Doberdó Observation Trail for the Education of Environmental Protection Engineers

Judit Németh-Katona

Óbuda University
Rejtő Sándor Faculty of Light Industry and Environmental Protection Engineering
Doberdó út 6, H-1034 Budapest, Hungary
e-mail: katona.judit@rkk.uni-obuda.hu

Abstract: The objective of this research: To comply a set of field exercises to evaluate environmental conditions with special emphasis on ecological and biological aspects, for the education of environmental engineering and engineering instructor students. Sets of tests to adequately analyze the environment in a complex way are practically non-existent. The few that exist are focused on some particular, narrow area, primarily examining inanimate environmental factors. The majority of these tests are chemical quick tests to detect the presence and level of a specific substance polluting the environment. The results are descriptive observations, merely stating facts, without offering any explanation for the causes of different phenomena, simply providing factual data measured in a particular moment in time. Based merely on these results, it could be hard or impossible to make any responsible suggestion regarding environmental or land development issues.

Keywords: Education for the environment, The Application of Field Exercise in the Education of Environmentalism and Nature Conservation, Observation trail, Biologically qualified environment, Ecologically evaluated conditions

1 Introduction

“Education for the environment”

The survival of life on earth depends on a harmonious equilibrium between human society and the environment. To achieve this balance through the process of sustainable development should be our eternal goal that could be attained only by an increased environmental awareness of people [3].

The necessity of paradigmatic changes has become a matter of life and death in our time. The domain of environmental education has been extended, it is rather “education FOR the environment” [2] [11] [12]. It includes the encouraging of a dedicated, environmentally conscious lifestyle, with constant affirmations, the shaping of behavior, values, attitudes, and emotions, increasing knowledge, and inspiring actions to prevent any further damage and degradation of the environment [10].

The education for sustainability is based on interpreting the environment as a system. The author focuses on observing living beings, because that is also an indication of the conditions of the inanimate components. The explanation of this statement is that transformations caused by use in a region always result in transformations of living beings on some level, thus the condition of living beings is an indicator of the condition of inanimate components [7].

Environmental field trips concentrating on complex observation of biocenosis can demonstrate causality, and can be operative [4]. [5].

2 Methods

Educational Methods on a Field Trip

The field trip completed together with the students, as an educational learning tool, covered the entire range of pedagogical issues regarding the concepts of sustainability.

The field exercises developed a critical approach based on experimental knowledge, and that improved the students' skills to evaluate, to make decisions, to deal with crisis situations. It promoted problem solving in thinking processes, and increased creativity in actions. By applying experimental knowledge, it produced practical, functional knowledge [8].

As opposed to the declarative communication of information, it emphasized an activity driven, "process" nature of learning, as revealed in the author's researches [1].

The experiences of field exercises confirmed that to comprehend the sustainability of environmental systems, it is not sufficient to rely on unidirectional declaration of theoretical data, or direct verbal communication. It is necessary to apply the knowledge in an actual environment because the preservation of the environment focuses on problems, and actions to solve them [8].

The field trips provided an active and constructive learning environment (promoting self-improvement and collective improvement) where knowledge and educational benefits were achieved by individual and collective experiences through completing tasks. That is why a field trip could be considered the method of direct demonstration and presentation, regarding the method of acquiring knowledge for the basics of the ecological approach [8] *(Figure 1).*

Figure 1

That is why a field trip could be considered the method of direct demonstration and presentation, regarding the method of acquiring knowledge for the basics of the ecological approach (The photo (picture) of the author's)

In the interiorization process, the educational effects (interactions) created by educational factors, and the educational methods resulting in these effects, were quite different on the field trip from the methods of traditional classroom education environment, as revealed by the research.

The primary difference can be found in the methods of organizing activities: On the field, due to the configurations of the terrain, any activity was efficient only when working in smaller groups.

Thus an environmentally conscious value system was developed by the indirect educational methods and impacts of collective activities, and by the influence of emerging customs, behavior and activity models, and convictions of the group.

In the opinion of educational researchers, the problem of applying indirect educational methods is that the results are hard to register [8].

By comparing the results of different groups when completing different tasks and exercises, it was possible not only to determine the level of skills and professional knowledge, but also to measure the degree of personality forming functions achieved.

In the author's experience, when working with groups the project method is the most efficient on the field, because the interiorization of knowledge is achieved as part of, and also the result of a creative process. This supports the idea previously mentioned that field exercises make it possible to measure how effective the indirect educational methods have been [8].

