A CURRICULUM FOR LEARNING NATURE VALUES.
CASE STUDY: LEARNING GEODIVERSITY FROM
BISTRIŢA ARDELEANĂ GORGE
(BISTRIŢA-NĂSĂUD COUNTY, ROMANIA)

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Abstract: In the process of conservation of geological heritage should be involved, in
addition to specialists, local communities, rangers, authorities and tourists. This
requires an appropriate educational setting to organize and coordinate the activities
of identification, evaluation and protection of geodiversity. This framework can be
assured by the curricula for learning the values of nature, which is a concept
proposed by Grundtvig project "Lena-Learning nature values in Europe" in the period
2012-2014, under the "Lifelong Learning" Program funded by the European
Commission, with the participation of environmental associations, groups of
specialists and learners from Estonia, Italy, Finland and Romania. A curricula for
learning nature values is a document structured in such a way to allow all interested
parties of nature the acquisition of knowledge and skills to identify, evaluate,
promotion, development and preservation of natural elements belonging to
biodiversity and geodiversity. This study proposes a curriculum for learning
geodiversity, i.e. geological structures (rocks, minerals, fossils), soils and landforms
with scientific, ecological, aesthetic, cultural and economic values. The application in
practice of this curricula was done with the opportunity of setting up the Action Plan
for conservation of geodiversity from Bistriţa Ardeleană Gorge (Bistriţa-Năsăud
County, Romania), which was attended by several stakeholders (county and local
authorities, local community, students, pupils, mountain rescuers).

Key words: geodiversity, geosite, geomorphosites, geoheritage, geoabundance,
geotourism, geoparks, geoconservation, curricula, lifelong learning, Grundtvig

INTRODUCTION
The geodiversity is a concept used by geologist in the 1990s to describe the variety of
abiotic nature. Meanwhile, this new term has received numerous definitions, as follows:
- the link between people, landscape and their culture: it is the variety of geological
environments, phenomena and processes that make those landscapes, rocks, minerals,
fossils and soils which provide the framework for life on Earth (Stanley, 2001);
-geological diversity or the variety of rocks, fossils and minerals and natural
processes (Prosser, 2002);

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http://gtg.webhost.uoradea.ro/
- geodiversity underpins biodiversity (Burek, 2001), and represent the abiotic factors, which together with biodiversity give a holistic view of the landscape (Burek, 2002);
- the variety of earth materials (minerals, rocks, sediments, fossils, soils and water), forms (folds, faults, landforms) and processes (tectonics, sediment transport, pedogenesis) that constitute and shape the Earth, either the whole or a specific part of it (Gray, 2003).

The geodiversity, as part of geosystem, has an economic, social, cultural, environmental and educational importance, highlighting by follow aspects:
- it provides the raw materials for building (stone, clay, gravels, sand), the fuel (coal, oil, gas), metals for industry, and the soils for agriculture;
- the location of many settlements is influenced by the distribution of mineral resources (coal, oil, metals), water (ground waters, surface waters), soils (fertile, less fertile), and landforms configuration (altitude, energy, fragmentation, slope, orientation);
- geodiversity plays a major role in defining the landscapes (landforms, soils, natural and anthropic processes);
- the complex relationships between geology, natural processes, landforms, landscape, soils and climate are fundamental to the distribution of habitats and species;
- geodiversity plays a key role in environmental regulation (absorbing pollution, buffering climate change, filtering, purifying and storing water);
- spectacular geology forms the backdrop to many of most popular tourist locations, and the geosites are often of great recreational and tourism value, inspiring people to enjoy or learn about nature;
- many geodiversity sites are used for outdoor education, because they provide a chance to study ancient volcanoes, caves, landslides, environmental change, and collect and record fossils or minerals.

Along with biodiversity and cultural creations, geodiversity it`s part of the total assets of a geographical area, and its knowledge is needed to establish the geological and geomorphological sites and to elaborating the strategies for protection and conservation of natural heritage. The geodiversity concept is associated with other two terms: geoconservation (intention and action to conserve natural abiotic values) and geoheritage (significant abiotic elements to be preserved). In this context, geodiversity is the basis for geoconservation and a way to preserve the geoheritage of a region, because Value + Threat = Conservation Need.

