1.2019

JATES

Journal of Applied Technical and Educational Sciences

Papers

ISSN 2560-5429

JATES

Journal of Applied Technical and Educational Sciences

Publisher
ST Press, Subotica

ISSN 2560-5429

Preface

This issue is a thematic volume dedicated to environmental education and sustainability with 8 articles. Environmental education is more and more important theme of our everyday life, and it was the main goal of the organising Committee of International Environmental Education Conference in Eger, IEEC 2018, held from 30th May to 1st June 2018. IEEC is the conference where good sustainable practices and their educational aspects can be presented for the wide public and for experts at the same time. Six scientific articles have been submitted as previous presentations of IEEC2018.

The following publications are topics from among environmental education themes as the practical analysis of knowledge elements in connection with plants in school biology textbooks by Éva Nagy. According to her content review the hierarchy of botanical knowledge elements should follow the biological conservation and national native plant conservation priorities.

The article, written by Katalin Szalay, Zsuzsa Emri and Károly Antal deals with the environment, nonspecific factors of drug consumption among young people. Researchers aim to find the implications of environmental inequities for disparities in substance use disorders and treatment outcomes. More detailed knowledge about the environment within the drug is consumed helps to form rule that are approved.

In the article of Ferenc Mónus environmental attitudes were investigated and self-declared behaviours as consumer habits, healthy food habits, thrifty habits, waste management. Not many previous study have investigated environmental awareness of students in such a diverse sample of schools (875 students from13 secondary schools)

Réka Könczey and Katalin Czippán wrote about an interesting topic within environmental education: sustainable development by exploring the details of people's potential set of motifs with local natural environmental content. They also examined the correlations of these potential motifs with ecosystem services.

What is edutainment in the Magic Tower? Izabella Benczik introduces it to the readers. Magic tower refers to the tower of the Lyceum building of Eszterházy Károly University in Eger which is operating as a centre of exciting teaching methodology and scientific exhibitions. Light pollution, solar energy, energy saving light bulbs are among the examples of the environmental issues discussed in their events.

Lívia Kürti deals with a permanently actual theme within environmental education: the topics of water and hydrology knowledge in Geography and Science education. She gives a short overview about what and how we teach about water.in primary and secondary school.

Outside education themes are very important areas of ESD, so it is a good way to develop and enrich the knowledge about environmental education trails with Zsuzsanna Angyal and her co-author, Katalin Négyesi.

The article of Éva Kovács-Bokora, Endre Domokos and Endre Kiss is about industrial sludge use for producing plants examine the process which starts with germination and it is a very sensitive part of the technology.

Journal of Applied Technical and Educational Sciences 2019/1 Volume definitely deals with the actual needs of education and gives a colourful picture about environmental education research. The publications show: we must think about school and life-long learning aspects of environmental education in a deeper and more practical way in the future.

1 of March, 2019

Erika Pénzesné Kónya,

Guest Editor

www.jates.org

Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.73
http://doi.org/10.24368/jates.v9i1.73

Preliminary examination of potential motifs of ecological origin as identity elements in an adult group, Hungary

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Abstract

The motifs (notions and concepts, in their psychosocial sense,) that make up the ecological identity and the other components of identity have been studied for two decades in several countries. We present a preliminary set of those potential motifs of ecological identity formation that come from the Carpathian landscape and landscape-related symbols. The elements of ecological identity of an adult group of Hungarian citizens, namely public administrators from all over the country, interested in learning for sustainable development have been collected by exploring the details of their potential set of motifs with local natural environmental content. Correlations of these potential motifs with ecosystem services were examined as well.

Potential or effective ecological motifs originating in the natural environment, in the local ecosystem of a group of adult learners were found to be mainly sensual notions. Old school or family excursions were also very common; as well as the fixation of imaginations and feelings belonging to memories of recreational sites. Well-known, frequently visited tourist sites are also reflected in ecological motifs. Concerning ecosystem services, the ecosystem elements that give an aesthetic sensation (namely, the cultural ecosystem services) are the most common and the strongest.

Encoding and seriating this set of ecological motifs serve to design a structured survey in the future. The examination of potential or actual ecological motifs of ecological identity, their formation and fixation can provide another point of reference in all areas of sustainability education, especially in environmental education, in global education, but also in aesthetic and moral education.

Keywords: ecological identity; ecological motifs; local natural environment, cultural ecosystem services

1. Introduction and background

An adult's self-image (identity) consists of many components, showing all the individual and community attributes that he or she consciously identifies himself/herself with. Identity, whether self-identity or the image of someone of others, almost always means not only perceptions but behaviours. An action is an elementary behavioural unit which is directed by a physical motive

also appearing as a mental motive, or by a mental motive in itself and has an independent consequence regarding its motive. This concept of action does not include physical-needs-driven behavior, and cannot be limited to purpose-driven behaviors only. It includes behaviors motivated by emotions and habits, regardless of whether these motifs are intended or not. (Farkas, 2017)

Physical or physiological motifs characterize the individual as a living being, such as hunger or thirst. Mental motifs, however, are the specific functions of the central nervous system, such as emotions, expectations, habits, goals, and so on. Within this, cognitive motifs are ideas that pertain to the consequences of actions. The motives trigger the actions. (Bandura, 1986) Motivational consciousness is a deliberate group of intentions that are the basis of sociological, such as environmental sociological or environmental educational (learning) considerations. Due to our interest in ecosystem services as a framework, it should be noted that the perceivable or conceivable elements of the environment can become personal motifs through their factual or symbolic character. Symbols are not primarily relevant in themselves, but through the transmitted meaning they carry.

1.1. Ecological identity and potential ecological motifs

The elements of ecological identity of an adult group of Hungarian citizens interested in learning for sustainable development have been collected by mapping the details of the natural, landscape origin content of their personal motifs.

Environmental identity is part of the way in which people form their self-concept: a sense of connection to salient parts of the nonhuman natural environment, based on history, emotional attachment, and/or similarity, that affects the ways in which we perceive and act toward the world; a belief that the environment is important to us and an important part of who we are. (Clayton, 2003) More specifically, the self-concept can be considered the sum of the cognitive and affective representations of the individual (and the consumer) itself (Sirgy, 1982), while identity is a social construction. (Baumeister, 1997)

Theories of personality development examine the age-related and the individual (environment-dependent, crises and experiences related) evolution of identity. Mitchell Tomasow (1995) collects the sources of natural experiences that lead to the manifestation of ecological identity. These include a range of memories from childhood locations, disturbed habitats or infamous environmental catastrophic sites, to wilderness meditation sanctuaries. The author notes that these are motifs because they have changed the personality the moment the person realized that its self-image was inherently related to his or her experiences in nature.

Ecological identity and willingness to or positive attitude toward (protecting and/or enjoy) the environment are correlated. (Schultz et al., 2004; Csonka, 2018; Molnos and Fetyko, 2018) We consider motifs as of the personality theory considers. Motifs and potential motifs – those available to the individual - together can be cornerstones of socialization with and for sustainability. The reflective knowledge of motifs is important for the people themselves, and of course, it is good for environmental educators, environmentalists, or even strategists.

In our present work, we do not dwell on the other features of ecological identity discussed in the literature: neither the environmental conscious attitudes and behavior patterns discussed in Hungary, nor the ecopolitical and deep-ecological relationships or the resource-sharing networks.

1.2. Ecosystem services

The concept of ecosystem services was made known to the Millennium Ecosystem Assessment (2003) based on the work of Robert Constanza et al. (1997). A summary of services provided by Sándor Orbán (2015, in Hungarian) argues that ecosystem services are the natural resources of sustainability. This argument looks false because several inorganic planetary materials are relevant natural resources for mankind, and because ecosystemic origin of a resource is irrespective of whether or not its use is sustainable. Although the difficult situation of the Hungarian language and professional language concerning “ecosystem” is precisely defined in András Báldi's article (2011), there is an outlasting simplified concept in a number of popular and professional articles (at least in Hungarian) in this sense: "Ecosystem services are the many benefits that humanity receives from the living world.” The sentence is incorrect because of the inclusion of "living world".

The relationship between ecosystems and mankind is understandable when we look at the resources produced by one-time ecosystems we use nowadays: the fossil resources. Humanity, however, uses resources (for example, ores) that cannot be classified among the benefits from the living world. Here we strictly use the original interpretation of ecosystem services rather than the simplification (bound to the living world). .

