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Doctoral School of Education

Environmental Education Doctoral Program

Presence of biodiversity values of European interest in public education, in environmental education and their link to understanding biodiversity

THESES OF DOCTORAL DISSERTATION

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Content

'... he will see that his own human existence, no matter how sublime it is, would be utterly impossible on earth as soon as the animals, plants or other phenomena that normally exist in nature no longer influence himself.'
Otto Herman, 1882[1]

Reasons for topic, research aim and research objectives

The quotation chosen as the motto highlights a natural value and characteristic, biological diversity, which, due to the threatening nature of its decline, is the subject of much attention. In addition to climate change and soil degradation, the rapid decline in biodiversity is the three most acute components of widespread unsustainable processes. (Mika & Pajtókné Tari, 2015) A The major threats to biodiversity beyond habitat loss and degradation include climate change, excessive nutrient load and other forms of environmental pollution, over-exploitation and unsustainable use, and the spread of invasive alien species. (Secretariat of the Convention on Biological Diversity, 2010) At land and freshwater ecosystems globally, habitat loss is the most important threat, including the seizure of land for agricultural production. (Leadley és mtsai., 2014)

Biodiversity is a natural feature which, due to the threatening nature of its decline, is receiving considerable attention. Because of this, the term is often used by both mass media and lay people. Preserving and measuring biodiversity is also an important and accepted goal, with national and European tools. The methodological requirements of the monitoring serve the usability, comparability, interpretability and reliability of the collected data. Understanding, learning and teaching biodiversity is considered necessary by developed societies.

The research and the thesis were simultaneously inspired by two phenomena: the appearance of natural values of European importance (i.e. those related to Natura 2000) in public education and the experience that even high school biology teachers assisting talented students may have misconceptions of biodiversity.

The Natura 2000 system (see Figure 1.) is an easy-to-understand, simple conceptual construction and conservation tool, as well as a spatial network that has been created and operates in Europe for the direct purpose of protecting biodiversity.

Biodiversity has been part of Hungarian public education for five decades within the subjects of natural history, biology and, more recently, complex science. The secondary school education, of course, is based on juvenile, simple images and interpretations of earlier school levels (as varieties of living things, specialties, certain human benefits), leading to naive concepts and misconceptions without appropriate pedagogical efforts. This can be seen not only in public education, but also in informal environmental education and, in many cases, in learning situations created outside of school.

A common, and previously described misconception is that the extent of biodiversity is the length of species lists, i.e. species richness. This is overshadowed by the importance of the presence or absence of certain flagship species (indicator species, specialties) or by the benefits of (high) biodiversity in general. However, they do not affect whether one

[1] ld. Herman 1883

understands the extent of biodiversity. ‘A layman’s list does not show taxon biodiversity in a given area.’ (Némethné, 2006) ‘The common interpretation that equates biodiversity with species richness is not only misleading but also problematic in terms of [local] problem-solving because the species and groups of species monitored are not objectively selected’ (Benedek, 2012)

The narrow interpretation of biodiversity to species numbers or species richness (in ecology: presence/absence information) is incorrect not only due to the haphazardness of the items included in the lists as indicated by Benedek, but also because of the sensitivity of species lists to data collection intensity. These are misinterpretations, or rather lay, childish (juvenile) interpretations. Although in this dissertation I examine the concept of ecosystem-level biodiversity, the misconception presumably also applies to other levels of biodiversity, that is, to genetic and individual-level biodiversity. The extent of biodiversity at each level must be estimated and calculated in the same way: by the entropy of the amount of information.

In my dissertation, I seek answers to what factors influence the teaching and learning of the concept of biodiversity at ISCED 0-3 levels. Thus, I analyze the factors affecting the biodiversity learning of pre-school and schoolchildren, especially secondary school students, in 2014–2017 in both formal and non-formal learning environments in Hungary. I study biodiversity learning not only for teachers working in public education, but also for field environmental educators, as they can also play a key role in the development of biodiversity-related competencies that are age-appropriate. Thus, the overall aim of my dissertation is to explore the factors influencing the teaching of the concept of biodiversity.

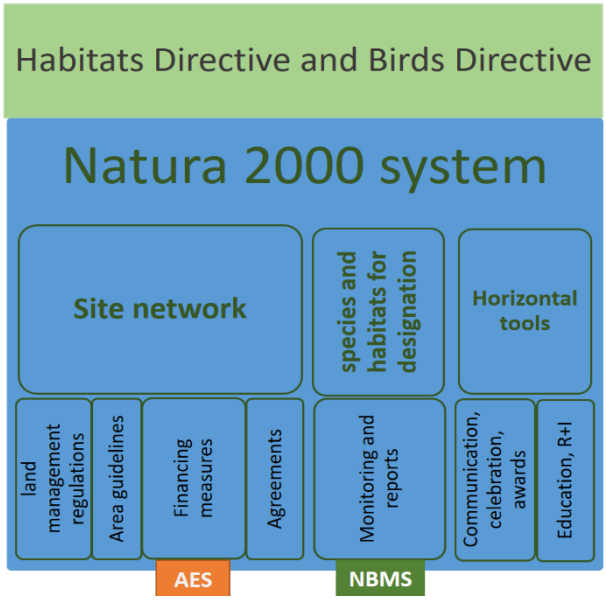

Figure 1. Elements of the Natura 2000 system (the two Directives, the European system established in 2000 with its site network and the signaling species and habitats on which the site is designated and the associated implementation tools) AES: agri-environment schemes; NBMS: National Biodiversity Monitoring System
Source: own

To study and evaluate the learning and teaching of biodiversity and of the new, powerful biodiversity protection tool, the Natura 2000 system, I set five research objectives and a development objective.