Inventory of geodiversity and geoconservation has strong traditions in Australia, Tasmania, the Nordic countries (Sweden, Norway, Finland, Denmark, Iceland), the United Kingdom and the United States, where it have been drawn up Geodiversity Audits and Action Plans for the conservation of the various geosites. There are many geoconservation method, such as secrecy, physical restraint, reburial, excavation/curation, permitting/licensing, supervision, benevolent ownership, legislation, policy and education (Gray, 2008b).

The last of this methods, education, can be applied to all elements of geodiversity, because knowing the nature is first step towards geoconservation, and the greatest threat to geodiversity is ignorance (Gray, 2003). In the Action Plans for geoconservation are more themes, among which we can mention the following three, aiming learning geodiversity values: to enhance local understanding of geodiversity, raise awareness, understanding and inspire people to value their local geodiversity, and collecting and managing information on local geodiversity.

Gray (2008 b) argues that education on geodiversity issues can be done in school and university using a suitable Earth science curricula. In addition with the systematic study of geodiversity other forms of learning can be organized, such as: training courses for local government and planning officers, politicians, nature conservation and ranger
staff, etc.; television shows; magazine and newspaper articles; websites; museums; visitor centres; parks and geoparks; site-interpretation panels; visitor activities such as fossil and mineral collecting; geological trails with accompanying leaflets; special events such as geology weeks etc. (Gray, 2003), and learning projects for natural values.

One such project is Grundtvig: Learning natural values in Europe (LENA), during the period 1 August 2012 - 31 July 2014 in the framework of "Lifelong learning" Program, funded by the European Commission, with the participation of environmental associations, specialists and learner from Estonia, Italy, Finland and Romania.

The project aims to implement nature conservation activities in Europe through education and providing opportunities for adults to improve their own lives, and the objectives of the project are:
- bringing together people of different target groups who are interested in nature and its values;
- educating people with long-term experiential experts on nature and outdoor learning methods (biologists, geographers, geologists, guide managers, curators, etc.);
- improving knowledge of people about the nature and values in Europe;
- helping adults people improve their way of living;
- development of educational methods of nature conservation;
- knowing people through international cooperation;

The final result of this project will be the development of a curriculum for learning natural values in Europe to serve all those who perform nature-related activities such as geoconservation, ecotourism planning etc.

In this context, the present study proposes a curriculum model for learning natural values of the geodiversity, which can be used both by local communities, specialists and other stakeholders who want to gain more knowledge about their abiotic environment, to act the protection and conservation of natural values.

**METHODOLOGY**

To accomplish this study were taken the following steps:
- consulting literature in geodiversity (Azevedo, 2006; Bâca, 2011; Brilha, 2005; Burek, 2001; Burek & Potter, 2002; Burek & Potter, 2006; Farsani et al., 2011; Gordon et al., 2012; Gray, 2003; Gray, 2008a; Gray, 2008b; Ilieş, Josan, 2007; Ilieş et al., 2009; Ilieş, Josan, 2009a; Ilieş, Josan, 2009b; Martínez-Frias et al., 2009; Kiernan, 1996; Kiernan, 1997; Kozłowski, 2004; Nieto, 2001; Pemberton, 2000; Piacente & Coratza, 2005; Prosser, 2002; Ruban, 2010; Soutberg, 1990; Sharpled, 1993; Stanley, 2001);
- consulting some Geodiversity Audits and Action Plans and Reports drawn up for specific areas (Australian Natural Heritage Charter, 1997; Australian Natural Heritage Charter, 2002; Durham Geodiversity Audit, 2004; Doncaster Geodiversity Assessment, 2007; Local Geodiversity Action Plans–Setting the context for geological conservation, 2006; North Pennines-Geodiversity Action Plan, 2010);
- participation to Grundtvig project LENA-Learning nature values in Europe 2012-2014;
- conducting field research to establish the practical methodology for learning natural values;
- camp theme for inventory, assessment and learning geodiversity in Bistriţa Ardeleană Gorge (Bistriţa-Năsăud County, Romania) and to elaborate The Action Plan for this geographic unit;
- consulting papers about Bistriţa Ardeleană Gorge area (Naum & Butnaru, 1989; Bâca & Şteff, 2010; Bâca & Ştefănescu, 2014).
RESULTS AND DISCUSSION

The curriculum for learning geodiversity is a document that can be used by people involved in the act of ecotourism (guides, instructors, animators, planners, local communities), in geoconservation action, in landscaping, and in learning activities for different age groups.