In this article, we have used an improved version of the ecosystem services described in 2003 (WWF, 2016), which is illustrated in Figure 1. Provisioning services are our resources directly derived from ecosystems, i.e. products: food, water, raw materials, medicinal substances. Regulating services are the benefits of the regulation of ecosystem processes. Cultural services are benefits from ecosystems that are not material. Maintenance (or supporting) services are essential to the production and production of all other ecosystem services. Later, the regulating

and the maintenance services were merged in the CICES concept (version 4.3.) widely used in Europe (Haines-Young and Potschin, 2013).

2. Methods

2.1. Sample

The potential ecological motifs provided by the Carpathian environment were collected from September 2015 to December 2016 at a total of 17 sustainability training courses organized for in-service education of public administrators by the National University of Public Service, Budapest. As students have chosen this training from hundreds of opportunities, we have assumed that they are interested in the complex theme of sustainable development. They came from all over the country, from a large number of central and local administrative positions and had the widest variety of competencies. Data on ecological identity was recorded as free text question in the second hour of the 16 hours (2 consecutive days) long course, after the ecosystem service concept was introduced. As a summary of the ecosystem services section, we made the data collection. 272 people (212 women and 60 men, reflecting the 0,73 women rate of the public sector, see Lovász, 2013) participated in the survey.

2.2. Data collecting

Participants did not encounter the concept of ecosystem identity before, they first encountered it in a game during the training. The instruction was like "Does anyone in the room can illustrate the ecological identity of Sándor Petőfi[1] with a verse of him?", actually within a Bingo activity. The task was accomplished jointly by all 17 training sessions. Students were asked to write down individually those decisive memories and moments with positive memories and feelings that have ecological service linkage within the Carpathian basin. Because of the sensitivity of the training situation, motifs were collected anonymously, without any identifiers, in a non-mandatory task, as single line free text answers. The overwhelming majority of participants wrote their short reminiscences with great pleasure. Some, less than one-tenth of the students, did not participate in the task. Respondents had 1-7 motifs per person, 4,26 on average.

2.3. Coding

The collected 1161 items, belonged to 683 semi-repetitive motifs. The occurrences were recorded in a database and then encoded by their attributes (e.g. systematics, urban or rural speciality, related ecosystem services, image or verbal information type). Most of the motifs

[1] Sándor Petőfi is the most famous Hungarian poet. His poems are the best-known lyrics of Hungary.

carried several attributes at one time. Data were insufficient to analyze the timing of motifs (such as of childhood origin or fresh memories) neither their narrative nor semantic origin (concrete experience or general knowledge of unidentifiable origin). Four motifs were identified as concepts (spring, water, watercress, green), all other were either notions (66), or a complex set of notions and concepts. There were some motifs that could not be grouped, such as rainbow, lure, water mills. In the present study, we did not take into account items from ecosystems other than the Carpathian Basin.

Encoding has been performed according to the following characteristics. Unless otherwise indicated, the 0/1 (no / yes) values could be obtained by the motifs according to their characteristics. Features were: image / verbal / mixed information; food; drink; verb; geographical name; fragrances; sight; sound and silence; touch; general landscape element (mountain, lake ...); natural habitat; economy and farming; cultural landscape; inhabited area; rural; urban; animal in general; pet or livestock; wildlife; cultivated plants; wild plants; herbaceous; woody; geological value; other; abstract; fault. Subsequently, the ecosystem service encoding was performed in the categories shown in Figure 3.

The encoding of motifs was particularly difficult in the cultural group of ecosystem services, including mental and physical health. The original Millennium Ecosystem Assessment, published in 2003, used “learning, education” verbs as a group marker, which would make it easier to link the motifs received. Mental and physical health could have been practically applicable to all elements of this series. This may also be due to the fact that data providers were focused on pleasing memories, and motifs with positive connotation during data collection. We classified (coded) those data into the mental and physical health group which had a presumably (written) health aspect, health motivation or expressed happiness.

3. Results

Except for some participants (training students) from conservation offices, and others environmentally active in their private life, students were unaware (unconscious, irreflective) of their own ecological motifs at the beginning of the sampling. Although they had no conscious and systematically understood emotional connection to the landscape before – landscape in a broad sense –, the vast majority of them took pleasure in the task. Even the professionals (ecologically qualified participants) did not know the concept of ecological identity.

Figure 1. Ecosystem services (WWF, 2016)

Among the 683 different motifs, the most common are the visuals and the geographical indications and names. 246 motifs (473 items) include a geographical name, including Lake Balaton (Balaton alone account for 5.5%, and with complex motifs and phrases for 8.3% in total data), Danube Bend, Danube, Tisza, Hortobágy and Pilis Mountains. Among the motifs that do not include a geographical marker are the Puli (the Puli dog breed), forests (generally), gray cattle (the Hungarian Grey), mountains (in general), poppies and the Tisza Mayfly (*Palingenia longicauda* together with the "flowering" Tisza River) are the most frequent.

By categorizing the motifs by senses, after the visual memories, odors and smells we found to be the most common. (Figure 2.) As already mentioned, a motif may have multiple attributes, even in the sense organ grouping. According to Csapó (1992), the sense organs do not share the same weight with cognition: vision and hearing have a distinct role. According to our present data, from the point of view of (potential or effective) ecological motifs, smells and odors are as important as sounds.

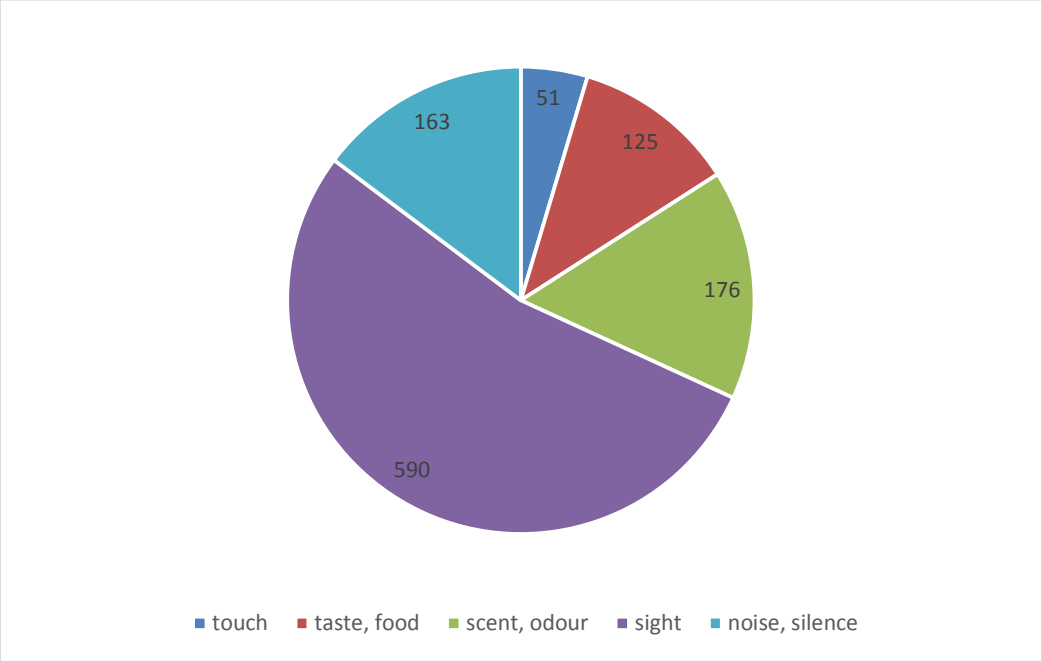

Figure 2. The mentioned motifs of the studied Hungarian adult group categorized by senses (amount of mentions)

Examining the motifs in connection with the ecosystem service groups, the importance of aesthetic elements of cultural goods as ecosystem services and of elements related to recreational services among the named motives were outstanding. (Figure 3.)

Within the big cultural, recreational services (mental and physical health included), a diverse set of situations, places, feelings, and symbols were found after coding. Some interesting examples which contain recreational attributions and motion (verbs) at the same time, were: animal-to-human relation; the livestock yard; scent/smelling of harvest; blackcurrant scent; earth smell after rain; domestic milk and dairy products; traditional low mountain vineyards and their natural and agricultural values; local food; wavy wheat field; garden and gardening; creek barking; old settlements. All these items had only a few (1-2) records.

A high proportion of motifs associated with food or green vegetation. The occurrence frequency of complex, difficult-to-understand or less attractive processes (material flows, soil formation, diseases, pest control) is low, similarly to pollination, pollen or clean air motifs. (Figure 3.)