Pedagogical Development Objective: To develop pedagogical tools for understanding the extent of biodiversity and integrating the Natura 2000 system into learning.

Research objectives in detail:

A. Examine whether a biology teacher can be expected to understand the concept of biodiversity.

B. Examine the competencies that are needed to teach biodiversity among the expectations towards environmental educators working in the field.

C. Examine whether workplace competence requirements for field environmental educators have adapted to the modern concept of learner-centered learning.

D. Investigate whether the Natura 2000 system has emerged as norm and value, how it has become known, and how and in what didactic means it appeared in education, and whether it is didactically linked related to the concept of biological diversity.

E. Examine whether there is a difference between eco-labeled institutions (green kindergartens or eco-schools) and other institutions in integrating and teaching new content, Natura 2000.

In Chapter 1 of the dissertation I present the background and structure of the research, with its aims, objectives and the hypotheses that have been pre-established. Chapter 2 shows the methods. In Chapter 3, I discuss three key concepts that define my topic: biodiversity, the Natura 2000 system, and environmental education, detailing those issues of the 19th century that have barely been discussed in the literature of the Hungarian environmental education history.

Chapter 4 presents the results of the surveys and Chapter 5 presents the results of the related educational development. In addition to my research goals, I also set a didactic development goal to support the study of biodiversity. To a large extent, this was made possible by the development of an environmental education network at the Hungarian Institute for Educational Research and Development, a process I led between 2013 and 2017. The *Go Natura!* series of handbooks, game applications and teacher training were made available to all interested in 2016-2017. With 20 digital assignments, a simple diversity index calculation or demonstration module, and an online content sharing community field action (‘Traces of Life’ Campaign) completed the didactic kit to help raise awareness of Natura 2000 values.

Hypotheses and methods

Seven hypotheses were formulated in advance along the objectives. The relationships between the preliminary hypotheses and the goals are shown in Table 1 (see below).

Hypothesis 1. Nature conservation tools support the learning of biodiversity, including biodiversity conservation, enhancement and valuing.

The most important tools of nature protection are:[2] site protection, protection of species and habitats, the restoration, development and management of habitats, the registration, the presentation, dissemination and forecasting, as well as communication and advocacy.

In my view, the need to understand biodiversity can be deduced from the interest of preserving natural values and should therefore be set as a goal in professional, international and national documents. According to the IPBES[3] Global Strategy, an iterative, interdisciplinary, interdisciplinary collaboration and self-reflective learning from this process is essential to slow down biodiversity loss. (IPBES, 2019)

Thus, the concept of biodiversity should also play a role in the Hungarian system of nature conservation instruments, together with its concrete and abstract knowledge and understanding.

Hypothesis 2. Public education regulators and auxiliaries enable and support the development of a basic level of biodiversity (including levels of biodiversity) understanding at maturity and the knowledge of the new European biodiversity protection system (the Natura 2000) through age-appropriate learning.

It is well-known as a thousand-year-old tradition that the social norm: the desirable – and therefore generic – human ethos or erudition appears in education and learning. If there is a scientific consensus on a phenomenon that has a major impact on life, then the phenomenon is naturally embedded in social norms and literacy content. The weight of the social and civilization risks resulting from its decline justifies biodiversity as an element of public education and of literacy in general.

When new events or changes happen in the environment or in the society, the education system adapts more slowly than the economy or the small-scale, non-widespread regulators, or than individuals and small community groups. The loss of biodiversity has been a phenomenon known for over 50 years since the work ‘The Silent Spring’ of Rachel Carson (Carson, 1962) and has since been in the focus of conservationists, environmentalists and agricultural experts, as well as educators in Hungary.

The concept of the extent of biodiversity (e.g. a biodiversity index) is complex, but not nearly as many other environmental or sustainability indicators. High school mathematical competence is sufficient to calculate the biodiversity index: squaring, sequence operations,

[2] Source: Act No. LIII. of 1996 on Natura Conservation in Hungary

[3] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

and logarithmic computation. In principle, students in grades 10-11 do know these. ‘Biodiversity’ has meaning that works with a simpler set of concepts, such as conservation knowledge and skills, so Natura 2000 as a topic for younger generations is a good preparation for high school when the concept of biodiversity needs to be addressed in more detail.

The Natura 2000 system, which has the direct and specific aim of protecting European biodiversity, was introduced in Hungary in 2004. The area network of the system covers one fifth of the country's territory. Because of its concreteness (simplicity, clarity) and its everyday importance, Natura 2000 is expected to be used by the public education.

Hypothesis 3. Teachers are prepared to teach the Natura 2000 system and biodiversity.

