflet or a poster about it.
- Organising relevant events, such as exhibitions, meetings, etc.

b. Lobbying

For such an action strategy the mode of expression of students is very important, particularly when they are addressing local authorities, academia, etc. To this end, it is recommended that they not base their presentation on ironic or negative comments and that they avoid being aggressive. Firm views should be expressed in a polite and objective -to the extent possible- manner. Students should clearly

[7] Kamarinou D. (1998) "Experiential learning in school", 3rd Edition, Paper Graph, Greece.

present their arguments on their proposals and recommendations about the problem. Therefore, they could also take into account whom they are addressing and adequately underpin the arguments used for their initiatives (e.g. whether these actions would have economic or social benefits in the long-term, etc.)
Additionally, other actions that could be undertaken are:

- Writing letters to relevant stakeholders - local authorities, scientific community, institutions, etc.

- Presenting orally in small meetings the problematic situation, including its causes and impacts, and proposing solution strategies to key persons, stressing the importance of the implementation of existing legal instruments, etc.

- Participating actively in public hearings and other relevant events or pressing for organising such initiatives.

c. Organising particular events

This may include a series of actions such as:

- Meetings, where experts are invited.

- Photo, poster, drawing, construction, etc. – competitions.

- Excursions.

- Festivals, e.g. music concerts, theatrical events, bazaar of environmentally friendly products.

- Campaigns.

- Boycotts.

All the previous should be implemented according to a number of criteria about the "nature" of the particular issue, the objectives of the action-strategy, the human, technical and economical resources and the people involved in the action process and most of all the degree of seriousness and urgency of the environmental problem and the relevance of the students' actions in solving it.

Activity: "Where does drinking water come from?"

In the particular activity students are asked to investigate potential problems that exist in the water supply system of their area (community/town) and propose proper solutions. Using the previous framework for a problem-solving approach we come up with the following steps of work:

STEP 1 WHAT DO WE KNOW about the origin and distribution of freshwater in our community?

Students discuss in small groups and exchange information about the local water system, while a "secretary" in each group keeps notes. After discussing, they list all the relevant issues raised and the problems which they think the water system suffers from. They should firstly be provided by the educator with some basic, guiding information. They could also conduct a bibliographic research concerning the purpose and the function of a water supply system and common problems in other areas.

STEP 2 EXPLORING THE PROBLEM/S of the local water supply system

At this stage students carry out activities in order to identify the problems that occur in the water system and explore the causes and impacts on natural resources and community life. They work in groups, allocating to each one specific tasks, such as ***bibliographic research****: investigating the past situation and problems of the water system;* ***interviewing*** *the people working in the water supply system, in the water company of the community;* ***interviewing*** *local people to find out their opinion about the quality of water, the water system and eventual relevant problems they might confront;* ***field-visits*** *to the water treatment plant, to the aqueduct (if there is any, especially in small communities) or even to the dam (for bigger towns) where the water is collected and stored;* ***field-work*** *for investigating eventual problems (e.g. leakages in the town's streets, damaged pipes, etc.).*

STEPS 3 & 4 IDENTIFYING, ASSESSING & DECIDING the most appropriate solution

Taking as an example the case in which students have identified "leakages" as the basic problem of the water system and having explored its causes and impacts in the previous steps, they now try to find possible solutions–strategies to adequately address the problem. In order to facilitate the "solution-finding process", the educator should encourage them to draft a plan of action, in which they should respond to questions such as:

"What should be done in order to mitigate the leakages?"
"By whom?"
"When?
"In which ways?"