Verbs, activities occurred in 54 motifs, with a total of 62 items . Among the actions mentioned and action-based imagination, the swimming and the excursion take the lead. Cycling and glamour are sometimes included; others were only mentioned once (for example, collecting rose hips, paddling, admiring the changing clouds; Hargita ski slopes, hiking in the snow, crunchy snow, crunchy dry leaves, walking in the woods, watering flowers, water sports). Their list is included here because they may signal many other notions and images of other several possible motifs which are actually associated with actions that were not written.

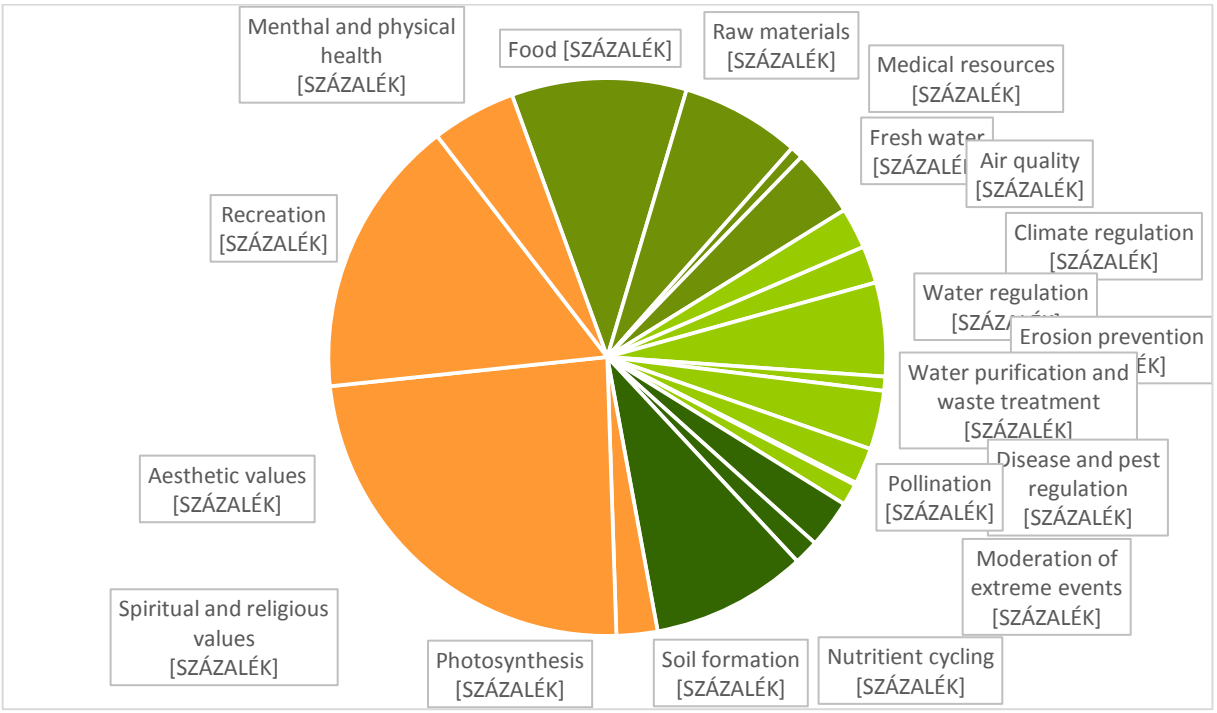

Figure 3. The connection of motifs to different ecosystem services (percentage of mentions according to total data set)

Natural habitats (a total of 170 items, such as Börzsöny forest and water, Bakony spring undergrowth, loessy grasslands, Bugac pedunculate oaks and juniper, Bükk [mountains] and its parts, volcanic cones on the Balaton Uplands) or general landscape elements without geo-indication (forests, rivers, hills, etc.) were mostly mountainous and forested landscapes. Among the images of the urban environment (77 references) the Budapest Danube shore and the Margaret Island, Hévíz, and Tihany are listed several times.

Among the cultivated plants, lavender and grapes are the most common (8-8 items). Of the 60 wild plants mentioned, the poppy and the fairy-tale (*Stipa*) are the most common ones; as well as some frequent /well-known tree species (beech, oak, robinia, pine).

Among the herbaceous plants named at least on the genus level, and among the plants as a whole, the fairy-tale and the red poppy were the most frequent. Lavender, grass, snowdrop, lily of the valley, cultivated onion and wild garlic, paprika, rape, sunflower, tulip are often included.

Between animals, Puli and the Gray cattle are often mentioned, Mangalica (curly pig) and Komondor (another dog breed) have been mentioned more than the others. Among the 116 wild animal species, Tisza Mayfly counts 10, followed by swallows, deer, and storks.

Terrestrial and mineral treasures, formations barely appeared in the data. The following were included in the database: Aggtelek dripstone, Aggtelek Cave, Gerence Valley Cliff at Bakony Mountains, Mount Gellért rock wall, sandstone, sandpit at Szamos, sand of the Körös Throat, touching stones (in general), yellow sand, salt cave, Sukoro Moving Rocks, Úrkut ancient karst,

Vadállókövek, Rám Deeps, flowering rocky slopes of mountains, water resources, red sandstone, volcanic cones on the Balaton Uplands. Only the Aggtelek Cave received several mentions.

Among the 37 drinks mentioned, the following can be related to the ecosystems of the Carpathian Basin: wine and grapes, pure water, linden tea. All other motifs are only mentioned 1-2, including those with milk or brandy (pálinka).

Among the 94 food items, the ratatouille and the mangalica account 5, followed by acacia honey, mulberry tree (Morus), fruit in general, raspberries, paprika, fish soup, and grapes with 3-4 items.

4. Discussion

We concluded that the motifs identified as ecological identity elements, potential or effective ecological motifs originating in the natural environment, in the local ecosystem of a group of adult learners are mainly sensual notions (thoughts based on more senses). Some of these are generated during school life, through cognitive processes. The well-known Hungarian motifs, schemas (stereotypes, moods), could be considered important, but this phenomenon has not been studied individually, as it does not require the collection of ecological motifs, but a text analysis of a standard Hungarian motif set.

As an ecological identity element, old school or family excursions were also very common; as well as the fixation of imaginations and feelings belonging to memories of recreational sites. Well-known, frequently visited tourist sites are also reflected in ecological motifs.

From the classification of ecosystem services, it is also apparent that the ecosystem elements that give an aesthetic sensation are the most common and the strongest.

As described in the introduction, nature-related motifs, and thus their knowledge, are considered to be important as a basis for environmental awareness and sustainability socialization.

The basics and effectiveness of ecological identity can be investigated in several ways. Among the motifs of a networking, active, creative and responsible person, one can suspect a close or far-off environmental damage, a fear of health damage (actual or newsworthy), but also a direct gain or an emotional, cultural, aesthetic affiliation. Conscious, formulated (usually: verbalized, sometimes illustrated), and therefore familiar ecological motifs reinforce environmental awareness and communities. They help people become acquainted with people living in a common space. The process sums up the so-called fourth pillar of 21st-century learning (UNESCO, 1996): the pillar to learn to live together. This pillar was reinforced by the Decade of Education for Sustainable Development as follows: learn to live together, here and now.

5. Summary and Outlook

Establishing emotional attachment to nature in many communities does not go automatically either today. The examination of potential or actual ecological motifs of ecological identity, their formation and fixation can provide another point of reference in all areas of sustainability education, especially in environmental education, in global education, but also in aesthetic and moral education.

The quality of human life basically depends on natural resources, on the "green capital" and the services it provides. Understanding and maintaining these resources are essential to us all. The understanding of complex systems and processes requires complex thinking – something that only a few of us allocate enough cognitive capacity to take the trouble. But emotional attachment has an extraordinary motivating power. The things by which we identify ourselves determines our attention, our learning, our actions. It is therefore important to investigate whether family-based and community-based socialization, education, adult learning, tourism, or the media create a positive bond to which ecological elements and how.

Another important area, although it is better known, the group of news and facts that triggers early or elemental indignation and ability to act, because of their negative, value-damaging nature -- see the environment and media researches, e.g. Székely (2003).

Common motifs, and in particular their threats, can transform their followers into a community, as is often the case. Actions, community moves, or new and renewed value libraries are born - depending on what competencies the community can build.

Enjoying and nurturing the ecological motifs of our self-identity, i.e., in their original occurrence form, gives pleasure and satisfaction. Their impairment, their threats trigger self-defense reactions, or grief, alienation. Knowing ecological motifs in the Carpathian Basin is important for people living together, and for landscape designers, nature conservationists, architects, leisure organizers, and educators. This work does not in any way represent the motif set of adults living in the Carpathian Basin, but it created an inquiry structure for mapping of ecological motifs, and highlighted the likely significance of cultural ecosystem services in identity creation.