This is a consequence of Hypothesis 2. I think that educators and teachers, depending on their background, education, knowledge and in function of their student’s age, can be expected to be prepared to teach the Natura 2000 system in particular and about biodiversity in general. It can be assumed that the five decades since the publication of the Rachel Carson book (1962) and the more than a decade since the introduction of the Natura 2000 system (2004) were sufficient to integrate the two subjects into the expertise of educators.

Hypothesis 4. Natura 2000 was introduced as new content not only in regulations and auxiliaries but also in the teaching practice of public education institutions by the time research questions were born, by the end of 2015.

Hypothesis 4 is also a consequence of Hypothesis 2, and its reasoning is the same as what we have seen there: the understanding of Natura 2000 system can be based on more concrete (less abstract) concepts than biodiversity. There are many known practices for outdoor education. Several innovative methods have been created in Hungary and spread around the world (such as the ‘happiness-sadness mapping’). Education about local realities and farming traditions has a millennial historical past. The boundary between the two areas almost precisely defines the Natura 2000 dimension of environmental education, so it is expected that public education will integrate the topic into its daily practice by 2016. There are many actions and activities involved in getting to know the Natura 2000 system, thus enabling action-based and experiential learning. It is easy for the educators to facilitate a constructive learning situation around this topic.

Hypothesis 5. Public education institutions that are consciously and publicly committed to education for sustainability and eco-education should have more accurate content and more innovative methods than non-committed schools.

The network of green kindergartens and eco-schools was established in Hungary in 2005 in order to clearly convey the conception of sustainability and its everyday values to children, parents, pedagogues, and school owners. By 2014, the two networks had reached one fifth of all kindergarten and school children and their pedagogues.

Hypothesis 6. Environmental educators or outdoor educators involved in the field learning situations of kindergarten and schoolchildren are prepared to teach the concepts of Natura 2000 and biodiversity.

I am convinced that field environmental education (nature education) has traditionally been strong in Hungary, with experts whether from state national parks, NGOs or for-profit tourism and forestry companies offering teachers independent or assisted programs. As with teachers (see the explanation of Hypothesis 3), the preparedness of these field educators can be expected regardless of whether or not they have pedagogical qualifications.

Hypothesis 7. The new topic (Natura 2000) in outdoor environmental education did not bring new pedagogical practice.

Nature conservation educational and recreational destinations are both found mostly in Natura 2000 areas. Due to the general management and the innovations of the destinations and the protected areas, innovations in nature educational activities of the National Park educators and of civil educators working on protected areas could take place. However, most adult educators of outdoor environmental centers have a scientific background, or they work for conservational, agricultural, forestry, or ecotourism firms and have similar qualifications (e.g. economy and tourism), and, nowadays, they may work as animators with secondary graduation. It is known that due to the seasonal nature of environmental education tasks and the increasingly scarce or less solvent demand toward environmental education, only a few employers have exclusive posts for this job. During the field season, a member of staff may, for example, provide educational, outreach activities, and in other periods general administration, research assistant job, or management. Due to economic considerations, one can suppose that these jobs and these environmental educators do not have the capacity to renew their practice, which was developed in those earlier decades, which were more favorable to field environmental education. They may routinely, resource-efficiently maintain and utilize those old and proven practice.

1. táblázat *Table 1. Relation of hypotheses to research and development objectives (BD: Biodiversity)*

↓ OBJECTIVES HYPOTHESES→	**H1.**	**H2.**	**H3.**	**H4.**	**H5.**	**H6.**	**H7.**
A. TEACHER'S BD CONCEPT		+	+		+		
B. BD AND OUTDOOR ENVIRONMENTAL EDUCATORS	+	+		+		+	+
C. LEARER-CENTERED PEDAGOGY IN OUTDOOR ENVIRONMENTAL EDUCATION						+	+
D. *NATURA 2000* THEMES	+	+	+	+	+	+	
E. ECO-INSTITUTIONAL ADVANTAGE			+	+	+		
PEDAGOGICAL DEVELOPMENT		+	+	+			+

The research strategy is both deductive and inductive. I used the convergent parallel design subtype of the mixed (quantitative and qualitative) methodology, so quantitative and qualitative data collection and data analysis were carried out independently of each other

and thus offering complementarity. (Király, Dén-Nagy, Géring és Nagy, 2014) Triangulation for several partial problems was applied in order to arrive at more reliable conclusions, since triangulation means the simultaneous use of different methods, techniques or source groups within one problem solving. (Sántha, 2007)

In the course of **document analysis**, I analyzed the professional materials belonging to the background of the research, not to the purpose of the research. From the first phase of the research, I have analyzed the decisive pedagogical documents, such as the National Core Curriculum for Kindergarten Education, the National Core Curriculum and the Central Framework Curricula, the maturity requirements, and the output requirements of higher education. I analyzed the biodiversity content of textbooks (Grades 5.-11.) of natural science, biology, environment, and complex science, those textbooks that were listed in the official Hungarian textbook register in 2016-2019. I completed the document analysis with the new Draft National Core Curricula published in August 2018 and with the 2019 textbooks. Regulatory texts, textbooks, assignments, callouts were evaluated for clarity, scientific accuracy, and student activity, as I treated these as key issues in terms of learning and teaching.