Brainstorming, discussions, bibliographic research, expert advise could help in finding out creative but feasible and alternative solutions to the above questions (Step 3). Then students prioritise the solutions in order of importance, attainability, effectiveness, feasibility, etc. elaborating on the advantages and disadvantages of each solution-strategy. By the end of this phase they reach Step 4 which is the identification of the most suitable solution, taking seriously into account its feasibility and the role the various parties could play in implementing it, e.g. the role of inhabitants, local authorities, community groups, school community, even the role of the particular environmental education group of students, and others. To support the selected solution they draft and further develop an "action plan", facilitated, if needed, by the educators and experts, in order to explain, to the extent possible, details of the solution. During steps 3 and 4, a *"check list"* could be used, in order to identify and categorise the possible actions by the various parties. An example of this is the following **general scheme:**

STAKEHOLDERS	Individuals	Environmental groups (NGOs, etc.)	Government	Private sector (Business, Industry, etc.)
Individuals	Educate yourself Be informed/aware Change lifestyle Send letters to the media Teach and/or inform others Participate	Provide information Persuade /raise awareness Advertise Create educational materials Stimulate & coordinate programmes	Regulate Tax Provide incentives Provide information Create educational materials	Provide jobs Advertise Make/limit options
Environmental groups (NGOs, CBOs, etc.)	Join – Support Write letters Elect leaders Become a leader Influence groups' agenda	Build coalitions/ partnerships, etc. Persuade Inform /exchange of experiences, knowledge, etc. Create network	Research Lobby Regulate Fund Change tax status	Research Donations Grants Provide jobs Endorsements
Government	Vote Send letters Run for office Raise funds Participate in public hearings	Research Monitor Lobby File lawsuits Endorse Participate in public hearings		Provide jobs File lawsuits Lobby Advertise
Private sector (Business, Industry, etc.)	Buy / boycott products Send letters Invest Report violations Draw media attention	Monitor Exploring ways of cooperation and synergy	Create incentives File lawsuits Fine Regulate License	Competition of price and quality File lawsuits Share knowledge/ technology Cooperate

STEP 5 ACTING

Students work based on the action plan they agreed upon during the previous phase. For the particular case of leakage problems, the action plan could include activities such as: setting up of task-groups undertaking the mitigation of leakages in specific parts of the community (mainly the parts that suffer most); writing reports regularly and reporting to the responsible persons working to the water system; writing letters to politicians or local authorities; informing local press and media; contacting experts and technicians in order to estimate the cost of the leakages in the particular area, as well as informing local community about this; raising awareness and involvement of schools, parents and other influential sectors of the local society, in order to increase the effectiveness of the action plan; etc.

Furthermore, after the completion of the students' action they could reflect and "examine" the outcomes of their action and their individual contribution as well. For example, such a group assessment might include the following questions:

- *To what extent were participants active, passive, neutral, or, perhaps, dominant?*
- *Has everyone played an active role and contributed to solving the problem?*
- *Has the problem been solved? To what extent?*
- *What more should be done?*
- *Who else could have been involved?*

Regarding students' reflection on their personal involvement and contribution – individual assessment:

- *Students could state what they believe they have contributed to the work*
- *Students are grouped in random pairs and allowed to comment on each other's contribution, or*
- *Each one writes down the time they believe they have devoted and the actions they believe to have contributed to, etc.*

D.2. Some Important Points When Carrying Out a Project

The "project" constitutes a widely used learning and teaching methodology, also known as an "*umbrella-method*". Projects have clearly defined goals, but the means of implementation may change according to the needs and opportunities offered. Such an approach requires the learners' **initiatives** and independent investigation.[1] Nevertheless, it could involve the local community and mobilise its resources. Projects, being **student-centred** and **an experiential learning approach** by nature[1], are based on the initiatives taken by the students. They choose the topic of the project, the means and processes that will be followed, and they organise themselves to **work in groups.** However, facilitation and guidance by one or more educators is, in most cases, absolutely crucial. In general, in the case of implementing a project in school, the educators should try to integrate the school curriculum objectives with the students' interests, needs and potential, and also consider the school's structural capacities.[2]

Within a project almost all kinds of methods of EE, EfES and ESD could be included and combined.

