

# “Discover Diversities”: A Trans-Inter-Disciplinary (SEMPEP) Project for Different School Levels and Teachers’ Training\*

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“Discover diversities” is a wide thematic developed within the SEMEP (South-Eastern Mediterranean Environmental Project) project, supported by UNESCO (United Nation Education, Science and Culture Organization). SEMEP is essentially a project for science education, focusing on Mediterranean environment. As the Mediterranean has been the cradle of Western civilization, the project also favours connection with humanistic disciplines like history and art in order to raise young people who have awareness of the Mediterranean valuable resources and its enormous cultural heritage to be appreciated and strongly protected. Moreover, SEMEP, through NC (National Coordinator), puts in touch students and teachers from different countries working on the same topics, favours mutual visits both of students and teachers, coordinates diffusion of materials (students’ worksheets and guidelines for teachers) and exchange of ideas, papers and products; in this way, schools share information and build a common knowledge. Moreover, summer schools for students and teachers coming from different countries as well as environmental competitions and stages, are often organized in a friendly environment stimulating knowledge and comparison of different cultures and experiences. In the annual meeting, the NC presents a report about activities carried out in their countries, discusses problems and proposes new topics for students’ investigations. In the present paper, we describe some SEMEP meaningful activities carried out in Italian schools.

*Keywords:* science education, environmental education, Mediterranean diet, diversities, SEMEP (South-Eastern Mediterranean Environmental Project) project

## Introduction

The dramatic increase in knowledge about science and environment has revealed the necessity of using and applying information from all disciplines, both natural and economic-social sciences, for the solution of environmental-related problems. In fact, owing to their complexity and the large number of parameters that

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should be taken into consideration, environmental issues lie at a unique juncture of both the physical and the social sciences, incorporating components from a wide group of disciplines, such as political science, economics, management, engineering, biology, chemistry and ecology (Hoffman & Ehrenfeld, 1998). According to a study published in 1992 (D. H. Meadows, D. L. Meadows, & Randers, 1992), we are overshooting such crucial resources as food and water while overwhelming nature with pollutants like those causing global warming. We add that biodiversity is also in danger; in fact, for instance, the over-exploitation of rain forests and seas for food supply impoverishes more and more biodiversity. The problem is so important that United Nations proclaimed 2010 “Year of Biodiversity”. It is up to us to take immediate remediating steps in order to avoid the collapse of the planetary environment’s ability to support not only our species, but also much of the rest of the biosphere (D. H. Meadows, D. L. Meadows, & Randers, 2004).

The process leading to change of individual and social behaviours is long and is based on education, which should begin in early age and continue along the life.

A survey about what happened in schools after the first signs of environmental crisis may help understanding of poor success in building and diffusing at wide range environment friendly habits. After the publication of *The Limits of Growth* (D. H. Meadows, D. L. Meadows, Randers, & Behrens III, 1972), environment became a fashion unfortunately, and teachers thought it was their duty to propose environmental themes, even without any conviction, training and qualification. In some countries where environment became a curricular discipline, many attentive teachers observed a paradox—Students got good marks in school, while continuing in their bad behaviour towards environment out of school!

Becoming environmentalist is a philosophy of life (Neyisci, 2007). Environmental education means that issues should be faced with taking into account how they affect or are related to the environment. People are more willing to assume new attentive (even tiring and demanding) habits if they realize the way their actions have repercussions on the world around. Concepts like feedback, oscillatory phenomenal, dynamic, stable and unstable systems are basic to understand the impact of human actions on environment. So, environmental education needs scientific knowledge.

Younger generations have grown up in a time when consumer culture has become dominant. So, raising environmental awareness requests much work and students’ involvement, and teachers should have professional competences, sound science knowledge and skills in involving and guiding students into a deep insight. Students should learn about scientific concepts needed to understand and make meaningful studies, develop criticism useful to disentangle information and build a method to cope with intrinsic complexity of any environmental topic. Moreover, students should have the perception that they can be protagonist and do much to improve the environment.

European community and many international organizations, like UNESCO (United Nation Education, Science and Culture Organization) and United Nations, have identified especially in young people’s education the main road to change habits and develop the needed awareness and the responsibility for environment and community. They sponsor many environmental researches and educational programs. Special attention is given to teachers’ training encouraging interdisciplinary programs.