A series of **structured telephone interviews** was conducted with employers and bosses of outdoor environmental educators between September and December 2018. The 47 interviews were recorded anonymously on paper. In my estimation, the 47 interviewees achieved represent more than half of all potential interviewees. The work leaders of all the national parks, larger zoos and showplaces, greater NGOs known for their environmental education activities, and some professional umbrella organizations have provided the sample. I applied snowball sampling method: the first interviewees were able to recommend additional employers themselves.

Through **online questionnaires and focus group interviews**, I collected opinions on the importance of biodiversity awareness, biodiversity attitudes, biodiversity teaching, and pro-biodiversity activity among kindergartens and schools providing different types of environmental education, by external interviewers. As the topic of the extent of biodiversity becomes relevant only in high school, I focused on the knowledge of Natura 2000, a new European nature conservation instrument, in this study.

The two questionnaires and the focus groups investigated partially identical questions to enhance the reliability of the measurement. In the interviews and online questionnaires, the questions focused on comparing the views of employers, educators and students on nature-, and on biodiversity-related learning with the pedagogical (and heritage and sustainability-related) idea that students are competent in the diversity of life, and have a positive attitude towards maintaining diversity at the end of secondary school. Each question generally consisted of two parts: first, questioned people had to judge the importance of a particular statement, and then the extent to which the statement was characteristic to their practice and their institution's practice.

One of the online questionnaires provided kindergarten and school surveys. In the spring of 2016, kindergartens (with and without a green kindergarten title) and schools (with and without an eco-school title) participated in the institutional survey, with representative sampling at the NUTS2 region-level in Hungary and at institution type level.

The other online survey was targeted at the results of the teacher training (including Natura 2000 content as part training) I have organized and led and at the training experiences of the teachers who participated in those courses. At the beginning of the training, the attitudes of the entrants to the issue of sustainability, including the Natura 2000 theme, could be examined. In-service training includes six hours of activities to introduce the Natura 2000 system (learning about the Natura 2000 approach, learning how to gather information on Natura 2000 values) and integrating local Natura 2000 knowledge into the activities of the green kindergarten / eco-school. Training output opinions were measured immediately after the courses, therefore the data set is not suitable for impact assessment, but it is for content reflection.

Also in spring 2016, a focus group interview series was conducted: green kindergartens and eco-schools, i.e. the eco-labeled institutions, were surveyed, including how the Natura 2000 theme appears and how it is treated in the learning process. My focus group interviews were conducted in 82 institutions (3 groups in each).

Pedagogical development was based on the coordination and leading of a wide range of experts and included a significant amount of individual work. Using the conclusions drawn from document analysis, in-depth interviews, and interviews with leaders of kindergartens, schools, and non-school environmental education center leaders, I have:

- made a short biodiversity index calculation exercise;
- made 20 digital learning assignments on the National Public Education Portal (see individual links in Appendix 8 of the dissertation);
- established and managed the 'Traces of Life' Campaign[4] for three years: a community experiential educational action that combines the learning benefits derived from pleasures in nature, from digitally accessible Natura 2000 datasets, and from social media usage (i.e. online content sharing of participants' visual inputs), while allowing groups to spatially and (over the years) timely connect with each other and with the land around;
- brought together the work of over 50 different experts to compile a series of pedagogical auxiliary materials with a game application-assisted (*N2K@Land*) textbook-series and workbooks (*Go Natura!*) on biodiversity knowledge, and I have led the accreditation of three related in-service courses for eco-educators, that later provided a total of 38 courses for 770 participating teachers.

[4] See short English description of the Traces of Life Campaign *(Budapest)* at the EU DG ENV website: https://ec.europa.eu/environment/nature/natura2000/EUnatura2000day/archive/2018/index_en.htm

Theses

Thesis 1.

As of 2017, the maturity requirements as a public education regulator has unquestionably required the development of a basic level of biodiversity literacy by the time of graduation, at least when it comes to students preparing for final exam on complex science or on advanced biology, and to their teachers. Secondary school textbooks, with two exceptions, adequately capture the concept of biodiversity. Abstract conceptualization is hardly supported by framework curricula and textbook exercises.

The need to understand biodiversity can be deduced from the interest of preserving natural values and thus, its role in general literacy. Understanding that the degree of biodiversity also contains information about system complexity and stability requires abstract thinking. Understanding that the degree of biodiversity also contains information about system complexity and stability requires abstraction. However, the found literacy requirement - in the system and practice of public education and in the workplace requirements of field environmental educators - reflects only the simplest content of the concept: 'species richness'. Nature conservation instruments also support the simple interpretation.

Two of the many secondary school textbooks examined allowed for superficial interpretation or misunderstanding (vocational complex science textbook Grade 10, biology textbook, Grade 12, Mozaik Ltd.), the others were perfectly enough for students and their teachers to understand the biodiversity concept. In several high school textbooks, instructions focus on the difference between species richness and biodiversity.