When working on the project, the participants did not simply search for the solution to a particular problem out of context, instead, they observed and analyzed multiple junctions and interconnections. This could not have been accomplished without discussion, arguments, mutual demand and control.

3 Results

Developing Skills of Environmental Awareness by Designing an Observation Trail

The development of information processing methods in evaluating the environment was focused on the potential applications and further elaborations of bioindicators.

Using the sulphur dioxide pollution examination as an example: The amount of sulphur dioxide present can be measured by instruments, but can also be determined by the degree of leaf necrosis of sensitive deciduous trees measured on a scale of experiences, or can also be determined by the presence of lichen species in the area.

The development of educational methods was intended to increase the efficiency of indirect educational methods in a group activity form, and it was accomplished by designing an interactive observation trail.

3.1 Location of Doberdó Observation Trail

The location of the field trip and observation trail project is Budapest's northwest part (Óbuda), between Doberdó street and Kiscelli street, beside Bécsi street *(Figure 2)*.

The location is characterized by the polarized and concentrated presence of a great variety of natural features and phenomena within a small, limited area. The location is easy to access from the Óbuda University, is beside it directly.

This location is extremely appropriate to demonstrate environmental qualities from ecological and biological aspects, and to observe and evaluate conditions in an objective manner, which is the very objective of the environmental and nature conservation field exercises. The law regulating the assessment of natural resources defines seven specific areas for the evaluation of conditions. With the exception of two of these areas (condition of agricultural land, and waste management), all other areas (condition of waters, condition of air, condition of living organisms, condition of built components, and level of noise pollution) can be analyzed and evaluated by the observations and exercises described in this presentation at the above mentioned location, thus providing a place of demonstration for field education.

Figure 2

The location of the Doberdó Observation Trail is Budapest' northwest part (Óbuda), between Doberdó street and Kiscelli street. (Comment's figure: Third Region of Budapest, Kiscelli castle's garden; ▲ North; Contour line of Relief is egal 10 metres) (The figure5 is the author's work Budapest based on a map (http://korlat.bmknet.hu/hun/kiscell/terkep.html 2007)

3.2 Interactive Observation Trail in the Óbuda

The 12 stations of the observation trail, can be completed with the assistance of a study guide or "information booklet." When designing the trail, the educational method was mainly focused on the questions of Where? What? and How? When designating the area, and selecting the topics to be studied, there were two major factors to be considered: The informative value, and the dedication to avoid any harm to the natural resources involved.

Through defined tasks, and relevant explanations the trail provides information about geographical features of the area, about geological and surface processes *(Figure 3)*, hydrological values, biocenosis of the area, peculiarities of the vegetation, ecological particulars, and historical cultural values.

Figure 3
Station 6 of The Doberdó Observation Trail; Terrace of Traventino limestone (The photo (picture) of the author's)

The stations are as follows: Opening station (geographical location, marking the boundaries of the region, rules of conduct, itinerary, time frame) *(Figure 4)*; the abandoned quarry; talus slope and forest community with linden and ash trees; oak trees; observing Traventino limestone; site of prehistoric fossil; the stone chamber.

Figure 4
Opening station of The Doberdó Observation Trail is beside the Óbuda University; geographical location, marking the boundaries of the region, rules of conduct, itinerary, time frame (The photo (picture) of the author's)

The algorithm introducing the stations in the study guide is as follows:

- Name of station;
- Geographical location of station;
- Phenomena to be observed, natural resources, collecting survey data:
- Description of phenomenon to be observed;

- Tasks;
    - Description of the process of observation or measuring, determining the time and frequency of task, listing the equipments required, suggestions for the type of equipments;
    - Determining the methods of analyzing recorded data (e.g. creating charts or diagrams, comparing photographic and film documents, cartographic representation);
    - Control: Reference to the requirement of evaluating results, interpreting consequences, drawing conclusions, finding explanations.
- Explanation of the emergence and specifics of the phenomenon.
- Summary of results to be expected:
    - As a result of applying methods to process information;
    - As a result of indirect educational methods, accomplished by group activities.

The algorithm is demonstrated on the 1rd station of the observation trail:

Station 1: *Abandoned quarry, clay-pit*

Location: The central part for the area, for the observation trail

Phenomena to be observed, natural resources: The study of successions of the vegetation.

Task: Identifying pioneer plant species, and species involved in the climactic forest community in the quarry yard, and the adjacent undisturbed hillside.