Indeed, interdisciplinary and trans-disciplinary teaching can help educators to implement alternative activities that could sustain a more relevant, less fragmented and stimulating experience for students.

### **What Is SEMEP?**

SEMEP (South-Eastern Mediterranean Environmental Project) is part of UNESCO's action in the Mediterranean region, where different cultures have developed over the past 4,000 years, promoting exchanges and cooperation among its member states in the fields of education, science, culture, communication and social sciences. It is based on successful UNESCO projects, such as the Baltic Sea, Blue Danube River, Chernobyl (and Caribbean Sea). As such, SEMEP is an educational project addressing teachers, students, and through them, their communities (Power, 1996). A primary UNESCO aim is developing the awareness of a specific "Mediterranean" among the various peoples inhabiting its shores and islands.

More in detail (see SEMEP Website) are as follows:

(1) SEMEP is a holistic and interdisciplinary environmental education project within the UNESCO Mediterranean initiatives, incorporating actions for the development of greater environmental consciousness in the region;

(2) It involves pupils and students from kindergarten to high secondary school level in both formal and non-formal sectors. It is intended to create an educational, environmental and cultural network for contact and cooperation among teachers and students as well as in the region that reaches beyond the school to the community;

(3) SEMEP provides an opportunity to consider environmental issues that are of common concern to countries in the region. More than just another curriculum initiative, it addresses the need to promote this consciousness in school children and the community;

(4) SEMEP, thus, aims at interrelating education, geared to both the natural and social environment, with cultural values. Such values are of particular importance in this part of the world (often scene of local conflicts) where the development of extremely rich civilizations involved a continuous interchange of social, philosophical and cultural values;

(5) SEMEP encourages a holistic approach to education within the framework of existing school curricula. It is based on problem-identification, problem-solving, determining decision-making parameters, actual experiencing, decision-making and skills in a wide range of communication techniques;

(6) The partnership involves the national coordinators which in turn organizes their annual meeting; they report about countries' initiatives, present and share good practices, discuss about problems, especially those involving governments and funds, suggest way to involve much more the schools in facing relationships and in favoring cooperation, choose new topics to be proposed to schools and design materials, with the support of researchers or experts, write guidelines for teachers and disseminate them, organize and carry out teachers' training courses, environmental tournaments among schools, exhibitions and awards.

SEMEP was born from a strong support of the Greek Ministry of Education in 1994. After the issues of a pilot project, the main project began in the school year of 1996-1997 and the Italian participation dates back to that period.

### **Discover Diversities**

"Discover diversities" has been one of the leading thematic in the SEMEP project.

Diversity is a very pregnant term which can be applied to biology, culture, anthropology and other fields, in any case, especially in a scientific context; it means a (desirable) variety, basis for evolution and progress.

In Italian schools, the theme "Discover diversities" has been a stimulus for teachers and students to

investigate different science topics, learn basic concepts and become aware that mathematics (often difficult to understand) is a powerful means to interpret and describe any, even complex, phenomenon and communicate results in a clear and synthetic language. Teachers have adapted the project to the features of their classes and surrounding territory. For example, two schools, a junior school and a high school, worked on “food and territory”. Variety in the territory means that landscape, flora, fauna and soil have different features affecting food, its quality, taste and production; Moreover, local food is affected by local traditions, history and culture, and many people now try to rediscover forgotten, genuine and natural tastes. Appreciation and consumption of local products should be encouraged—there are advantages for health (fresh food contains more vitamins, which are tasty and do not need preservatives, their production is controlled by health authorities), environment (less traffic, energy consumption and CO<sub>2</sub> production), and family economy (local products are cheaper). Variety and seasonal food are the best way to keep our body in good health. Alimentary education can be developed as a branch of “food and territory”; it is much important in pre-adolescence and adolescence to prevent alimentary diseases.

### **Feedback**

An important concept to understand the complexity of systems under investigation (biodiversity is a parameter measuring both the health of a natural system and its complexity) is feedback. Feedback or retroaction is the ability of a dynamic system to keep in mind the results of the system operation to modify its own characteristics. The theory of those systems is used in many fields of sciences (including automatic controls) and biology. In this last field it is very interesting the application of the retroaction to the study of the planetary ecosystem, known as “GAIA”. The concept of feedback has been introduced by the American mathematician Norbert Wiener in the forties, while James Lovelock applied it to our planet, GAIA. The hypothesis of GAIA describes the Earth as a self-regulating system which is able to maintain its chemical-physics characteristics like mean temperature, percentages of the gases, acidity, and so on, under conditions suitable for life really thanks to the behavior of the living organisms.