Of the investigations that have been conducted, document analysis has shown that secondary grammar school students learning advanced biology, vocational school students preparing for regular complex science final exam or environmental and water management students preparing for vocational final exam, altogether giving less than one-tenth of the graduate students in these subjects, and their teachers related, have to understand the difference between species richness and biodiversity. Prior to 2017, the text of the biology maturity requirements allowed for superficial interpretation or misunderstanding.

Thesis 2.

Natura 2000-based learning in the teaching of biodiversity would be scientifically and didactically appropriate as well. However, on the basis of document analyzes and teacher interviews, teachers are generally not prepared for this.

The European Natura 2000 system is specifically designed to maintain a high level of biodiversity, at different levels of organization (within species, within habitats, within ecosystems). Based on focus group interviews teachers were able to interpret the Natura 2000 system in a lay way by referring to public media. Of course, there are exceptional high school biology teachers who teach biodiversity in a scientifically and didactically appropriate way, building on the opportunities offered by the Natura 2000 system as well. Behind this exceptional nature of educators, there may be the professors of teacher

education, as long as they were effectively taught experiential learning and teaching, and teaching based on personal relevance, in addition to age-appropriate processing of biodiversity.

Output requirements for higher education in teacher education and for other science disciplines refer to biodiversity in three pedagogical training (biology teacher; science teacher; technology-lifestyle-handicraft teacher), but not mention it in all other programs. Of course, analyzing the requirements does not mean that instructors do not teach biodiversity with its extent, especially in the light of the fact that we have witnessed the collapse of global and regional biodiversity over the past decade and a half. This latter trend is the reason behind my expectation to higher education enhances formally the value of biodiversity education in the future, for example by naming it in output requirements.

Thesis 3.

Public education regulators do not, two of the listed pedagogical materials deal with the Natura 2000 system in a very superficial way that does not appeal to students.

The Natura 2000 system has personal relevance: it gives a living environment, a livelihood and a daily practice in one fifth of our country's territory. Engaging and thus effective learning would be facilitated by working through socially, locally valid examples and actions or even through learning by the interpersonal relevance of biodiversity. In a problem-based (problem-solving) biodiversity learning process, social and personal relevance become naturally evident for the learner.

Based on the results of document analysis and teacher and student opinion surveys, Natura 2000 content (independently of the teaching practices and interpretation of biodiversity) appears in grades 7 and 10, biology. I could not detect it in other grades, nor in other subjects or as cross-curricular content, and only sporadically as a place of learning. Prior to my development work, there was one type of inner learning motivation phenomenal: learning Natura 2000 based on national pride. This is, of course, very important, but in the pedagogy of sustainability, classroom and outdoor activities that help to sense local and personal relevance are indispensable.

As rare exceptions, there were kindergartens that at least dealt with the Natura 2000 theme in educational activities or in the locations of the activities before 2015. Where Natura 2000 is integrated into school life, is included in the eco-school annual program; or in class lessons (biology or geography). In 2016 only 24.7% (16-30% by region) of respondents are familiar with or believe they know the Natura 2000 emblem, 75.3% do not. Institutions with eco-pedagogical title have a significantly higher rate of awareness of the emblem, 36%, compared with 22% of non-eco-labeled institutions. None of the eco-school students of focus groups knew that they had ever been to a Natura 2000 site, which is unlikely given that 22% of the country area has such a designation.

The meaning of the Natura 2000 nature conservation instrument system could be interesting to the students because of its nature embedded in lifestyle and economic activity. However, they were not covered by earlier pedagogical materials or by those of nature conservation promotion. These aspects were not even covered by earlier pedagogical materials nor by those of nature conservation PR. The familiar textbook content and materials, with the

exception of those developed under my guidance during 2015-2016, do not carry Natura 2000 content relevant to formal education.

I suggested a short numerical exercise to make anyone aware that biodiversity changes significantly not only with increasing or decreasing item (e.g. species) numbers, but also with changes in their frequency. The lesson can be done as a demonstration by a teacher in mathematics, IT or biology, or by a high school student without even knowing the logarithmic functions, just as an applied IT exercise. The assignment can be solved individually or in pairs in advanced high school mathematics education.

I created a complex learning-teaching set (Go Natura!) in a network led. The toolkit includes: 7 manuals for teachers + 7 manuals for kindergarten teachers + 2 workbooks for kindergarten kids and pupils + offline and online game application for 5–15-year-old pupils in Hungarian and English + 3 accredited teacher in-service trainings. I have introduced the toolkit in many ways and for different audiences. We conducted a total of 38 in-service training sessions for 385 + 387 kindergarten teachers and teachers together with my colleagues. At the end of 2016, the printed materials were distributed to libraries of Hungarian teacher training universities and to larger field education centers.

A 'Traces of Life' Campaign was established and operated in addition to the Go Natura! Series, and to field learning and in-kind experiences. The action combines the knowledge of the Natura 2000 concept, the learning benefits derived from pleasures in nature, and the pedagogical use of digital opportunities. I consider it important to accurately select and identify Natura 2000 sites in accordance with Natura rules. Thanks to this step, anyone who support the action will, in the future, be able to identify Natura 2000 sites and the specific values of each site.