Explanation: Succession means the progress of the vegetation. In the quarry yard, due to the disturbance (the mining operations of the quarry), secondary succession can be observed that began when the mining operation was terminated. The area of the quarry was not recultivated, it attained its present condition through the process of natural reforestation. The process of succession is the process of changes in the vegetation in time: Stages of different combinations of species succeed one another, starting from pioneer communities, and ending with climactic communities.

3.3 Methods of Measuring To Qualify the Environment

The tools of education for the environment and nature conservation on a field trip are surveying, measuring, observing, testing.

As the result of my researches, a set of tests was compiled to examine the following: Microclimatic and air quality values, establishing the level of air pollution by observing bioindicators, testing the reducing effect of vegetation on noise pollution, testing the soil from the ecological aspect, evaluating the condition of natural waters by observing bioindicators, geological and geomorphologic observations, examining characteristics and quality indicators in communities of living organisms [6].

Each test is built on the principle of practical evaluation of the environment: When examining the conditions in a biocenosis, both the qualitative and quantitative biological composition, and also the abiotic factors causing the particular distribution in space and time are taken into consideration as characteristic traits.

Using the microclimatic and air quality examinations regarding the characteristics of the vegetation as an example, this means the observations are not based only on instrumentally measured data (light intensity, temperature, humidity level) but also on surveying and studying the species composing a phytocenosis in different seasons, and by determining the extent of foliage closing, and the degree of exposition on slopes, some cause and effect connections are also revealed.

3.3.1 Examination of the Microclimate and State of the Air on the Basis of the Features of the Vegetation

Examination of periods of sunshine and intensity of light in open and closed surfaces covered with plants

Task. Record of hors of sunlight. Measurement of the strength of direct radiation with the help of lux measure device. Graphic representation of the recorded data (in relation to time) in different periods of the day, in various associations, in areas with various sun expositions and tree-stratum.

Comparison of data of habitats with various tree-stratum but identical exposition, furthermore with various exposition but similar value tree-stratum biotops. Explanation of the differences and interpretation of the consequences.

Anticipated results with application of knowledge-processing (data-processing) methods. The microclimate signifies the climate of smaller areas, which differ significantly from the surrounding area. The relief, exposition of slope, geographical position, soil and vegetation have significant role in their formation. Therefore, the climate is local and may differ significantly from teh mezoclimate of the larger surrounding area.

Observation of types of plants with various light- and temperature demand

Task. Compilation of records of types of plants at the same location in early spring, in summer and autumn. Observation of light and temperature features of groups of plants in he living terrains, recording and graphic representation of the daily temperature flucuation (it is necessary to measure the temperature at least three times daily in various groups, for more precise definition at every hour). The most widely used devices for this examination are station thermometers, which are also used by metheorologists, which serve for the record of momentary temperature values. The measurement of the temperature fluctuation (extreme values) with a minimum, maximum thermometer of the various groups of trees and turf, as well as the vertical wood levels, the various tree-stratum groups. Interpretation of the measured values. Drafting (preparation) of a comparative diagram for the various associations using measurement data completed at identical point of time, Evaluation and explanation of the results.

Anticipated results with application of knowledge-processing (data-processing) methods. During their evolution plants adapted to various light and temperature conditions. In moderate and cold zones the amount of light and warmth differs significantly with the alteration of seasonsand according to the time of day. The quantity of light of the habitat is also influenced by the vegetation. In spring before leaf-opening the turf level of a horn-bean wood receives one-third of the total quantity of light which arrives at the surface (geofiton aspect of early spring). During opening of leaves this value decreases to 1/8th-1/30th of the total quantity of light, while at mid-summerthe soil level gets only 1/60th of the light quantity *(*Szerényi G. 1988).

3.3.2 Examination of the Air Pollution with the Help of Biological Indicators

Observation of sulphur-dioxyde pollution impact on the leaves of sensitive diciduous trees

Task. With the help of a Coverage Scale (*Figure 5*) the value of leave necrosis can be shown by examination of leaves of birch, maple and elm trees, then deduction can be made on the level of sulphur-dioxyde.

Anticipated results with application of knowledge-processing (data-processing) methods. As bilogical indicators trees can be regarded as sensitive monitors or accummulative monitors.

Sensitive monitors (coniferous, birch, small-leave linden, maple, elm, black elderberry) are very sensitive to air polluting substances, well-visible damage can be observed on the outside.

Leave necrosis means the death of cells and tissues. The impact of the air polluting substance begins on the margin of the leaves, then it continues into the inner surface of the leaves. With the majority of trees the blemishes begin at value of the sulphur-dioxyde air pollution higher than 0,9 ppm.