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Short professional biography

Réka Könczey is a biologist with behavioural and population ecological studies, as well as an environmental activist since the Danube movement of the eighties. She is recently co-ordinating collaborative research projects in the field of environmental education, sustainability science and working as an educational researcher in the Hungarian Institute for Educational Research and Development at Eszterházy Károly University. Beside being involved in the development and implementation of several governmental strategies for environmental protection and environmental/sustainability education in Hungary she is also the author of a popular book on everyday environmental practices, namely the Green Daily Practices (Zöldköznapi Kalauz) and she is a board member of the Hungarian Society for Environmental Education. https://ofi.academia.edu/R%C3%A9kaK%C3%B6nczey

Katalin Czippán is an educator, having experience in the field of communication and education for sustainable development. She works for the National University of Public Service (NUPS) and as an international consultant on education and communication for sustainable development issues. She served Hungarian and other governments, organizations to develop and implement education strategies, programs, campaigns to connect people with nature for valuing and protecting the planet. She serves as deputy chair of the Commission on Education and Communication of the IUCN. Experienced presenter and author of several books and articles on education and communication for sustainability for example Collaboration and Education for Sustainable Development (2010), editor and co-author of Health Promoting Universities (2015), Social responsibility of public officers (2019).

http://jates.org

Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.68
http://doi.org/10.24368/jates.v9i1.68

Comparing environmental awareness of Hungarian students in secondary schools with different socio-economical background

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Abstract

The importance of education for sustainable development and environmental sustainability (ESD) was acknowledged decades ago. Many studies investigated students' environmental awareness, but the majority are simple descriptive ones. Only few studies try to investigate efficiency of ESD in schools and the causal background that shapes students' environmental awareness. By means of questionnaires, environmental awareness of 845 students and their socio-economical background was measured in 13 Hungarian secondary schools. A pragmatic analysis was performed in order to explore which are the main factors, either student's background or school's background related factors, responsible for the huge variation observed in the environmental awareness of students. Different aspects of environmental awareness were investigated, such as self-declared behaviours (consumer habits, healthy food habits, thrifty habits, waste management) and environmental attitudes. In a preliminary study, teachers were also asked in detail on environmental education principles and the related infrastructural background in the schools. We found that aspects of environmental awareness are strongly determined by the students' socio-economic background. Elaborated further analyses of schools' environmental education principles (including eco-school title and practice) are needed to ascertain the effect of ESD on students' attitudes and behaviours.

Keywords: education for sustainability; socio-economical background; eco-schools;

1. Introduction

The concept of sustainability, education for sustainable development and environmental sustainability (ESD) gained attention mainly during the early '90s, after the Brundtland Report of the World Commission in 1987 ("Our Common Future") and the Earth Summit UN conference at Rio de Janeiro in 1992. ESD could be a unique tool to generate transition in human societies in order to be able to protect the environmental equilibrium of our planet or at least to slow down the negative impacts it is suffering due to present-day consumer habits and the intensification of industrial and agricultural production. Accordingly, ESD has been anchored in various forms in trainings and different levels of education (Ware, 1999; Neal & Palmer, 2003; Dillon, 2014). Nevertheless, the overall social attitude that would effectively enable the reduction of environmental burdens is very slowly changing, even in the case of simplest, everyday-to-life

solutions (Wals et al., 2014). Researches both at international (e.g. Palmer, 2002; Jickling & Wals, 2008; Lechner & Rauch, 2014) and national (Zsóka et al., 2011; Marjainé et al., 2012; Mónus & Császár, 2016) level emphasize that improving the efficiency of environmental education in public education is crucial. However the most researches on Hungarian students do investigate only environmental awareness – attitudes, behaviours, and knowledge – per se (e.g. Szittnerné & Szabó, 2009; Marjainé et al., 2012; Pethe, 2012; Török & Lövei, 2012). In order to explore how ESD can be constructed in a more effective way studies that investigate efficiency of ESD and factors affecting students' environmental awareness are essentially needed (Varga, 2004; Kosáros, 2007; Zsóka et al., 2011; Leskó, 2017).

In this study, several aspects of environmental awareness of Hungarian secondary school students, such as self-declared behaviours (consumer habits, healthy food habits, thrifty habits, waste management) and environmental attitudes were investigated. The main factors (students' socio-economic background, school type, and schools' environmental education principles) shaping aspects of students' environmental awareness were explored. Pro-environmental behaviour is affected by personal socio-economical background in a complex way. International studies investigating attitudes, behaviours and its relationships with social factors go back in time to the 1990s (reviewed in Gifford & Nilsson 2014). However, this study is a unique investigation in Hungary, given that to our knowledge, no previous study investigated environmental awareness of students in such a diverse sample of schools.

2. Methods

Questionnaires filled in by 845 students from 38 classes of 13 Hungarian secondary schools were investigated. In each school, only first year (14-15 years old) and last year students (17-18 years old) were targeted. Schools included four schools from the western part of Hungary (Veszprém county; three in the county seat and one in a different town), eight schools from the eastern part of Hungary (Szabolcs-Szatmár-Bereg county; five in the county seat and three in different town), and one school from the capital (Budapest). Four of the schools were a vocational school, seven were general secondary school (grammar school) and two of them had both vocational and grammar school training types. Five of the schools had an eco-school title, eight did not have it. Table 1 shows in detail the composition of the sample. Students filled in the questionnaire in the presence of their teacher from September 2015 to Mars 2016, mainly in an online format, but in some cases, teachers asked us to provide them with printed copies. Filling in the questionnaire took about 20-25 minutes.

The student's questionnaire included 75 items and was constructed based on previous studies performed on students of similar age (Szittnerné & Szabó, 2009; Marjainé et al., 2012; Pethe, 2012; Török & Lövei, 2012). In order to fit the questionnaire to explore the five different aspects of environmental awareness (see below) some new questions were also used. Aspects of environmental awareness analyzed in this study were based on 30 items measured in a five levels Likert-scale, open-ended questions and some other questions irrelevant to this study were not analyzed in this paper. All five aspects were calculated as a mean of five to eight items (Zsóka et al., 2011). Table 2 shows the name, number of items included and the standardized Cronbach's alpha value of the investigated aspects. Items in the questionnaire were organized in successive topics; they were formulated in order to be easily understandable, interesting and not so long considering the motivation of students to fill in completely the questionnaire (Babbie, 1992).

After carefully analyzing students' answers to some highly similar items, and to similar but reversed scale items answers of 69 students were excluded due to serious inconsistency. Altogether answers of 776 students were included to the study for further analyses, from which 690 students answered all relevant questions including items on their socio-economical background.

Table 1. Sample composition according to students' class year, sex, residency, school location, and school type

		students	**proportion in the sample**
class	first year	414	53%
	last year	362	47%
sex	male	320	41%
	female	456	59%
residency	county seat	294	38%
	town	249	32%
	village	233	30%
county	Eastern Hungary (Szabolcs-Sz.-Bereg megye)	419	54%
	Western Hungary (Veszprém & Pest megye)	357	46%
training type	vocational	198	26%
	grammar school	578	74%
ESD principle	eco-school	335	43%
	non-eco-school	441	57%

Table 2. Aspects of environmental awareness analyzed, the number of items they include (see Methods), and the Cronbach's alpha value (standardized) of the measure

name	number of items	Cronbach's alpha
consumer habits	5	0.48
healthy food habits	8	0.63
thrifty habits	6	0.50
waste management	6	0.49
environmental attitude	5	0.58

Statistical analyses were performed using the R statistical and computing environment (R Core Team, 2016). Linear mixed effect models (*lmer* function in R) were used to analyze data. These models allowed to deal with the huge variance found among schools (Fig. 1.; see also Mónus & Császár 2016) and the fact that students' answers from one specific school may intercorrelate with each other since should not be treated as fully independent. In order to statistically deal with this issue, schools were entered as a random factor to the linear models. Each composite variable (aspects of environmental awareness) was analyzed separately and checked for