Thesis 4.

Public schools that are consciously and publicly committed to environmental education and eco-pedagogy (green kindergartens and eco-schools) are using significantly more accurate Natura 2000 content and more innovative environmental education methods and more outdoor learning.

According to my results, the within-institution (school, kindergarten) learning and activity are much more common than the field-based forms of learning that require more resource, more collaboration and may require cooperation with external actors in any kind of school or kindergarten. In general, learning in nature is much rarer than desired across the country and across all types of public education.

According to the answers, 5-13% of kindergartens never take their children even on to short trips. Two thirds of kindergartens in Northern Hungary and Central Transdanubia never organize a forest kindergarten program, while one fifth in kindergartens in West Transdanubia, South Transdanubia and Central Hungary organize it every year. Schools take students to forest schools - typically - either annually or not at all. Surprisingly, one fifth of the schools do not organize an excursion a year or ever.

Unfortunately, long trips and forest nurseries, even for green kindergartens, are the rarest of the surveyed methods. At the same time, green kindergartens and eco-schools are not only theoretically consider learning in nature more efficient, but they also employ more natural

learning situations, are better prepared and devote more learning resources to this topic than the other, non-eco-labeled institutions. They are more likely to use innovative methods of teamwork, educational project assignments, forest nursery or forest school, student research and action. It is interesting to note that in the focus groups of eco-pedagogues I received several opinions that 'activities related to waste management and garbage collection are overrepresented' in the eco-activities of kindergartens and schools, and 'there is a need to shift the emphasis to living environment and health education.'

Students want nature history to play a greater role in schools; they would prefer more outdoor activities (such as landscaping, gardening, visiting green investments and developments), more hiking, more biking, more excursions, more learning projects, and generally more activities to promote environmentally conscious behavior. Student focus group responses indicate that they prefer those classroom activities that include activity, work in group or pair work, or physical activity. It is reasonable to assume that even in field learning situations they prefer group and pair activities. They have traditionally had a good opportunity to do so in standard field learning situations, and they are given such tasks and challenges, at least by civilian and national park environmental educators.

The institutional distribution of the examined natural education practices, topics and principles has a clear advantage for eco-labeled institutions in the online nationwide representative measurement. Along the green themes, the difference found in 'relationship with neighboring actors' is the largest between eco-labeled and non-labeled institutions. The vast majority of green title holding institutions are in contact with external partners, while non-labeled ones report occasional contacts with local actors. Also, the practice of composting, gardening, cooking and learning based on local natural (conservational) value are more common in eco-label schools and kindergartens. Eco-labeled and non-labeled institutions differ the least in terms of 'paying attention to the global impact of meeting local needs', but this is still significant.

The parent-kindergarten cooperation is carried out in many areas (waste management, plant care, hiking, kindergarten parties) according to the green kindergarten parent focus groups. It is also recognized in many places by parents that kindergartens make good use of the local environment. Parents are familiar with all forms of green days, bird feeding and plant care from the work of green kindergartens.

Thesis 5.

At present, understanding and measuring the extent of biodiversity is not considered to be an important objective of natural education in the field learning process.

The degree requirements for non-pedagogical higher education (HE) and for post-secondary vocational education relevant to outdoor environmental education do not explicitly mention biodiversity (and its related concepts) as knowledge and competence to be acquired. As the main requirements do not prescribe, the concept of biodiversity can be treated by HE educators as competences acquired in secondary education, which, however, as presented above, are uncertain.

According to my research, in the case of field environmental educators who do not work in kindergarten or school, teaching or presenting the essential feature of biodiversity, namely

its extent, was not proved to be a significant workplace requirement. (An exceptional wording from an employer: ‘One have to understand the logic of biodiversity. Biodiversity is information.’) Field environmental educators could only be prepared for the job because of their professional commitment and, possibly, their initial degree or in-service education. The work of field environmental educators contributes to the affective factors of learning biodiversity by staying in an interesting, special, beautiful or prideful natural environment; staying amongst natural values that pupils, students can observe and enjoy. Activities (as habitat maintenance, role play, student research) based on real conservation issues or local beliefs, lifestyle and habits support effective learning. These kind of field activities themselves facilitate the affective and effective factors of learning biodiversity, but not the abstraction or cognitive development requiring increased concentration.

Thesis 6.

Field or in-school learning events organized around the Natura 2000 system support experiences in understanding the importance and nature of diversity. The completed toolkit development supports science-based and didactic biodiversity learning and, through the involvement of stakeholders, provided mutual competence development among participating scientists, conservationists, kindergarten teachers and teachers, and field environmental educators.

The Natura 2000 system has been operating in Hungary for one and a half decades. The communication role of its public benefit (i.e. benefits other than of land users, farmers) is focused on providing nature experiences and uniqueness, or reciting legislation in general awareness-raising practice which itself is less motivating for laymen and students, instead of emphasizing to preserve European biodiversity.