International bibliography suggests the following general phases in order to efficiently and sufficiently implement projects. [1, 2, 3, 4, 5]

[1] Frey K. (1986) "The Project-Method", Greek Edition, Publ. Kyriakides, Thessaloniki.
[2] Matsagouras E. (2003) "The interdisciplinarity in School Knowledge", 2nd edition, Publ. Grigoris, Athens.
[3] UNESCO, UNEP, IEEP (1988) Series No 26, "Environmental Education: a process for pre-service teacher training curriculum development", Paris.
[4] Kamarinou D. (1998) "Experiential learning in school", 3rd edition, Paper Graph, Greece.
[5] Michailides M. (2003) "Group environmental activities, projects and cooperation", guide-booklet for youth and groups' advisors, General Secretariat for Youth, National Centre for Social Research, Athens.

1st Phase: Choosing the topic
Defining the topic & the general objectives of the project

↓

2nd Phase: Setting the framework
Objectives & activities, Group Setting, Timetable, Group work planning- Allocation of tasks

↓

3rd Phase: Implementation
Group & individual work, Elaboration of findings/outcomes, Synthesis of group work

↓

4th Phase: Presentation
Oral, Written, Artistic,
Informing local society, Events

↓

5th Phase: Assessment
Work assessment and group assessment

1st Phase: Choosing the topic

Students decide jointly on the topic of the project. Thus, the topic should be compatible with their interests and needs. It is extremely important to provide freedom for students to take their own initiatives from the very beginning. To this end, every student should be encouraged to express his/her opinion and ideas. However, in most cases, this does not occur automatically, but rather requires a series of activities, e.g. meetings, lectures by experts, etc., or the use of a current topic of particular local importance. Students discuss about the various environmental issues and the relevant concepts and make suggestions about themes, while the educators encourage the process, stimulating interests and identifying their ideas, e.g. by concept mapping, brainstorming, etc. on the various issues.

Topics of "priority" are considered those which require an interdisciplinary approach for their implementation and facilitate the development of responsible environmental behaviour, attitudes and values relevant to the sustainability notion.

At this phase the students communicate with various persons within the school community (e.g. the school director or principal, educators) or of the local community (e.g. social groups, local authorities, etc.) in order to define who else will participate in the project, depending on the project's theme.

2nd Phase: Setting the framework

During this phase the students and educators should jointly decide on a series of parameters, such as:

"What are the objectives of the project?"

"What basic activities are going to take place & what are their objectives?"

"Who is going to participate?"

"What is the needed time for the implementation of the activities and what is the available time for the project?"

"What are the necessary and available resources and facilities for the project (material, equipment, space, etc.)?"

"What is the timetable which is going to be followed?"

"What is/are the expected outcome/s?"

Students decide and develop the plan of work and the timetable of the project, ensuring that it is flexible, in order to cope with unforeseen circumstances. To this end, they clarify the particular principles and terms of implementation that will be

followed throughout the project's duration, both within individual and team work: the working groups are set and the activities-tasks are allocated to each one; the task duration of each group is defined, e.g. within a week; provisions are taken in order to replace a member of a group, if the need arises; the minimum means and resources are identified (time, equipment, and regulations), etc. It is also noteworthy that there is no point in distinguishing between "manual" and "mental" contributions to the project: they are both important provided that all students know and understand the entire project strategy.

3rd Phase: Implementation

The project might involve various methods (depending on its topic and objectives), such as: bibliographic research, experiments, interviewing of experts and local stakeholders, surveys, field visits, research, etc.

Once a group has completed its scheduled activities the students should elaborate on their findings and outcomes. They gather, classify and analyse the information collected by e.g. the questionnaires and surveys, the field and bibliographic research, the experiments, etc. and they build upon their findings and make tables, graphs, reports, etc.

It is important to elaborate information and reach conclusions taking into account and integrating the various dimensions and parameters from all sectors: environment, economy, society, technology, culture, etc. Exploration of the various viewpoints, attitudes and actions relevant to the topic, is of equal importance.

At the end of the implementation phase students should formulate their conclusions and report their proposals. This should be done jointly by all groups, compiling their findings and formulating their final positions, recommendations, suggestions.