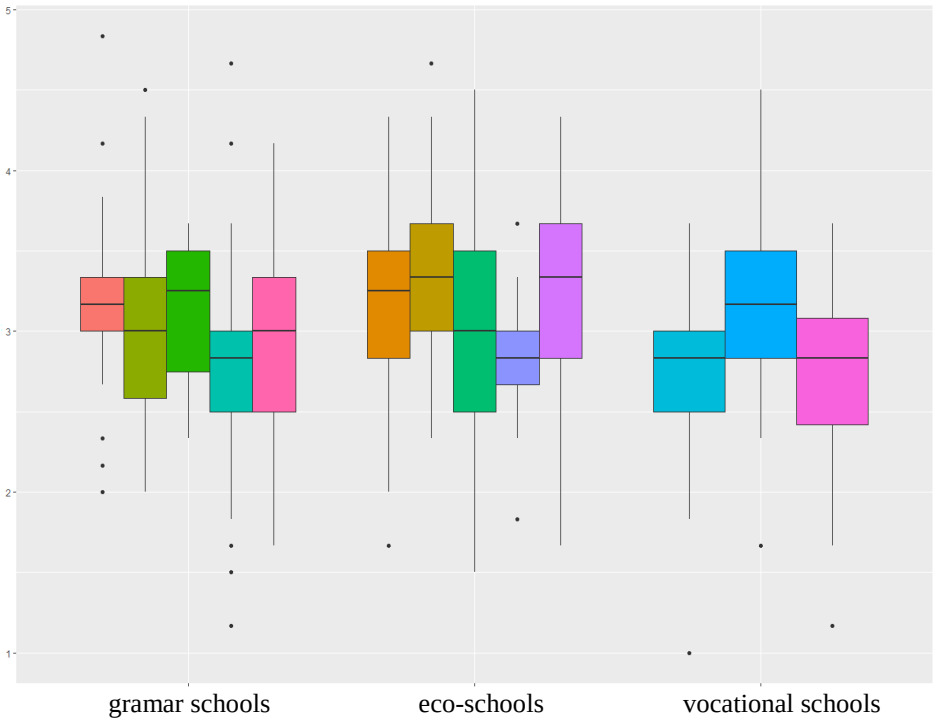

Fig. 1. Descriptives (medians, interquartile ranges, and ranges) of composite variable describing consumer habits of students in different schools. Each of the five investigated aspects of environmental awareness shows similar variability among schools and school types

significant ($\alpha = 0.05$) fixed effects using *Anova* function (*car* package in R; type III variance analysis with Wald chi-square tests; see Fox et al. 2012). The following explanatory variables were entered in each model as fixed effect variables. Education score of parents, county (eastern or western part of Hungary) and type of residency (county seat city, town, and village) described the socio-economical background of students. Training type including vocational or general secondary school (grammar school) categories and ESD principle including eco-school or non-eco-school categories described different school types. Education score of parents was determined from 1 to 6 based on the answers regarding the education of both parents: 1 for less educated parents where one or both parents have only elementary school education (or neither that), and 6 for most educated parents where both parents have higher education diploma.

Table 3. Environmental awareness of Hungarian secondary school students in relation to socio-economical background and school type (results of linear mixed effect models; p-values under 0.05 significance level are bolded)

consumer habits	χ^2	df	P	**healthy food habits**	χ^2	df	P
parents' education	0.006	1	0.936	parents' education	9.801	1	**0.002**
county	9.869	1	**0.002**	county	0.063	1	0.802
residency	6.184	2	**0.045**	residency	0.015	2	0.992
training type	1.339	1	0.247	training type	1.081	1	0.298
ESD principle	2.368	1	0.124	ESD principle	0.003	1	0.959
thrifty habits	χ^2	df	P	**waste management**	χ^2	df	P
parents' education	1.240	1	0.266	parents' education	6.915	1	**0.009**
county	6.739	1	**0.009**	county	5.457	1	**0.019**
residency	2.501	2	0.286	residency	2.476	2	0.290
training type	11.195	1	**0.001**	training type	14.130	1	**0.001**
ESD principle	4.615	1	**0.032**	ESD principle	8.005	1	**0.005**

environmental attitude	χ^2	df	P
parents' education	3.077	1	0.079
county	2.024	1	0.155
residency	2.445	2	0.294
training type	14.229	1	**0.001**
ESD principle	3.457	1	0.063

3. Results

Socio-economical background of students has a significant effect on the aspects of students' environmental awareness in a complex way. Green waste management and healthy food habits were significantly, environmental education attitudes were marginally positively correlated with the parents' education score. Consumer habits, thrifty habits, and waste management were significantly more environmentally friendly in the students living in the western part of Hungary (including Budapest). Type of residency has a significant effect on the consumer habits of students but does not have on other aspects of environmental awareness. Student living in county seat cities or in bigger towns were less environmentally friendly in their consumer habits than students living in villages. School type also affected different aspects of students' environmental awareness. Students learning in vocational schools live and think less green; they are significantly less environmentally friendly in their thrifty habits, waste management, and environmental attitudes. However, interestingly students learning in eco-schools live and think also less green concerning the same aspects of environmental awareness (thrifty habits and waste management), while in the case of their environmental attitudes this effect is only marginally significant. Results with the corresponding statistics are summarized in Table 3. Table 4 and 5 show mean scores for the different aspects of environmental awareness for subgroups of students. Each of the five aspects shows neutral attitude when its score is 3, shows positive pro-environmental attitude in cases when scores are greater than 3, and negative pro-environmental attitude in cases when scores are smaller than 3. Based on Table 4 and 5, healthy food habits of students learning in vocational non-eco-schools with low educated parents show the worst values (mean score for the subgroup: 2.78), and environmental attitudes of students leaving in villages of Eastern Hungary with highly educated parents show the best values (mean score for the subgroup: 3.69) in their pro-environmental aspects.

4. Discussions

Based on the mean scores of total sample (Table 4) we can conclude, that the population averages are worst in the case of healthy food habits and of consumer habits – they are close to neutral; and are the better in the case of environmental attitudes. A pattern frequently found in previous studies; active pro-environmental behaviours are not necessary the consequence of positive pro-environmental emotions and environmental knowledge (Kollmuss & Agyeman, 2002; Varga, 2004; Marjainé et al., 2012; Gifford & Nilsson, 2014).

Table 4. Mean scores of subgroups and total sample for the aspects of environmental awareness in Hungarian secondary school students in relation to their socio-economical background (for significance tests see Table 3)

parents' education[a] (subgroup N)	county	residency	healthy food habits	consumer habits	waste management	thrifty habits	environmental attitude
low (76)	Eastern HU	village	2.92	3.06	3.25	3.11	3.25
low (76)	Western HU	village	2.90	3.42	3.38	3.38	3.32
low (44)	Eastern HU	county seat	3.11	3.13	3.39	3.07	3.38
low (28)	Western HU	county seat	2.96	3.22	3.23	3.15	3.34
low (61)	Eastern HU	town	2.83	2.89	3.06	2.96	3.13
low (59)	Western HU	town	2.99	3.25	3.11	3.16	3.32
high (20)	Eastern HU	village	3.03	3.30	3.28	3.13	3.69
high (36)	Western HU	village	3.11	3.42	3.38	3.09	3.54
high (133)	Eastern HU	county seat	3.23	3.11	3.50	3.11	3.59
high (63)	Western HU	county seat	3.07	3.33	3.42	3.22	3.47
high (48)	Eastern HU	town	3.17	3.05	3.48	3.31	3.53
high (46)	Western HU	town	3.00	3.41	3.49	3.18	3.33
SD ranges for all subgroups:			0.52-0.64	0.57-0.78	0.58-0.78	0.67-0.89	0.55-0.84
mean score for total sample (N = 776):			3.02	3.03	3.19	3.15	3.53
total SD (N = 776):			0.60	0.58	0.71	0.74	0.70

Table 5. Mean scores of subgroups for the aspects of environmental awareness in Hungarian secondary school students in relation to parents' education, school type and school ESD principle (for significance tests see Table 3)

parents' education[a] (subgroup N)	training type	ESD principle	healthy food habits	consumer habits	waste management	thrifty habits	environmental attitude
low (86)	grammar	non-eco-school	3.08	3.14	3.40	3.18	3.43
low (97)	vocational	non-eco-school	2.78	3.09	3.15	2.98	3.10
low (135)	grammar	eco-school	2.93	3.15	3.22	3.23	3.34
low (26)	vocational	eco-school	3.11	3.56	3.14	3.26	3.18
high (177)	grammar	non-eco-school	3.22	3.18	3.54	3.23	3.64
high (28)	vocational	non-eco-school	2.88	3.05	3.08	2.90	3.18
high (129)	grammar	eco-school	3.08	3.31	3.45	3.17	3.49
high (12)	vocational	eco-school	3.03	3.37	3.08	2.89	2.97
SD ranges for all subgroups:			0.52-0.68	0.61-0.71	0.60-0.74	0.69-0.93	0.55-0.88

[a] – Both in Table 4 and 5: students were groupped in high and low parents' education categories according to at or above, and below the median parents' education score (total sample), respectively.