Based on my managerial interview series, the introduction of Natura 2000 for national park, forestry and civilian environmental education staff did not change employer expectations for staff. Didactic (methodological) innovations are expected by the few local leaders who recognize that pedagogical ability and personal effectiveness are more important than science content. (One example of the two: ‘You need a pedagogical ability, followed by a knowledge of nature, from any source. You have to deal with the child, not the nature or the environment. The miracle is what they [pupils, visitors] experience through it.’) Two out of the 47 interviewees formulated opinions supporting constructive pedagogical learning theory. The others focused on either 'transferring knowledge' or acting, that is to say, if didactically unconsciously, they evaluated the work of their environmental education staff according to two other learning theories. This means that field-based environmental educators are not expected to have learning-centered, constructive organization of learning and environmental education.

As an interim result of my research, between 2014 and 2016, methodological and content innovations were made for areas and/or NGOs of whose experts, managers, or environmental educators participated in iterative, community-based learning kit design. At the time of developing the materials and training courses, the ‘network-like cooperation’ between scientists and environmental educators and educational institutions, which had disappeared for half a decade, was revived, which was an added benefit of my work. Mutual knowledge sharing and competence development has taken place between nature conservation

professionals and bodies, pedagogical developers, digital developers, environmental and socio-economic organizations, scientists and analysts in the field of science and society.

From mid-2015, the piloting of a number of pedagogical tools (handbook with 92 field modules for all ages and regions, workbooks, N2KaLand (N2K@Land) game application, teacher in-service trainings) has been successful. This work aroused the interest of teachers in the Natura 2000 theme, which is an important achievement in itself. As a result of the intensive and multi-stakeholder development process, a more relevant (more accurate and effective) Natura 2000 learning content and methodology is available from 2016 to any educator and non-teacher environmental educator. The most advanced methodological chapter of the series, which includes field games and short activities, has been made available in English.[5] Thanks to this, for example, a twenty-year-old Hungarian field methodology, the joy-sorrow mapping (happiness-sadness mapping), has once again become the focus of environmental educators across Europe.

Thesis 7.

A characteristic and newly described element of the Hungarian history of environmental education and sustainability education is present in the first half of the 19th century: animal protection attitudes appeared at the Annual Conferences of the Hungarian Society of Physicians and Naturalists and at the Hungarian Society for Natural Sciences of that era.

Animal welfare disputes of those old scientific fora, and influenced by the famous agricultural school creators (János Nagyváthy, Ferenc Pethe) even earlier during the 19th century at the Georgikon College of Keszthely and by the works of Ferenc and István Széchenyi can be regarded as an important ancestor of the Day of Birds and Trees. The Day was introduced into school life after its' first tests at the end of the 19th century. At the beginning of the 20th century, celebrating this memorial day became compulsory for public educational institutions. This first green day is an iconic point in environmental and nature education.

Utilization of results

Within the cultural and literacy system of means and institutions, the education system, among others, must respond and adapt to the process of biodiversity devastation that threatens the survival of culture, the civilization. For this, the understanding of biodiversity and its extent is essential.

The apperception of biodiversity manifests on a lower level than its cultural significance suggests. Time by time we are confronted with a common reductive, juvenile interpretation of the concept of diversity: reducing it to lists of species. It happens even at the closing stages of secondary education, or in talent management (competitions) of secondary schools. Restricting biodiversity to species lists (of which ecological information level is:

[5] Download: http://ofi.hu/sites/default/files/attachments/natura_2000_games.pdf

presence/absence,) is deteriorative for a variety of reasons. These are the randomness of the items (elements) included in the species; the sensitivity of the species lists to the intensity of data collecting, and, above all, the lack of abundance or frequency variables.

I examined the process, tools and actors of teaching biodiversity and related Natura 2000 concepts inside and out of public education. Summarizing my suggestions, the assessment and interpretation of biodiversity in public education can be improved by:

a) precise definition of species richness and diversity, biodiversity in all secondary school materials, clarification and improvement of the wording of the vocational high school science textbook and in the 12th biology textbook of the Mosaic publisher;

b) teacher education and in-service training teaches the concept in a simple and effective manner;

c) pupils and HE teacher students receive at least twice as much field education as they currently have; and

d) sufficient time and space are provided for environmental educators and communicators in preparing for constructive pedagogy and for modern ways of experience-based learning.

The prerequisite for all this is that the output (maturity) requirements related to biodiversity will not be reduced compared to 2019. After the beginning of my research, the advanced biology maturity requirement was modified[6] as of January 2017. It precisely defines biodiversity, thus preventing the spreading of misinterpretation or imperfect interpretation caused by the earlier wording among secondary school teachers. The amendment was independent of me, but it significantly influenced my results.

It is needful that all high school textbooks in biology or science use proper wording of species richness, multiplicity and of diversity, variety. In present and future national curriculum work I look forward to retaining the most important dimensions of the concept of biodiversity: variability, specialty and evenness (i.e. richness, quality, and density), both in the advanced level biology maturity requirements and in the curricula.

Hungary represents a unique value in the European Natura 2000 system, and it affects one-fifth of the country's territory with the purpose of preserving this unique biodiversity value. Because Natura 2000-related utilization (farming) is easy to understand, many innovative eco-pedagogical approaches can be applied to the Natura 2000 theme. The theme is suitable for all ages and groups of students. I recommend that Natura 2000 themes be used by those working in public education, adult education, higher education, and non-formal and informal learning.