The structure of a such curriculum was discussed and outlined in the Grundtvig project LENA-Learning Nature Values in Europe 2012-2014 (Lifelong Learning Programme, with reference number GRU-12-P-LP-220-BN-EE) in meetings in Rome (Italy, Figure 1) and Haapsalu (Estonia, Figure 2) and is as follows (table 1):

<table>
<thead>
<tr>
<th>Chapter of curricula</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argument</td>
<td>Developing a curriculum for learning natural values, in this case the number and complexity of geological features and landforms, is particularly important because the landscape is the support of all components of environment (water units, plants, animals, soils, human settlements, economic activities), and an attractive target during any type of recreational outdoor activities (hiking, cycling, climbing, etc). Once developed, this curriculum will help educate local communities and specialists in planning, and will support the actions of the inventory and evaluation of geodiversity.</td>
</tr>
</tbody>
</table>
| Objectives           | a) General objective
The general objective of this curriculum is the acquisition of knowledge about the genesis, evolution, typology, distribution, impact, economic exploitation, protection and preservation of geodiversity in a reference area. |

<table>
<thead>
<tr>
<th></th>
<th>b) Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As specific objectives for this curricula can be mentioned:</td>
</tr>
<tr>
<td></td>
<td>-to learn more about landforms, geological and geomorphological processes;</td>
</tr>
<tr>
<td></td>
<td>-to identify landforms, rocks, mineral and soil types;</td>
</tr>
<tr>
<td></td>
<td>-to learn about the effects of human impact to landforms and geomorphological landscape;</td>
</tr>
<tr>
<td></td>
<td>-to protect the landforms, the geosites and the geomorphosites;</td>
</tr>
<tr>
<td></td>
<td>-to educate local communities, local government and planning officers, politicians, nature conservation and ranger staff.</td>
</tr>
</tbody>
</table>
| Learning tools | -representative places of learning (protected areas, geomorphosites, geological structures, outcrops, etc.);  
|               | -books;  
|               | -photos and videos;  
|               | -topographic, geological, geomorphological and tourism maps;  
|               | -equipment (clothing, footwear, photo camera, video camera, binoculars, GPS, notebook, etc.). |
| Learning methods | -explanation;  
|                 | -direct observation;  
|                 | -non-direct observation;  
|                 | -comparison;  
|                 | -demonstration;  
|                 | -discussions. |
| Stages of learning | a) Indoor stage:  
|                   | -consultation of specialized materials about rocks, minerals, fossils, landforms (genetic types, models of evolution, environmental impact, economic use);  
|                   | -setting the parameters characterizing landforms geomorphometry (altitude, slope, fragmentation, energy) and attractive features (peaks, ridges, cliffs, beaches, waterfalls, gorges, canyons, rock formations, etc);  
|                   | -watching photo and video materials about specific geomorphological processes (erosion, accumulation, volcanic eruptions, etc) and landforms;  
|                   | b) Outdoor stage:  
|                   | -study trip and camps in nature;  
|                   | -completion of routes and representative field identification of rocks, minerals, fossils, soils, landforms, present pedologic, geologic and geomorphological processes;  
|                   | -performing hiking, thematic camps or trips;  
|                   | -establish the regional geosites. |
| Actions | -preparation of materials and equipment;  
|         | -establish the route or place of learning;  
|         | -identification of landforms, minerals, rocks, soils and providing specialized information related to it;  
|         | -observation, analysis and comparison of the landforms, rocks, soils and minerals;  
|         | -taking pictures and video with landforms and rocks encountered;  
|         | -mapping landforms, rocks and processes;  
|         | -completion of observation sheet;  
|         | -creating portfolios (conventional and digital);  
|         | -creating the local geodiversity map or geotourist map. |
| Assessment of learning process | a) Quantitative aspects  
|                              | -enumeration of rocks, minerals, fossils, soils and landforms identified on the ground;  
|                              | -the development of the inventory sheets or portofolias for rocks, minerals, soils and landforms types.  
| b) Quality aspects | -genetic and evolutionary classification of rocks, minerals, soils and landforms;  
|                    | -mentioning the attractiveness of rocks, minerals, solis and landforms;  
|                    | -description of modeling processes and anthropogenic impact acting on the rocks and landforms;  
|                    | -setting the geoconservation ways;  
|                    | -establish the relationship between geodiversity and biodiversity. |
| Results | -acquisition of knowledge and skills to identify rocks, minerals, fossils, soils and landforms in the field, to specify their economic, environmental and attractive potential and to establish the recovery and conservation mode. |
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This curriculum model is general, but it may be adapted, in particular, depending on targeted field (rocks, minerals, fossils, soils, landforms, geological and geomorphological processes, etc.), and purpose (inventory, evaluating, planning, conservation) (Figure 3).