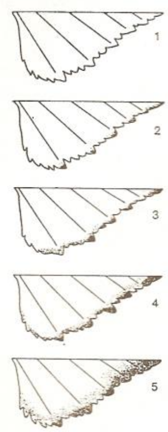

Figure 5
The value of leaf necrosis (Kárász, I. 1992 [8])

Demonstration of air pollution with the help of bark of trees as accumulative indicator

Task. Very vareful carving off of a 2 mm thick 2 cm² surface of the bark of fir, maple and/or oak trees, at the height of 1,3 m. The sample should be placed in destilled water for one day, afterwards using a pH meaure device the chemical reaction in the liquid should be measured.

Anticipated results with application of knowledge-processing (data-processing) methods. Under the influence of pollutung substances accumulative monitors do not demonstrate visible alterations in the short term. However, they accumulate polluting substances in themselves, thus polluting substances can be detected in the bark. The content of heavy metals and sulphur in the bark of trees is proportional with the level of pollution in the area.

Determining air pollution level with the help of lichens

Task. Selection of obseravtion, sample locations at least 300 meters apart from each other in the vicinity of an air polluting source (heavy traffic road, industrial plant, power station). Definition of the available lichen and their marking on a field map, afterwards interpretation of the results, deduction of consequences regarding level of pollution. The interpretaion may be done after marking the results oall the sample places on a single map, so the air polluted zones stand out and thus the level of air pollution in the area can be evaluated:

- Lichen deserts, where the content of sulphur dioxide is higher than 0,15 mg/m³
- Struggler zone, where the content of sulphur dioxide is smaller than 0,17 mg/m³ and is greater than 0,15 mg/m³.

- Less polluted zone, where the content of sulphur dioxide is smaller than 0,07 mg/m³ and is greater than 0,05 mg/m³.

Normal or free zones, where the content of sulphur dioxide is 0,05 mg/m³ or lower.

Anticipated results with application of knowledge-processing (data-processing) methods. Lichen are living creatures which originated from the symbiosis of letiferous (fungus) and one-cell blue algae. Letiferous (fungus) is an obligatory parasite and is not capble of living separately from the algae, it cannot be found by itself. Lichen algae lives on photosynthesis, this way the fungus gets organic subsztances. Regarding their form of growth three types of lichen can be distinguished: lichen living on bark, leaves and bushes.

Lichen can be found on a number of different underlay (stand): soil, rocks, tree-bark, fences, housewalls), they are extremely adaptable and appear everywhere, except in air-polluted areas. Lichen are especially sensitive to high content of sulphur-dioxide and nitrogen-oxide in the air. They also well signal (denote) the presence of hydrogen-fluoride, chlorine, ozone, heavy metals and radi-active isotopes. Their extraordinary sensitivity, and thus their role as indicators for air polluting substances derives from the fact they do not have cuticules, therefore polluting substances easily get into the body of lichen. Their chlorophile content is low, therefore their metabolism, growth, regeneration capacity is limited. Their waterbalance depends entirely on the the air humidity and rain frequency. Their assimilation and regeneration time is quite short. They display activity mainly during rainy autumn and winter time, when the sulphur-dioxide content of the air is considerably higher than in summer. Lichen have been known as air pollution indicators and their presence and state of development has been observed for about 130 years.

Air Quality Index (AQI) can be calculated on the basis of lichen-coverage: the amount of lichen taxon (type, generation) value, and lichen coverage of the surface on the bases of percentage value evaluated 1-10 (0-10%=1 point, 11-20%=2 point, 21-30%=3point…91-100%=10 point).

3.3.3 Ecological Soil Examinations

The role of the chemical structure of the soil in influencing the plant species

Task. Defining the pH value of the soil with the help o fan indicator slip or pH measurement device.

Establishing correlation between the vegetation coverage, diversity of plants and chemical strucure of the soil.

Anticipated results with application of knowledge-processing methods. The chemical structure of the soil is determined by the ratio of the hydrogen and hydroxil ions present in the soil solutions.