It is very important that all students understand not only their particular role and expected contribution (individually and collectively), but also the entire structure and main objective of the project throughout all its phases.

4th Phase: Presentation

The presentation of the work done by the students is a very basic part of a project. It requires coordination and careful preparation for the appropriate synthesis, organization and promotion of the outcomes. Unfortunately, educators often do not bestow the appropriate attention to this last phase, usually due to lack of time. However, they should manage efficiently the time allocated and urge and coordinate students in order to meet the deadlines.

Students should be encouraged to present their work properly, since the presentation itself could be an action towards the sensitisation and awareness raising of other students, educators and families, other schools, local society, media, etc.

The presentation may be oral, written or performance-based and may: take place within school events, e.g. a photo, poster or painting exhibition; be combined with a theatrical event; be on the form of a small newspaper, leaflet, or even, an article in the local press; etc.

Nevertheless, a publication inclusive of illustrations (e.g. photographs) is always a strong component of the final presentation and a good souvenir with a significant impact on the students.

5th Phase: Assessment

Assessment could be conducted on the outcomes of the project and on the project itself, as well as on the manner (efficient or not) in which the groups worked. In any case, the assessment of a project should be carried out as stipulated in its objectives, as set in the beginning. The assessment of how groups worked could be conducted either in the form of self-assessment by each member of the group, either at personal or group level, (see also page 95) or by the educator.
Some criteria for the assessment of a project are the following:

- **Students' interests,** meaning the degree to which the project corresponded to the interests of the students and expanded and enriched them.

- **Participatory processes,** meaning the degree of active participation of each student in all the project phases and also, the degree to which the groups worked cooperatively.

- **Interdisciplinarity,** meaning the degree of involvement of the relevant and necessary disciplines and domains in the exploration of the project's topic.

- **Social dimension,** meaning the degree of active involvement of the local community in the project, as well as the degree of connection of the "final product" of the project to the issues and concerns of the local society.

- **Project outcomes** and "products" in relation to its objectives.

- **The promotion of human relationships** as they were developed through out the project.

Experience has shown that it is very important to include regular "*info-breaks*". These breaks, at regular intervals, may serve as a "compass" facilitating the guidance and coordination of the activities. As students have stated during various projects, breaks are needed for:

- *sharing information between the groups on the progress of each other' work,*

- *scheduling the next steps,*

D.3. An Activity Implemented Using Different Methods

- *making known some first results and reviewing,*
- *deciding eventual change in direction or in the rhythm of work or in the allocation of tasks,*
- *re-planning of timetable, if needed, or reaffirming it.*

In the following pages an attempt is made to present the ways by which the theme of the "water cycle" could be introduced within a programme of EE, EfES, and ESD using different teaching methods, as they were presented in the previous chapters. The main objectives of the activity are, for students to comprehend the phenomenon of the water-cycle and the human interventions within it, as well as to adopt an informed attitude and behaviour for respect to water, protection of water resources and against water wastage and pollution. The relevant key-concepts to be studied could be: *precipitation, evaporation, condensation, percolation, water flow/water bodies, groundwater, pollution, acid rain, annual rainfall, climate, human interventions in the water cycle, social responsibility, integrated management of water resources, as well as understanding the deep cultural roots of our attitudes towards water, water as a right, water and health, etc.* The methods used for implementing the activities on this topic are the following: brainstorming, concept mapping, bibliographic research, modelling, experiments, use of ICTs, role-playing, surveys, field research, problem-solving and projects.