We speak of positive retroaction (or feedback) when the results of the system amplify the functioning of the same system, that, in consequence, will produce greater results that will subsequently amplify the operation of the system. The systems with positive retroaction are unstable; positive retroaction typically brings the system to diverge.

An example of positive retroaction is the melting of North Pole ices. Glaciers of poles, thanks to the fact that they are white, reject the solar rays. An increase of the global temperature favors the melting of glaciers. The effect is an increase of the quantity of solar rays absorbed by the earth, causing an increase of the global temperature that increases the melting of other glaciers and so on. This system is surely unstable and tends to diverge.

We speak of negative retroaction when the results of the system damp its functioning, so stabilizing the system itself. Systems with negative retroaction are stable, because negative retroaction leads them to converge. An example of system with negative retroaction, taken by the hypothesis of GAIA is the presence of the aqueous vapor in the atmosphere. An increasing of the global temperature favors the formation of a greater quantity of aqueous vapor in the atmosphere, so raising a larger amount of clouds. Clouds, like pole glaciers, are white and therefore they reflect the solar rays. A smaller absorption of the solar rays from the Earth reduces the global temperature, and therefore, it decreases the aqueous vapor in the atmosphere. Thanks to this phenomenon, in absence of other variables, the quantity of aqueous vapor in the atmosphere tends to be stable.

On this thematic, our research group has carried out a national summer school addressed to high school science teachers. We developed experiments on mechanics, thermodynamics and chemistry, according to a trans-disciplinary perspective. Teachers studied retroaction in the physics laboratory using different kinds of servomechanisms. Usually, servomechanisms work according to the principle of retroaction, where the size of the control quantity in entry is compared to the size in exit, measured with some kind of transducers. Any difference between the size of the measured quantity and the one expected is amplified and used to drive the system in the right direction to reduce or to eliminate the error. A branch of science (theory of automatic controls) born to support and develop this type of systems. Common types of devices based on retroaction are thermostats (used to control the temperature of a confined environment) or servomechanisms used to control a position.

Observations, experiments and collection of data using a device are the best ways to understand feedback and recognize it also in other fields. In fact, examples of feedbacks can be found not only in science, even in economics and social subjects. Participants to the summer school appreciated the different perspectives opened by the unusual trans-disciplinary thematic and declared to put into practice in their classes the stimuli they received.

### **Methodology and Assessment**

Teachers and students make use of different instruments and means for their investigations:

- (1) Interviews;
- (2) Work in the field (selection and observation, collection of samples);
- (3) Experimental work in the science laboratory;
- (4) Different sources (books, scientific reviews, official documents, internet, etc.);
- (5) Data processing.

Students' assessment and the project's evaluation take into account: learning of scientific concepts, skills in data processing, critical thinking, coping with new open problems, according to a constructivist point of view (De Paz, Pilo, & Pastorino, 1999; Pilo, 2000).

At the end, the meaningful materials are collected in posters, reports, booklet, books and CDs for dissemination.

### **School Works**

Now we present some works carried out by teachers with their students as example of research and good practice on "diversity" at different school levels.

#### **Diversity in Nature: Junior School "G. Garibaldi"—Chiavari**

Students of the junior school are 11-14 years old. Chiavari is a little town (about 50,000 inhabitants) in North Western Italy, about 35 km from Genoa (birthplace of Christopher Columbus), lying on the sea coast, whose east boundary is a river.

A fluvial park, included in the European Project "Nature 2000", has been investigated by students aged 12 years. Aims of investigation are to study:

(1) The main valuable environment in the territory with its natural patrimony, geomorphology, history and culture. The river is the basic element of modelling landscape and is a resource (water for domestic use, agriculture and other human activities);

(2) The faunal Oasis: "discover" the way the river affects animals and vegetation;

(3) Modifications caused by human intervention (tourist ports, electric power plant, vegetable garden,

orchards, buildings, etc.).