Participants in this project for learning the values of nature will be able to convey this curriculum to others in their environment, interested in the natural values, on different occasions (travel, visits in protected areas, development of recreational areas, conferences, symposiums, etc.).

![Figure 3. The implement model of curricula for learning nature values and rise public awareness](image)

![Figure 4. Geographical position of Bistrița Ardeleană Gorge in Eastern Carpathian Chain of Romania (source: http://www.welcometoromania.ro-with changes)](image)
CASE STUDY: LEARNING GEODIVERSITY OF BISTRIȚA ARDELEANĂ GORGE (BISTRIȚA-NĂSĂUD COUNTY, ROMANIA)

This model of curriculum for learning geodiversity were applied for inventory and assessment of geodiversity from Bistrița Ardeleană Gorge, and to elaborate The Action Plan for geoconservation in this area.

The Bistrița Ardeleană Gorge are located in the eastern part of the Bistrița-Năsăud County, in Bistrița Bârgăului commune (Figure 4, 5), are oriented in the WNW-ESE direction, have a length of 6 km and connecting The Bistrița Bârgăului Depression and Colibita Depression. This geographical unit were carved in the volcanic conglomerates of Câlimani Plateau (ashes, sands, gravels, andesitic blocks) from the upper pliocene by paleo Bistrița River.

In this project attended by volunteers from the local community Bistrița Bârgăului, City Hall Bistrița Bârgăului employees, students from Faculty of Geography and Phisical Education and Sport from Babes-Bolyai University, Bistrița Extension, Mountain Rescue Team of Bistrița-Năsăud County.

The project has completed the following steps:

a) the presentation of the area and its geodiversity represented by landforms carved on volcanic conglomerates (video and photo);

b) the development of inventory sheets for identify the main landforms (Figure 6);

c) field trip in Bistrița Ardeleană Gorge to identify the geodiversity and to complet the inventory sheets;

d) establish of regionaly geosites in Bistrița Ardeleană Gorge;

e) achieving of an indicative map with the main elements of geodiversity (Figure 7);

f) drafting the action plan for geoconservation of this area.

After inventory and assessment operation were established the following geosites: Șoimu Valley, Stegea Valley, Repedea Valley and Piatra Mare Massif, wich was evaluated by few criteria (table 2). At the end of this project, at Bistrița Bârgăului City Hall, was
structurated The Geodiversity Action Plan for Bistrița Ardealănă Gorge which will form the basis of the proposal to create a geopark and an adventure park in this area (table 3).

<table>
<thead>
<tr>
<th>Geosite</th>
<th>Şoimu Valley</th>
<th>Stegea Valley</th>
<th>Repedea Valley</th>
<th>Piatra Mare Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acces</strong></td>
<td>Forest road</td>
<td>Forest road</td>
<td>Forest road</td>
<td>Paths</td>
</tr>
<tr>
<td><strong>Scientific value</strong></td>
<td>Erosional processes in volcanic conglomerates</td>
<td>Erosional processes in volcanic conglomerates</td>
<td>Erosional processes in volcanic conglomerates</td>
<td>Erosional processes in volcanic conglomerates</td>
</tr>
<tr>
<td><strong>Ecological value</strong></td>
<td>Forests, mammals, birds, reptiles</td>
<td>Forests, mammals, birds, reptiles</td>
<td>Forests, mammals, birds, reptiles, protected area</td>
<td>Forests, mammals, birds, reptiles</td>
</tr>
<tr>
<td><strong>Aesthetic value</strong></td>
<td>Residual rocky formations</td>
<td>Residual rocky formations</td>
<td>Residual rocky formations</td>
<td>Scenic point, residual rocky formations</td>
</tr>
<tr>
<td><strong>Educational value</strong></td>
<td>Residual landforms, forest ecosystem, consequences of deforestation</td>
<td>Residual landforms, forest ecosystem, consequences of deforestation</td>
<td>Residual landforms, flood erosion consequences, protected area</td>
<td>Residual landforms Observation point</td>
</tr>
</tbody>
</table>