Furthermore, our study found a complex pattern of socio-economical background affecting several aspects of environmental awareness in secondary school students. Parents' education strongly affected healthy food habits and environmentally friendly waste management habits of students, and slightly (only marginally significantly) affected environmental attitudes. Results suggest that ESD should make special attention to develop a highly effective way of changing students' motivation and socially inherited habits in order to achieve significant change in pro-environmental behaviours of societies. Our result contrasts to that of Lallukka et al. (2007) where investigating healthy food habits of employees in Finland they found an effect of own education, but not of parents' education. On the other hand, the relationship between parents' education and green waste management or environmental attitudes suggests that educated people are more receptive to pro-environmental behaviours and attitudes, and they can socially transmit their habits. A fact that draws the attention to the importance of ESD in secondary schools and even in higher education institutes, the levels of education where ESD did not receive sufficient emphasis yet in Hungary (Havas et al. 2004).

The study gives additional support to the findings on a smaller incomplete subsample of the current sample analyzed in an earlier stage of data collection. In Mónus & Császár (2016) differences were found between students of the western and eastern part of Hungary in their thrifty habits, consumer habits, and to some extent in their waste management. This study confirms the previous findings using a more comprehensive analysis using more background (confounding) variables and a mixed effect design. Differences between counties of Hungary may be attributable to various cultural and socio-economical backgrounds. Veszprém county and the capital outreaches Szabolcs-Szatmár-Bereg county practically in all relevant socio-economical macrostatistics, e.g. in national student competency indicators (Szabó et al. 2018), per capita income and rate of unemployment (Hungarian Central Statistical Office; www.ksh.hu). On the other hand, people from the western part of Hungary may have intensive interplay with Austria (and its inhabitants), a country with people and education more developed considering pro-environmental behaviour and ESD. All these differences may be responsible for the spatial pattern found in environmental awareness. Concerning the last investigated socio-economical variable, students with their residency in county seat cities or in bigger towns were significantly less environmentally friendly in their consumer habits than students living in villages, which is supposedly mostly attributable to the different possibilities these students can achieve. Our results well fit previous studies as the rural-urban gradients, economic and cultural differences in pro-environmental behaviours are well documented in the literature (Kollmuss & Agyeman 2002; Vicente-Molina et al. 2013; Gifford & Nilsson 2014).

Furthermore, significant differences were found in several aspects of environmental awareness among school types, a very important result of the present study which should involve development in ESD integration in secondary schools. Students learning in vocational schools and even in eco-schools (eco-schools are acknowledged by the ‘eco' title due to their elaborate and complex ESD; Breiting et al. 2005) were less environmentally friendly in their thrifty habits, waste management, and environmental attitudes. It was already documented in Hungary that vocational school generally has lower efforts in ESD, and hence integrating more elaborated ESD practices to the vocational trainings are crucial in order to approach sustainability of societies (Havas et al. 2004). However, the results on pro-environmental behaviours and environmental attitudes (even the latter differ only marginally from general secondary schools’ students) of eco-school students in the present study are astonishing. Previous researches on the effect of ESD are also contrasting. Some study found improvement in pro-environmental behaviours even after some week of intensive ESD curriculum (e.g. McNeill & Vaughn 2012), while other studies did not find evidence of change in behaviour even after extended curriculum compared in case of Flemish eco-schools and control schools (Boeve-de Pauw & Van Petegem, 2011). Without questioning the impact and the intensive ESD related work in Hungarian eco-schools the following explanations are proposed to the above mentionned finding. As the study investigated self-declared answers on behaviour instead of the behaviour itself, one can imagine that eco-schools' students perceived their own behaviour less environmentally friendly than students from general secondary schools. However, this scenario does not explain why students from vocational schools self-declared less their behaviour to be pro-environmental, and more interestingly, why exactly in case of the same aspects of environmental awareness. A more plausible explanation for authors is that students learning in the analyzed eco-schools are students of lower socio-economical status, between the status of students of the analyzed general secondary schools and of the analyzed vocational schools. As eco-school title may contribute to the recognition of a school, but gives no other advantage (e.g. financial support), it is possible that highly recognized schools apply less often for the title than medium or poorly recognized ones. In that situation, the found pattern may also reflect the socio-economical status of schools, and hence the students who learn in. Further, elaborated research is needed to explore how the excessive ESD related pedagogical work affect the improvement of pro-environmental behaviour and environmental attitudes of students in Hungarian eco-schools. Preliminary analyses on the relationship of students' environmental awareness and teachers' declared environmental education policy of schools suggest that socio-economical background of students is more determinative in developing pro-environmental behaviours than the schools' environmental education policy.

Acknowledgements

I am very grateful to several of my students, especially to Eszter Császár and Miklós Nagy, who helped this study by reaching secondary school teachers distributing questionnaires to students. As well as to the many teachers who kindly coordinated the students to fill in the questionnaires online or printed. Special thanks to the many teachers and members of schools' management who provided me with information on the environmental policy of their school and meticulously filled in the schools' questionnaire, and to Edina Malmos who helped me to reach many of the school staff.

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Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.77
http://doi.org/10.24368/jates.v9i1.77

Environmental, non-specific factors affecting legal and illegal drug consumption

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Abstract

The threat of psychotropic substances has been rising significantly in Hungary. Serious health problems arise not only from illicit drug use but also from tobacco and alcohol consumption. Although genetic predisposition determines the progress from recreational use to addiction, environmental factors are equally important. To find the best way of intervention, environmental factors should be taken into account. We studied the effect of environmental and demographic factors on illicit and legal drug consumption in a population reached via homepages and social media sites, using a questionnaire, filled out mainly by students and also reaching their relatives and acquaintances. Cannabis was the most frequently used illicit drug, and the usage of legal and illicit drugs correlated. Anti-smoking campaigns had not yet diminished the number of smokers, who were equally present in each age group, among wealthy and poor, both in rural or urban areas. Alcohol consumption was independent of wealth but not of the place of residence or education level, while drug consumption corresponded with the place of residence. Alcohol and drug, especially cannabis consumption are higher in urban than in rural areas. The majority of those who never tried them are just above the poverty line or have an average income. In conclusion, to increase the effectiveness of prevention programs the focus of National Anti-Drug Strategy 2013-20, should be broadened to include problems of both illicit and legal drug uses equally in different socioeconomic environments.

Keywords: illicit drug; legal drug; environmental factors;

1. Introduction

Substances such as alcohol, nicotine, and illicit drugs affect the reward circuitry of the brain, and their long-term, heavy use can permanently change its structure and function (Volkov and Li, 2005). Therefore, addiction is a brain disease, and as many other health conditions, it is associated with genetic and environmental risk factors as well. Genetic predisposition accounts for 51-75% of addictions, and determines the progress from substance use to addiction, while psychological

and environmental factors influence whether individuals start to use substances and what substances they choose (Cox et al., 2017). Environmental factors include access and exposure to substances of abuse, neighborhood disadvantage and disorder, and environmental barriers to treatment (Mennis et al., 2016). Since the threat by psychotropic substances had been rising significantly in countries around the world, and the problem of youth drug abuse significantly increased during the last decades, substance use disorders are recognized as one of the most pressing global public health problems (Hall et al., 2016). Legal drugs like tobacco and alcohol are frequently used substances in Hungary. Smoking is the biggest cause of preventable death in the European Union, especially in Eastern European Countries (EU Open Data Portal, 2015). In Hungary, the prevalence of smoking slightly decreased during the last 10 years, but it is still very high, 26.6% of Hungarians smoke daily (EU Open Data Portal, 2015). The proportion of heavy smokers (more than 20 cigarettes a day) among men is 25.8%, one of the highest in the European Union, thus it is not surprising, that more than 20 000 people died as a direct result of smoking in 2012 (CDC, 2017). As to alcohol consumption, it is very difficult to estimate the number of people who are addicted in Hungary. In point of alcohol consumption, 48 percent of 17-year-old students drank alcohol and 35 percent was drunk in the last 30 days. The presence of binge drinking is an existing feature in Hungary. This becomes clear, if we examine students between 14 and 16, 50 percent of whom was drunk at least once in their life (Elekes, 2007). The situation is much worse if we examine the data of alcohol-specific mortality. It has been one of the most frequent mortality rate cause for a long time. The number of these cases are twice higher in Hungary than in the European Union. The alcohol-caused mortality increased until 1993 after it decreased until 2005, then it increased again, more slowly than during the ‘90s. Generally, we can say that Hungary is one of the leading countries in alcohol-caused mortality (Elekes, 2014). Data on the consumption of illegal drugs in Hungary are similar to the European ones. The most frequently used drugs were marijuana and hashish in 2011 (Drogfókuszpont, 2012). Almost 10 % of inhabitants between 18 and 64 have tried some kind of illicit drug. 7.4 % of this population has tried the above mentioned forms of Cannabis. In 2016, 29 people’s death was caused by drug overdose (Country Drug Report, Hungary, 2018). The prevalence of illicit drugs increased from 1995 to 2003. After 2003 there was a short period when drug consumption dropped, but from 2007 it kept on the increase until 2011 (Drogfókuszpont, 2012).