It was meaningful for the class to explore features of territory around one of the main rivers of the region, celebrated by the most important Italian poet Dante Alighieri, in the 13th century.

The teacher, a naturalist, guided students to select a stretch of river, collect samples, carry out an experimental work in the school laboratory and inquire into modification caused by human interventions using interviews with old people, official documents, reports, old chronicles, paintings, pictures and even poetries and stories related to the concerned territory (see Figures 1, 2 and 3).



*Figure 1.* The river Entella: Railway bridge.



*Figure 2.* The river Entella: Oasis.



*Figure 3.* The river Entella separates two villages: Chiavari and Lavagna.

At the river mouth, two tourist ports are visible. The one on the right is considered to be the largest tourist port in the Mediterranean which can host up to 1,600 boats.

In the province of Genoa, there are more than 100 water courses, but only the Entella has the feature of a river owing to its flow.

It is very important not only as water reserve used also for hydroelectric power plant, but even for feeding beaches damaged by violent sea storms—the construction of two tourist ports at its mouth has blocked the natural feeding and now beaches are fed in artificial way highly expensive for the community.

Activities in the field are as follows:

Excursions along the river to observe the various environments: estuary and fluvial environment widely modified by man, a more natural environment upriver and collect samples to study in the laboratory.

Attention is focused on human actions and their consequences on ecosystems.

Activities have the support of worksheets prepared by the teacher to facilitate observations and collection of data. Students are provided of a net to take samples and observe organisms living there.

Data are compared with those provided by naturalist tables describing water organisms.

Students draw conclusions about the index of biodiversity in the river.

The work is part of a post-graduation thesis (Master in Didactics of Science) and it is much appreciated because it tries to build awareness towards environment on sound scientific basis, but not as a “green fashion”.

Some considerations are: Such work promotes in young people a responsible citizenship that means sensitiveness towards a common patrimony and attention towards decisions that authorities may take into concern.

### **Biodiversity in Nature and Human Beings: High School ITIS “Sandro Pertini”—Genzano—Roma**

ITIS is a technical high secondary school (students' age: 14-19 years). A small group of students aged 15 years has been involved in studying biodiversity.

Aims of the school are to:

(1) Understand the various cultural contexts (territory, religion, history, etc.) in which biodiversity is relevant;

(2) Stimulate a constructive comparison among different cultural realities;

(3) Sensitise to dialogue and cooperation among peoples;

(4) Appreciate and exploit different cultures.

During four months (January to April, 2008), it has been carried out an investigation about biodiversity in nature, including human beings and diet of Mediterranean peoples going so far as to discuss the current problem of shortage and famine in some countries.

The students' group included some foreign boys, so the teacher, a biologist, proposed a survey about theories on “human races”. She intended to start a discussion, teach some important concepts of biology, stimulate a critical thinking and prevent racist attitudes.

For this purpose, a survey has been done from the French scientist Georges Buffon (1707-1788), author of the monumental work *Natural History* who perhaps has been the first to speak of “race”, passing through Johan Blumenbach (1758-1840), who classified human beings into five races, based on skin colour, Charles Darwin (1809-1882), author of *Origin of Species* (1859), up to American anthropologist Franz Boas (1858-1942), the concept of monogenesis: existence of only one humane race. The various somatic types are due to a variability existing in any species which can be hardly affected by environment.



In a society becoming more and more multicultural, education should stimulate a critical thinking, favour integration and prevent arising racism. Nowadays, in Italian schools, there is a big number of immigrants and it is a main priority to avoid any kind of violence, bullying and racist acts.

Through the SEMEP project, students have been strongly motivated to study biology and investigate similarities and diversities within Mediterranean people, especially “food habits”, such as investigation on diet, taking into account the result of questionnaires submitted to immigrants in Australia, compared four groups (see Figures 4 and 5):

(1) Western group: Spain, France, Italy and Malta marked out by a large consume of pasta, meal, rice and potatoes (Spain), oil as fat, while in France, butter is used more;

(2) Adriatic group: Albania, Bosnia, Croatia marked out by consumption of wheat flour bread, milk products (butter and cheese), vegetables olive oil;

(3) East group: more use of products based on wheat flour and potatoes. Cheese has importance in diet. In Turkey, a distinctive vegetable—melokhia (*Corchorus olitorius*), is used in soup. In Egypt, dried broad beans are used for a special dish (foulmedames). Consumption of Okra (*Hibiscus esculentus*)—fruit of an African origin plant is diffused. Tubers like Taro (*Colocasia esculenta*) are consumed in Egypt, Cyprus and Greece;

(4) North Africa Group: frequent use of wholemeal flour—couscous is more consumed than rice, while cheese is rarely used.