Method	Activity	Key-points of the methods
Brainstorming	**"Water cycle brainstorming"** *Write down, in the centre of a piece of paper, the words "water cycle" and around it every word and phrase which comes to your mind. You have 10 minutes, but don't think about it too much!*	Brainstorming is a good starting point, regardless of what the results may be, in order to identify students' knowledge and ideas about the theme, as well as to stimulate interest.
Concept mapping	**"Construct a water cycle map"** *Make a concept map about the water cycle. Try to include links with human interventions and their impact on the water cycle.*	Concept mapping offers the possibility to acquaint the students with the concepts and issues linked to the water cycle. It could be used for pre-testing, as well as for post-testing processes.
Bibliographic Research	**"The Mediterranean water cycle & climate"** *Find out information about the relationship between the water cycle and climate, in particular the Mediterranean climate, and the water cycle's peculiarities in the Mediterranean region.*	Bibliographic research is quite useful in order to gain knowledge on specific topics, such as the linkages between climate and the water cycle, particularly in the case of the Mediterranean. This is very difficult to accomplish using other methods. Books, scientific journals, newspapers, encyclopaedias, internet websites, documentaries, movies, etc. are some of the possible available sources.
Modelling	**"Create a mini water cycle"** *Construct a model of the water cycle using simple equipment (see subchapter C.5) to demonstrate how the water cycle "works".*	The construction of the model facilitates students to use the acquired knowledge and develop the appropriate skills in order to "concretise" analogically the water cycle.
Experiments	**" Percolation"** *Set up a filtration apparatus and experiment by conducting filtrations of different solutions (see sub-chapter C.4)*	Conducting experiments prompts students to study and gain first-hand experience "discovering" on their own the significant processes.

Method	Activity	Key-points of the methods
ICT Packages	**"Simulating the water cycle"** *Many interesting educational computer packages have been produced that include the water cycle and issues related to it.*	Educational computer packages could provide a great opportunity to "view" the water cycle and its "movement" in its totality, allowing at the same time the students to interact by interfering with the cycle.
Role-Playing	**"The story of a drop of water"** *Organise a role-playing game where the students act as water drops. Imagine and try to include all of the possible journeys within the water cycle, giving emphasis to the "difficulties" they face due to human activities.*	Role-playing offers two very important elements: the opportunity to improvise and transfer to others in a creative way the knowledge gained from previous activities and methods concerning the water cycle.
Survey	**Conduct a survey on what people in your community think about the water cycle"** *Make a questionnaire that will provide information about the people's ideas on water and the various aspects of the water cycle. Try to include not only general questions about its phases but also, about the impacts of human activities, giving emphasis on what is happening in your local environment.*	A survey offers the opportunity to students to collect their own "original" (primary) data on people's attitudes and knowledge about the water cycle, to work on and draw conclusions.
Field Research	**Investigate eventual disturbances in the water cycle within your community"** *Related problems could be: pollution of water bodies, deterioration of water quality, water shortage, changes in the micro-climate of the wider region (season irregularity), depletion of groundwater, acceleration of erosion, etc. The compilation of a relevant brief but concise report is the main objective and task of the activity.*	Field research gives the opportunity to students to actively work on the topic, using a variety of tools. The educator's role is very important in such a method and it requires continuous coordination and facilitation, as well as a carefully designed work plan, in cooperation with the students.

Method	Activity	Key-points of the methods
Problem - Solving	**"Acting for the benefit of the water cycle"** *After conducting the necessary field research, identify the main problem related to the water cycle in your area, propose a solution and participate actively in its implementation.*	The problem-solving methodology goes beyond the necessary field work, focusing on a single problem and using a combination of other methods in addressing it. The main task is to identify and propose a solution–strategy and act accordingly.
Project	**"Travelling through the water cycle"** *Work in groups focusing on the different aspects of the water cycle, using all possible tools and methods, in order to compile a hand-book with the theme "The water cycle in our area".*	The educator should prepare with the students a work plan, as a guide of action, which should include the objectives and desired outcomes of work.