1.1. Social and environmental effects on alcohol drinking

Cox and Klinger (1988) have proposed a motivational model of alcohol use. The drinker can exercise control over the decision to drink, or not do so, but several variables might increase the

value of drinking, thus a weight will be added to this person's decisions to drink. The society in which the person lives determine the value that a person attributes to drinking alcohol, and also define the circumstances in which it is appropriate to drink and how much alcohol should they drink (Orford, 2001, Room, 2013, Wild, 2002). People whose drinking habit matches the expectation of their environment are rewarded for their behavior (Cox et al., 2017). In Hungary, alcohol consumption is generally accepted at family or religious celebrations, like birthdays, Christmas, parties, etc. Society is extremely tolerant of alcohol drinking and being drunken. People think that being drunken is acceptable if they have problems in their private life or workplace (Elekes, 2014). Drinking alcohol is also regarded as a criterion of masculinity.

1.2. Environmental determinants of tobacco use

Nicotine in tobacco is a highly addictive substance and there is no doubt that nicotine addiction sustains tobacco use in most cases (Dunn, 1972). Individual response to tobacco varies among individuals and this variation mainly depends on biological factors. However, variations of tobacco use among countries and regions of a country cannot be fully explained by biological differences (Cummings et al., 2009), tobacco use at a population level is the product of the interaction of agent (product design and marketing), host (consumers), and environmental factors (social acceptance, availability) (Cummings, 2002, Cummings et al., 2009). A social environment where smoking is supported helps expressing innate genetic profile, and makes people more susceptible to nicotine dependency, while increased governmental actions to regulate the use, sale, and advertising of tobacco products, such as prohibiting smoking in most public and workplaces, contributed to the social marginalization of smoking as an accepted behavior (Hyland et al. 2009). In Hungary, smoking is prohibited in all public places, schools, the law is one of the strictest in Europe, but these rules did not make the situation better yet. Nowadays, we can find that the environment less tolerant, many people have a hard, negative opinion about smoking. Tobacco can be bought only by adults in special shops but young people still claim that buying these products is easy or very easy (Elekes, 2014). It is not difficult to notice that this provision is not effective enough. Successful control of tobacco use only gained when a multidimensional approach is used combining of educational, clinical, and social strategies (CDC, 2017) helping the prevention as well as the cessation of tobacco use.

1.3. Cannabis and other illicit drug use

Cannabis is the most widely used illicit substance, although the use of psychostimulants is also quite common in most countries. Since most of the drug users do not access drug treatment services, the consequences of their drug use are mainly unclear. Heavy drug use may cause

physical health problems, but illicit drugs, particularly cannabis, could cause psychological and social problems as well (Hall and Solowij 1998). A causal relation between drug use and psychosocial harm could plausibly be provoked by two principal mechanisms: directly, through neurophysiological pathways, or indirectly, through involvement in the criminal culture and commerce associated with the use of an illegal substance (Lenton, 2001, Macleod et al., 2004). In Hungary, ordering anything from the internet is a legal activity. Many websites offer "fumigants" or "pot-pourries". These products seem to be innocent but in reality, they are illicit drugs. It is almost impossible to detect and punish these companies because if somebody orders fumigants to scent his or her house, it is a legal action. Drug trafficking via internet sites increased the availability of illicit drugs, and at the same time caused a number of drug-related problems: among others psychosomatic problems and marginalization.

1.4. Environmental factors in health development and drug prevention programs

Countries around the world have introduced numerous treatment approaches to address the need of drug abusers. Since several studies concluded that specific and non-specific factors in addiction treatment are equally important (Miller and Moyers, 2015), treatment and rehabilitation services focus on environmental factors as well as preventing relapse, introducing approaches that help to develop a lifestyle and environment securing improvement. These services include residential care and intensive inpatient services, community-based outpatient and day treatments, behavioral therapy, family therapy and outreach programs to mention some of them. Apart from the treatment and rehabilitation of abusers, national drug strategies define other areas of intervention as well, most strategies focus on prevention and the determination of risky substance use environments. Researchers aim to find the implications of environmental inequities for disparities in substance use disorders and treatment outcomes (Mennis et al., 2016). Environmental prevention policies and interventions seek to provide a stimulus that evokes healthier decisions: peers, friends and the working environment can be just as instrumental to an addict's recovery as they can be to a drug problem (Tracy and Wallace, 2016). Environmental management strategies also aim to limit availability, restrict marketing, moreover offer alcohol-free social and public service options as well as the health-promoting environment (EMCDDA, 2018). Detailed knowledge about the environment within which the drug is consumed, helps to form directives that are approved by the users and therefore viewed as an opportunity to either quit altogether or to reduce consumption (Cummings et al., 2009). In Hungary, the National Core Curriculum, and in the Frame Curricula contain a complex health educational program for public schools. They describe the responsibility and tasks of the schools to prevent addiction to legal and illegal drugs. Every school has to make

a local curriculum, which helps to avoid behavioral attitudes that lead to health damage. In practice, the usual methods of this work are presentations or lectures, given by teachers, police officers or health visitors. These lectures mainly display different kinds of drugs and direct attention to the dangers of consuming drugs.

1.5. The aim of the study

We studied the effect of environmental and demographic factors on illicit and legal drug consumption in a population that consisted of mainly university students, using a questionnaire with 25 multiple choice items. We believe that the targeted population represents a financially consolidated, well-educated group, aged mainly between 19-25 years. Therefore, both legal and illicit drug use choices showed low levels of consumptions: non-users (never used the substance), experiencers (tried 1-5 times) occasional consumers (lifetime use 31-100 times or persons used a substance occasionally once in their life: 6-30 times) and experienced consumers (>100 times). Participation was voluntary and the online questionnaire was filled anonymously.

2. Method

The questionnaire was distributed via the homepage of teachers of the Eszterházy Károly University, also using their social media sites. It consists of multiple choice items regarding the environmental factors (education level, place of residence, financial situation) of the participants and the amount of legal or illegal drugs they consumed during their life and the last 30 days. Self-reports of different drug uses were pooled and the total drug consumption was calculated. Participants also filled in the following general information: gender, age, occupation: selected from the built-in list of the internet site we used to prepare our questionnaire (http://www.kerdoivem.hu). Data were analyzed using the R statistical environment (2018). Spearman rank correlation coefficients were used to assess monotonic relations between tobacco, alcohol and illicit drug consumption. Possible connections between substance use and several different environmental and demographic factors were analyzed using the χ^2 test of independence. Data of participants below 14 years were omitted.

3. Results and implications

The net sample size was 756, (191 male), participants were between ages 14 and 77, the majority of them aged between 18 and 25 years (62.4%). Taking their financial situation, place of residence and education into account the majority of the participants have enough income to cover his/her expenses (65.6%) or have financial problems only at unexpected circumstances (26.1%), live in

villages (39.8%) or smaller towns (38.8/), and they are either students (35.7%) or already have a university degree (30.0%).

The incidence of tobacco use was the highest, as only 18.7% never smoked a cigarette, 38.5% smoked more than 100 cigarettes in his/her life, and 21.5% had more than 30 cigarettes during the last 30 days. Although only 4.5% of the participants never drank alcohol (at least one alcohol unit) but from the 37.1% who consumed more than 100 alcohol units during his/her life only 2.5% drunk more than 30 alcohol units during the last 30 days. Cannabis was the most widely used illicit substance, 32.0% of the participants used it at least once. Apart from cannabis, the illicit use of prescription medicines was considerable, 20.4% used it at least once. The incidence of the use of other drugs was below 10%, after pooling the consumption of the different drugs, 42.7% of the population used at least one of them at least once. During the last 30 days, only 14.8 used any drug, and mainly in a small amount. Although the incidence of drug use is surprisingly high, the amount of consumption is low, suggesting that an occasional recreational use of illicit drugs occurs in the studied population. A strong association was found between tobacco, alcohol, and illicit drug use. Those, who used drugs usually tried smoking and drunk alcohol as well (figure 1). Our questionnaire shows that the prevalence of smoking is lower than the national level. In regard to alcohol, the prevalence is similar to the national data, the amount of consumption seems to be moderate, although with our questionnaire we could not detect heavy binge drinkers.