According to chemical structure (regarding water pH) types of soil can be categorized in the following way:

pH value under 4,5 - strongly acidic soils

pH value 4,4 -5,5 - acidic soils

pH value 5,5 - 6,5 - mildly acidic soils

pH value 6,5 – 7,5 - chemically neutral soils

pH value 7,5 – 8,2 - soils with mildly base character

pH value 6,2 – 9, 0 - base-character soils

pH value higher than 9, 0 - soils with strong base character

There is a correspondence between the devlopment of various types of vegetation and the pH value of the soil. Soils with pH value 3,5 -4,5 are too acidic for most of the plants. A pH value of about 4,5 is indicated by club moss, and coniferous types (spruce, redwood). Huckle-berries, pine trees, holly, willow-trees, birch denote 5,0 – 6,0 pH value. Most of the plants develop well in 6,5 – 7,0 pH value soils, the main indicators being aspen, ash, beech, red oak and maple. Blackberry, albespine and catalpa indicate pH value 7,0 - 8,0. the range of pH value above 8,5 is unfavourable for most of the plants.

3.3.4 Geological and Geomorphological Observations

Recognition and dtermination of rocks on the basis of observaton of rocks and and surface formations (paleotological examination)

Task. Examination and detrmination of rocks typical for the living place (magmatic, sedimentary, metamorphic). Categorization of sedimentary clastic rock according to the size of particles, differentiationof chemical sedimentary rocks using an acid-dripping method (lime, dolomite), distinguishing deep magmatic rocks on the basis of their mineral content.

Anticipated results with application of knowledge-processing methods. Classification of different types of rock and distinguishing their typical characteristics.

Defining types of surface formations, observation of their typical features

Task. Classification of prominent or flat formations on field upthrust, staired formation, valley, ghat (pass), canon, saddle. Observation of their charcteristics, and determining their geographical exposition (with a compass). Correlation between surface formations and and surface or subterraneal water currents.

Anticipated results with application of knowledge-processing methods. Classification of relief formations, differentiation of their typical features.

3.3.5 Measurement of Noise-Screening Property of Vegetation

Task. Determining the noise-screening influence of the vegetation (the ability of leaves to reflect noise for example at tree-lined roads), graphic representation of the comparative data and interpretation. Making a noise-level map. (*Figure 6*).

Measurement of noise level at different points of the sample area. Defining of points and periods of measurement depending on the type of observation area. In woods it is reasonable to complete the measurement at dawn, in the morning, at dusk and at night. Near common roads it is recommended to measure at every hour and to record the average value of 5-minute measure time. Measurement points should be designated at various distances to the source of noise.

Anticipated results with application of knowledge-processing methods. Noise-moderating influence of the greenery and the distance from the source of noise.

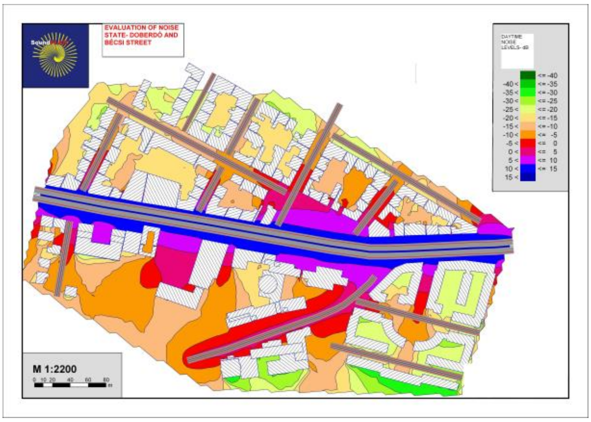

Figure 6

Measurement of noise, evaluation of noise state (Podmaniczky J. 2003, [9])

Conclusions

To sum up our research project: It has been verified that a field trip at a natural, actual location provides an extremely effective educational environment to develop the skills of environmental awareness, to convey information regarding sustainability issues, and to substantiate the holistic approach. Considering these facts, the author suggests that field exercises should be given high priority in the course requirements and curriculum of students majoring as environmental engineers and engineering instructors.

A field trip focusing on the environment and nature conservation is a form of educating and learning, and it can be successfully accomplished by completing the Doberdó Observation Trail designed by the author in the Óbuda.

From the aspect of environmental education, it has a holistic approach, focusing on the main characteristics of the region in a complex manner.

From the aspect of processing information, it emphasizes causality, interpreting the environment as a system. It is a tool to evaluate the environment ecologically and biologically, and to determine conditions objectively, assisted by the set of tasks to analyze the environment in the Doberdó Observation Trail, as described in this presentation.

From the aspect of acquiring knowledge, it is a method of direct demonstration and presentation accomplished in a natural, actual environment.

As a learning process, the field trip focuses on activity, it is an operative learning method based on experience, with preference to working in groups. By elaborating the environmental educational specifics of field exercises, the dissertation contributes to a more effective application of this educating-learning tool in environmental education, also providing a way to measure the efficiency of indirect educational methods.

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