Abbreviations - Acronyms

EE: Environmental Education

EfES: Education for Environment & Sustainability

ESD: Education for Sustainable Development

ICTs: Information and Communication Technologies

UN CSD: United Nations Commission for Sustainable Development

UNECE: United Nations Economic Commission for Europe

UNEP: United Nations Environment Programme

UNESCO: United Nations Education, Scientific and Cultural Organisation

REFERENCES

- Anastasi A. and S. Urbina (1997) "Psychological Testing", 7th Edition, Prentice Hall.
- Ballantyne, et al. (2001) "Programme effectiveness in facilitating intergenerational influence in environmental education: lessons from the field", The Journal of Environmental Education, 2001, 32, 4, pp.8-16.
- Basile C. (2000) "Environmental Education as a Catalyst for Transfer of Learning in young children" The Journal of Environmental Education, 2000, 32, 1, pp. 21-27.
- Bloom, B. S., Englehatt, M D., Furst, E. J., Hill, W. H., & Krathwohl, D. R, (1956) "Taxonomy of educational objectives: Handbook I Cognitive domain" New York, Wiley.
- Brunner W., et al. (2001) "Ecologic! Environmental education: Methods and examples", Keep Sweden Tidy Foundation, 2nd edition.
- Delors J. et al. (1996) "Learning: The Treasure Within", International Commission on Education for the 21st century, Report to UNESCO, UNESCO Publishing.
- Disinger J.F. and E. C. Roth (1992) "Environmental Literacy" Eric Digest ERIC (ED351201), ERIC Clearinghouse for Science Mathematics and Environmental Education Columbus OH.
- "Environment and Society: Education and Public Awareness for Sustainability" Proceedings of the Thessaloniki International Conference, organised by UNESCO & the Government of Greece, 8-12 December 1997, Scoullos M. (ed.), Athens, 1998.
- Farmer A.J. and J.A.Wott (1995) "Field trips & follow-up activities: fourth graders in a public garden", The Journal of Environmental Education, 1995, 27, 1, 33-35.
- Flogaitis E. (1998) "Environmental Education", Ellinika Gramata, Athens.
- Franson N., Garling T. (1999) «Environmental Concern: Conceptual definitions, measurements methods and research findings», Journal of Environmental Psychology, 1999, 19, pp. 369-382.
- Frey K. (1986) "The Project-Method", Greek Edition, Publ. Kyriakides, Thessaloninki.
- Gayford C. (2001) "Education for Sustainability: an approach to the professional development of teachers", European Journal of Teacher Education, 2001, 24, 3, pp. 313-327.
- Giolitto P. (ed.) (1997) "Environmental Education in the European Union", Office of the Official Publications of the European Communities, Luxembourg.
- Hungerford R., Knapp D.H., Volk T.L., "Global Change", Environmental Education Module, UNESCO/UNEP, IEEP, Paris.
- Johnson D. and R. Johnson (1989) "Cooperative Learning", in "The Effective Teacher" Study Guide & Readings, (ed.) L.W.Anderson, USA.
- Kamarinou D. (1998) "Experiential learning in school", 3rd edition, Publ. Paper Graph, Greece.

REFERENCES

- Kapyla M. and R. Wahkstrom (2000) "An environmental education programme for teacher trainers in Finland", The Journal of Environmental Education, 2000, 31, 2, pp. 31-37.
- Klein E.S. and E. Merritt (1994) "Environmental education as a model for constructivist teaching", The Journal of Environmental Education, 1994, 25, 3, pp. 14-21.
- Knapp D., Volk T. & Hungerford H. (1997) "The identification of empirically derived goals for programme development in environmental interpretation", The Journal of Environmental Education, 1997, 28, 3, pp. 24-34.
- Lord T. (1999) "A comparison between traditional and constructivistic teaching in environmental science", The Journal of Environmental Education, 1999, 30, 3, pp. 22-28.
- Madanat H. (1998) "Environmental Education in the Jordanian Education Curriculum" Report of the Second Jett Environment Workshop (Amman, 16-17 February1998).
- Malotidi V. and M. J. Scoullos (2003) "Potable water & wastewater: a research-guide for the development of educational material for Environmental Education" International Symposium "Environment 2010, Situation & Perspectives for the European Union" Proceedings (Porto, 6-10 May, 2003) co-organised by UNESCO, EU DG ENV & University of Porto, 2003.
- Matsagouras E, Helmis S. (2003) "Production of educational material: Theoretical assumptions and technical standards" in the "Designing and production of pedagogic material for Environmental Education" Proceedings of the Pan-Hellenic Symposium organized by "ELLINIKI ETAIREIA for the Protection of Nature and Cultural Heritage and the Piraeus University (21-23 February 2003). ed. by V.Psallidas, Athens, 2003.
- Matsagouras E. (2003) "The interdisciplinarity in School Knowledge", 2nd edition, Publ. Gregoris, Athens.
- Matsagouras, E. (2000) "Cooperative Teaching & Learning", 2nd edition, Publ. Gregoris, Athens.
- May T.S. (2000) "Elements of Success in Environmental Education through practitioner eyes", The Journal of Environmental Education, 2000, 31, 3, pp. 4-11.
- Michailides M. (2003) "Group environmental activities, projects and cooperation", guide-book for youth and groups' advisors, General Secretariat for Youth, National Centre for Social Research, Athens.
- Mordock K. and M. E. Krasny (2001) "Participatory Action Research: A theoretical and practical framework for EE", The Journal of Environmental Education, 2001, 32, 3 pp.15-20.
- Nichols J.D. (1996) "Cooperative learning: A motivational tool to enhance student persistence, self-regulation and efforts to please teachers & parents", Educational Research and Evaluation, 1996, 2, 3, 246-260.