Figure 4. Bread and pasta, typical food of West group people.



Figure 5. Example of spices used by West and North African groups.



Students concluded their work celebrating the “Earth Planet Day” through seminars and discussions about biodiversity decreasing owe to the ongoing climate changes.

In carrying out the investigation, different fonts have been used—scientific books, reviews and magazines, Internet, under the teacher’s supervision in order to make use of criticism and to choose reliable information.

The whole work has been summarised in a document, including photos, pictures and a 19-pages written text.

**“Discover the Diversities Around Yourself: Ecological, Biological, Cultural or Technological Diversities”—Junior Secondary School “Camillo B. di Cavour”, Marcianise**

It has been a long trip among the alimentary culture, the nature, the history, the myths and the traditions of this territory that, in spite of the worrying news about the social and environmental disasters, it is redeemed by the pride and the passion of its people.

Students have been guided towards a correct diet, and in the meanwhile, towards a civic conscience, sensitive to the environmental protection of our territory.

The teacher tried to carry out such task not only through rules and prohibitions, but also through more interactive and attractive approaches. She stressed the importance of the Mediterranean diet and the taste of typical local products, as they are very important both on the side of a nutritional point and as symbols and consequences of history, tradition and customs of our territory that never cease to amaze us.

Students analyzed the main elements of a healthy diet, especially for an adolescent (as they were), properties of aliments, and learnt about some important concepts like cellular breathing and metabolism.

A rapid survey about diet from pre-historical period till now puts to evidence its evolution; students also had to face basic concepts concerning biology and physics which are related to production of food and alimentation.

Questionnaires have been submitted to students to collect information about their diet and data have been processed. Recommendations and data provided by World Health Organization about Body Mass Index and guidelines for a healthy diet have been discussed in order to become aware of the correctness of their own habits and understand which changes, in case, are to be made (see Figure 6).

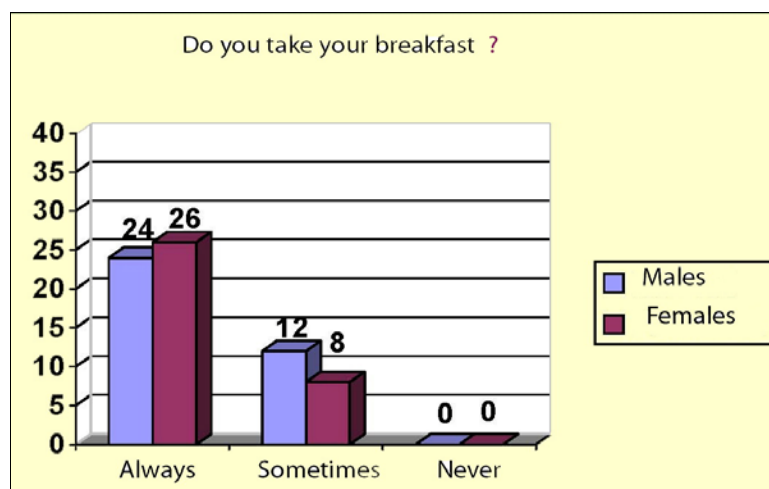


Figure 6. Graphic representation of data concerning breakfast.

## Conclusions

A high quality learning, which means a stable learning, is the outcome of work stimulating interest,

creativity, intuition, active involvement and dynamic interaction with peers and adults. Clever teachers are able to raise the conditions for a suitable learning environment, like those discussed above; their theoretical teaching/learning models have been inspired by the principles of social constructivism, while in the school daily work they favoured the cooperative learning and reflective practice (Pilo, De Paz, Fabbri, & Pastorino, 1999). Discovery has been the leading concept. Students appreciated the proposal and worked with enthusiasm, they produced booklets, video, CD-Rom and pictures; such materials, often very valuable, are now a patrimony of the schools, evidence of the engagement and work carried out.

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