Figure 6. The model of the inventory sheet for geodiversity of Bistrița Ardeleană Gorge

Table 2. Regionaly geosites in Bistrița Ardeleană Gorge
<table>
<thead>
<tr>
<th>Economic value</th>
<th>Forest exploitation, capture hydropower plant, collect the berries and mushrooms</th>
<th>Forest exploitation, collect the berries and mushrooms</th>
<th>Forest exploitation, collect the berries and mushrooms, capture hydropower plant</th>
<th>Collect the berries and mushrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threats</td>
<td>Deforestation, floods erosion</td>
<td>Deforestation, floods erosion</td>
<td>Deforestation, floods erosion</td>
<td>Deforestation</td>
</tr>
</tbody>
</table>

**Figure 7.** The geomorphological map of Bistrița Ardeleană Gorge

**Table 3.** The structure of Geodiversity Action Plan for Bistrița Ardeleană Gorge

<table>
<thead>
<tr>
<th>Themes</th>
<th>Objectives</th>
<th>Actions</th>
<th>Timescale</th>
<th>Costs</th>
<th>Partners</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhance local understanding of geodiversity</td>
<td>Rise awareness and interest of local communities, local authorities, and tourists</td>
<td>Field trips, video projections, symposium, development of brochures, location of information boards</td>
<td>2014-2016</td>
<td>in the course of establishment</td>
<td>Primary School of Bistrița Bârgăului, Babeș-Bolyai University, Bistrița Bârgăului City Hall, Local Action Group Bârgău-Călimani</td>
<td></td>
</tr>
<tr>
<td>Collecting and managing information on local geodiversity</td>
<td>Implementation of a database</td>
<td>Development of questionnaires Processing information from the locals</td>
<td>2014-2016</td>
<td>in the course of establishment</td>
<td>Primary School of Bistrița Bârgăului, Prundu Bârgăului Highe School, Babeș-Bolyai University, Harta Verde Association</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Conserving and managing local geodiversity</th>
<th>Development of strategies</th>
<th>The establishment of thematic routes, identify high-value geosites</th>
<th>2014-2016 in the course of establishment</th>
<th>Bistrița Bârgăului Forest administration, Bistrița Bârgăului City Hall, Babeș-Bolyai University, Harta Verde Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of facilities for tourism and leisure</td>
<td>Tourist exploitation of the area, increasing the income of the local population, promoting the image of the area</td>
<td>Arranging places to rest, observation towers, information boards, camping</td>
<td>2014-2016 in the course of establishment</td>
<td>Bistrița Bârgăului Forest administration, Bistrița Bârgăului City Hall, Local Action Group Bârgău-Călimani</td>
</tr>
<tr>
<td>Achieving geopark status</td>
<td>Protection and conservation of geodiversity</td>
<td>Drawing up the specific documents</td>
<td>2014-2016 in the course of establishment</td>
<td>National Agency of Environment, County Council Bistrița-Năsăud</td>
</tr>
</tbody>
</table>

CONCLUSIONS
Learning natural values of biodiversity and geodiversity is a necessity, because education is the basis for all planning activities, recovery and conservation of natural heritage. Community awareness of the natural values of its life is a task that must be well established methodological framework with which must operate all who developed cultural and educational activities, management, planning and conservation (teachers, students, guides and tourist entertainers, tourists, managers, planners, nature rangers, professionals, volunteers).

Therefore, a curriculum for learning natural values is particularly important because it provides learning algorithm and ensure goals and objectives for rational use of natural elements and their conservation. The function and utility of this curriculum has been demonstrated in the project Bistrița Ardeleană Gorge Geodiversity-Action Plan where were involved numerous persons and institutions who have contributed to the identification and evaluation of geodiversity of this area.

ACKNOWLEDGEMENTS
This contribution presents some results from researches Grundtvig Project LENA-Learning nature values in Europe 2012-2014, and The Geodiversity Audit and Action Plan of Bistrița Ardeleană Gorge Project, developed in partnership between Bistrița Bârgăului Local Council and Babeș-Bolyai University, Faculty of Geography-Faculty of Physical Education and Sport, Bistrița Extension. The author wished to thank to Harta Verde Association Bistrița, Romania, for opportunity to participate at this project, and to anonymous reviewer for their thoughtful suggestions and comments.

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