REFERENCES

- Novac J.D. and D.B.Gowin (1984) "Knowing how to learn", Cambridge University Press.
- Palmberg I.E. and J. Kuru (2000) "Outdoor activities as a basis for environmental responsibility", The Journal of Environmental Education, 2000, 31, 4, 32-36.
- Papadimitiou V. (2002) "Problem solving in Environmental Education", in "Environmental Education: the Mediterranean Perspective, Workshop on Environmental Education", Athens, 15 December 2002; Proceedings of the meeting", MIO-ECSDE, Athens, 2003, pp. 107-117.
- Papadimitriou V. (1999) "Seeking the Identity and Prospects of EE in the 21st century", in 1st Panhellenic Conference on the Environmental Education, (ed. by Calaitzidis D.), Athens, 1999, pp. 97-100.
- "Plan of Implementation" World Summit on Sustainable Development, Johannesburg, 26 August -4 September, 2002.
- Psallidas V. et al. (2002) "Nautilus Travels…A Network for the Environment, Culture and Peace in the Mediterranean Sea for Children who are 4 to 12 years old" in the Proceedings of the "Environmental Education: the Mediterranean Perspective-Workshop on Environmental Education", Athens, 15 December 2002, MIO-ECSDE, Athens, 2003, pp. 99-101.
- Ross K. (2002) "Teaching Secondary Science: Constructing Meaning & Developing Understanding", The Cromwell Press Ltd.
- Roy M., Petty R., Durgin R. (1997) "Travelling boxes: A new tool for Environmental Education", The Journal of Environmental Education, 1997, 28, 4, 9-17.
- Sarantopoulos P. "Analogies as a didactic tool in Teaching Science", in "Teaching Science & Chemistry", (ed. Tsaparlis G.),ΔιXnNET, Ioannina, Greece, 2000, pp. 211-245.
- Saul D. (2000) "Expanding environmental education: thinking critically, thinking culturally", The Journal of Environmental Education, 2000, 31, 2, pp. 9-15.
- Scoullos M., Alampei A., Boulouxi A., Malotidi V., Vazaiou S. (2001) "Water in the Mediterranean" Educational Package, MIO-ECSDE & GWP-Med, Athens.
- Smith-Sebasto N. (1998) "Environmental education in the University of Illinois Cooperative Extension Service: An Educator Survey", The Journal of Environmental Education, 1998, 29, 2, pp. 21-30
- Stokes E., Edge A., West A. (2001) "Environmental education in the educational systems of the European Union", Synthesis Report, EC DG ENV.
- Teaching about environmental issues", Module 3, The Essentials of Environmental Education for Pennsylvania, (ed. by Johnson P., Rosenberg L.), Pennsylvania Centre for Environmental Education.
- Tsaparlis G. (2000) "An introduction to the constructivism", in "Teaching Science & Chemistry" (ed) Tsaparlis G., ΔιXnNET, Ioannina, pp. 19-36.