The ‘Traces of Life’ Action linked to Natura 2000 as a playful learning based on community research and appreciation of local biodiversity values was established and proved in 2016. The action was repeated in 2017 and 2019 by the Educational Research and Development Institute of Eszterházy University. The action can be repeated year after year during the late spring nature holidays and class excursions.

[6] 33/2015. (VI. 24.) educational decree amending the 40/2002 (V.24.) educational decree on the detailed requirements of the final examination.

Basing on the natural curiosity of learners, the concrete, action-based, experiential learning, that often happens outdoor, and based on digital tools, is obviously not limited to the Go Natura! series. Learning in and from nature offers indispensable benefits not only for scientific but also for social, linguistic, mathematical and artistic knowledge, as well as in personality development. The natural environment provides an excellent opportunity to support sensorimotor development, experience positive feelings, self-knowledge and self-reflection. It is good for as many learning communities as possible to have their own good practice in outskirt pedagogy based on schoolyard, forest school, camp, outdoor student research, for which the tools developed provide support.

For the first time in Hungary, a national survey on employers' expectations of environmental educators has been revitalizing the eco-educational profession in several ways. The survey also attracted the attention of employers and higher education institutions (which have various programs releasing environmental educators), as well as the attention of central management of the nature conservation sector. The quality of the environmental education profession has given rise to a new chapter in the National Environmental Education Strategy: a chapter on eco-educators. Based on my example, the concept of *eco-pedagogy* started slowly spreading to replace the many cumbersome vocabulary (sustainability education, global education, natural and environmental education, education for sustainability).

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Könczey R, Czippán K (2019): Preliminary examination of potential motifs of ecological origin as identity elements in an adult group, Hungary. jATES Vol 9.: No. 1. pp. 5–16

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Albert J, Bojtor A, Czippán K, Könczey R, Kray Zs, Sziva D (2018): A fenntarthatóság tanulása és tanítása – módszertani gyűjtemény. (Learning and Teaching Sustainability - A Methodological Collection. National University of Public Service) Nemzeti Közszolgálati Egyetem, Budapest, Baja. 230 pp.

Könczey R (2017): *Ott vagyok honn, ott az én világom* - ökológiai motívumok, ökológiai identitásalkotók. XI. Magyar Természetvédelmi Biológiai Konferencia 'Sikerek és tanulságok a természetvédelemben' (Ecological motifs, ecological identity elements. Plenary at Hungarian Conference on Conservation Biology): plenáris előadás, Eger, 2017. és Absztraktkötet (2017) p.28.

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Könczey R, Halácsy Á (2016): N@túrázzunk?! Digitális Oktatási Napok, (Do Natura?! Section at Digital Education Days) Budapest, 2016. december 7–8. (konferenciaelőadás)

N2KaLand – mobil and PC application game for children 5–15. Professional designers: Könczey R és Halácsy Á (OFI, 2016 december) in Hungarian and in English, see at Google Play, iOS and http://ofi.hu/letoltheto-dokumentumok

Natúrázzunk! (Go Natura!) Natura 2000 handbook for eco-pedagogues, 14+2 part book textbook series. Editors: Haraszthy L, Könczey R, Neumayer É, Halácsy Á, Széger K; Authors different by items (OFI, 2016) Download: http://ofi.hu/letoltheto-dokumentumok

Examples:

Haraszthy L, Könczey R, Neumayer É, Halácsy Á, Széger K (eds.): Natúrázzunk! Natura 2000 kézikönyv zöld óvoda pedagógusoknak, Dél-Dunántúl régió. (Go Natura! – Handbook for green kindergarten teachers at South-Transdanubia.) Budapest, Magyarország: Oktatáskutató és Fejlesztő Intézet (OFI) (2016) , 80 p.

Kondorosy Sz, Halácsy Á, Könczey R (authors); Könczey R (ed): . (Go Natura! – Booklet for kids.) Natúrázzunk! Foglalkoztató füzet zöld óvodásoknak és ökoiskolásoknak , 20 p. (2016) Budapest, Oktatáskutató és Fejlesztő Intézet (OFI)

Haraszthy L, Könczey R, Neumayer É, Halácsy Á, Széger K (eds.): . (Go Natura! – Handbook for ecoschool teachers at Central-Hungary.) Natúrázzunk! Natura 2000 kézikönyv ökoiskola pedagógusoknak, Közép-Magyarország régió. Budapest, Magyarország: Oktatáskutató és Fejlesztő Intézet (OFI) (2016), 78 p.

Halácsy Á, Kondorosy Sz, Könczey R (authors); Könczey R (ed): Natúrázzunk! Rejtvényfüzet ökoiskolásoknak. (Go Natura! – Puzzle booklet for ecoschool pupils.) 20 p. (2016) Budapest, OFI

The list of 20 digital modules for biodiversity learning and environmental education (student assignments and best practices) prepared and published for the National Public Education Portal can be found in Annex 8 of the dissertation.

The above list contains only the most important publications concerning the dissertation. Other scientific publications can be found in the Hungarian National Scientific Bibliography (mtmt.hu).