REFERENCES

- UN Resolution 57/254 UN General Assembly, 57th Session, 2002.
- UNCSD "Promoting Education, Public Awareness and Training", Chapter 36, Agenda 21, UN Conference on Environment and Development, Rio de Janeiro, 1992.
- UNECE "Basic Elements for the UNECE Strategy for Education for Sustainable Development", Statement on Education for Sustainable Development by the Ministers of the Environment, UNECE 5th Ministerial Conference "Environment for Europe" Kiev, 21-23 May 2003.
- UNESCO (1980) "Environmental Education in the light of the Tbilisi Conference", Paris.
- UNESCO (2002) "Education for Sustainability, From Rio to Johannesburg: Lessons learnt from a decade of commitment", Paris.
- UNESCO (2001) "Teaching and Learning for a Sustainable Future", Paris.
- UNESCO "Framework for a Draft International Implementation Scheme for the UN Decade of Education for Sustainable Development" (January 2005-December 2015), Draft, July 2003.
- UNESCO-UNEP (1987) "International Strategy for Action in the field of Environmental Education and Training for the 1990s" International Congress on Environmental Education & Training, Moscow.
- UNESCO-UNEP, IEEP Series 15 (1985) "A Problem-Solving Approach to Environmental Education", Paris.
- UNESCO-UNEP, IEEP Series 22 (1986) "Procedures for Developing an Environmental Education Curriculum", Paris.
- UNESCO-UNEP, IEEP Series 26 (1988) "A process for pre-service teacher training curriculum development", Paris.
- UNESCO-UNEP, IEEP Series 29 (1994) "A prototype environmental education curriculum for the Middle School", Paris.
- UNESCO-UNEP, IEEP Series 30 (1994) "An environmental education approach to the training of middle level teachers: a prototype programme", Paris.
- UNESCO-UNEP, IEEP (1998) Series, No 39, "Environmental Education: Curriculum guide for pre-service teacher education in the Caribbean", Paris.
- Vachtsevanou M. (1999) "Educators' Attitudes towards Environmental Education", in the Proceedings of the 1st Panhellenic Conference on the Environmental Education, (edit. by Kalaitzidis D.), 8-10 October 1999, Athens, pp.123-124.
- Vazeou S. (2002) "Water Cycle: Guide-research for the development of an educational material for Environmental Education", Master Thesis in Teaching Chemistry, National & Kapodistrian University of Athens.

REFERENCES

- Ventura F. (1993) "Science & Environmental Education at the primary level in Malta: separate interests, different roles", International Journal of Science Education, 15, 5, pp. 509-519.
- Vlastaris C. "The Environmental games as tools for the Environmental Education in Elementary Schools", in "Designing and production of pedagogic material for the Environmental Education", Proceedings of the Pan-Hellenic Symposium organised by HELLINIKI ETAIREIA for the Protection of the Environment and Cultural Heritage" and the Piraeus University (21-23 February 2003) Ed. by V. Psalidas, Athens, 2003.
- Zelensky L. (1999) "Educational interventions that improve environmental behaviours: A meta-analysis", The Journal of Environmental Education, 1999, 31, 1, pp. 5-14.
- Zoller U. (1999) "Interdisciplinary systemic HOCS development –the key for meaningful STES oriented Chemical Education", CERAPIE (Chemistry Education: Research & Practice in Europe), 2000, 1, 2, pp.189-200.

REFERENCES

Mediterranean Education Initiative for Environment and Sustainability-MEdIES: http://www.medies.net

The Telematics Centre, University of Exeter, School of Education and Lifelong Learning: http://telematics.ex.ac.uk

UNECE: http://www.unece.org

UN Division for Sustainable Development: http://www.un.org/esa/sustdev

UNESCO: http://www.unesco.org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