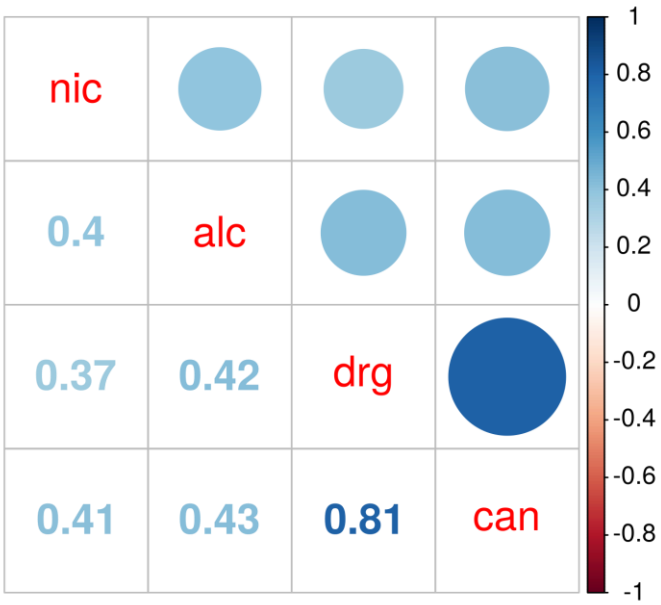

Figure 1. Correlation between legal and illicit drug use

The consumption of tobacco (nic), alcohol (alc), illicit drugs (drg) and cannabis highly correlated. Numbers show the Spearman rank correlation coefficient.

Examining illicit drug consumption shows that our data are higher than the average

national data, but the majority of the participants are aged between 18-25 years, thus represent the most vulnerable population in this respect.

3.1 Environmental effects on tobacco use

Nearly 80% of the participants experienced smoking by the age of 21 (Figure. 2), thus anti-smoking campaigns should aim primary and secondary school students. Nicotine is a highly addictive substance, so most people, who begin smoking during their teenage or university years then struggle to quit as adults, and regret having started to smoke (Fong et al., 2004). The percentage of non-smokers (who never smoked) was the lowest in the young adult population. The higher percentage of non-smokers among adults possibly reflects the fact that smoking among women started increasing recently, that is women within the older generations smoked less. None of the studied environmental factors affected tobacco use, thus the prevalence of smoking was similar in rural and urban areas. Neither did it differ among people with different financial situation or did not change with education (not shown). Recent restrictions on tobacco products marketing to children or measures to prohibit smoking in public places decreased the availability of tobacco products and the prevalence of smoking by 5% but they could not yet achieve a drastic change in attitude towards smoking.. According to the Global Youth Tobacco Survey (GYTS) Hungarian children regarded the purchase of cigarettes easy, and 14% of them believed that he or she would smoke in the next 12 months (Dohányzás Fókuszpont, 2016).

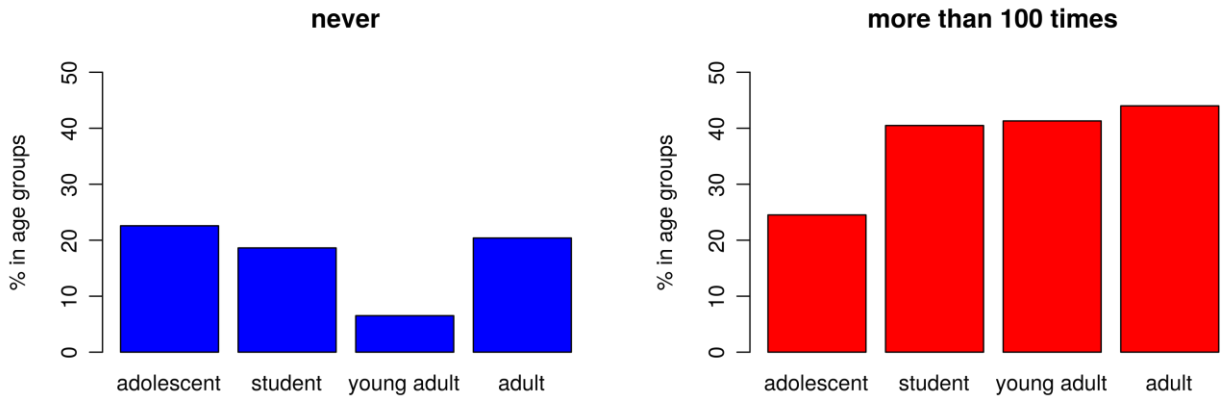

Figure 2. The percentage of non-smokers and smokers in different age groups.

The percentage of non-smokers (never) was the highest among adolescents (14-19 years old) 22.6%, and 24.5% of the adolescents already smoked more than 100 cigarettes. Around 40% of students (19-21) young adults (22-25), and adults >25 smoked more than 100 cigarettes, suggesting that the majority of people experienced smoking <21 years old.

3.2 Environmental effects on alcohol use

Hungary has always belonged to the group of nations characterized by high alcohol consumption (Elekes, 2014), and it is nearly impossible to attend any formal or informal gathering without being offered a drink (Grelinger, 2010), thus the small percentage of lifetime abstinence (4.7%) or no consumption during the last 30 days (23.9%) is not surprising. Since only 2.3% of the participants reported the consumption of more than 30 alcohol units during the last 30 days, we can assume that the studied population is a moderate or occasional drinker. According to Lukács and coworkers (Lukács et al., 2013), most students drink alcohol regularly, students and teachers usually see it as an integral part of the higher-education life. Heavy drinkers could be underrepresented in our sample, due to the fact that they do not visit their teacher's homepage or social media site or they just did not volunteer to fill out this questionnaire. The extent of binge drinking and alcohol consumption should be studied in more detail, because alcohol-related problems among university students are in a rise worldwide (Bravo et al., 2016, López-Caneda et al. 2017, White et al., 2016). The majority of the participants had no serious financial problems, only 4.2% of the participant felt that he or she was poor and/or needed financial support, and 4.1% felt that he or she was rich. Thus, it is not surprising that we did not find a connection between alcohol consumption and wealth, but interestingly those who reported financial difficulties or needed financial support and those who were wealthy regardless their age had drunk some alcohol (Figure 3). Those who never drink any alcohol mainly live in urban areas, and alcohol consumption in the capital is more moderate (fewer participants reported the consumption of more than 100 units) than anywhere else. With education, alcohol consumption tends to decrease (Figure 3). Our data suggest a tendency towards more moderate alcohol consumption at least among educated people, especially in bigger cities.

3.3 Environmental effects on drug consumptions

Although in Hungary the purchase, consumption, and possession of illegal drugs are all criminal offenses, the lifetime incidence of illicit drug use was surprisingly high in our sample (42.7%). This result suggests that despite the strict regulation, accessibility of drugs increased notably during the last decade. Drug consumption became more accepted, and the presence of drugs at parties and clubs seems to be almost normal. Drug use is not strong in our sample the lifetime use of the drug was less than 30 used for the majority of the participants who ever tried them. According to our data, students and young adults experienced illicit drugs a few times (Figure 4). Non-users lived mainly in villages and small towns, probably because rural places are still relatively less frequented by suppliers. Drug use did not depend on the level of education,

secondary school students and university students are equally likely to try some of them. In previous studies, it was shown that drug use and availability were highly correlated, and ease of availability was slightly more predictive of drug use than drug preference (Feldman et al., 2011). Also, the social composition of drug users is continuously changing as new forms of drug use are emerging (Flynn and Hoffer, 2017, Gerevich and Bácskai, 1995) thus it is rather an education that affects the choice of drug consumed than the fact that a person tries it or not. An association between different drug types and education might be detected in a larger sample. According to these results, prevention programs should be strengthened, universal prevention activities implemented mainly in the educational setting have not yet achieved the desired effects, drug-related knowledge should be improved as well as the awareness of drug-related health and social problems.

4. Conclusions

The present study shows that legal and illicit drug consumption are highly correlated. Therefore, prevention programs should equally aim at the limitation of all addictive substances. An anti-smoking behavior should be formed during primary or secondary school years because people try out smoking usually during these years. The high prevalence of illicit drug use is alarming. Although the consumption of drugs was moderate, people should be aware that the harmful effect of several drugs (especially some of the designer drugs) can already emerge after a few uses (Vearrier et al., 2012). To improve the situation and refine our knowledge, changes of attitudes and related normative beliefs, as well as changes in behavior patterns would be necessary. While the present prevention programs will help to improve the first two aspects, the required behavioral changes are not yet facilitated by the majority of presently executed school-based prevention activities.

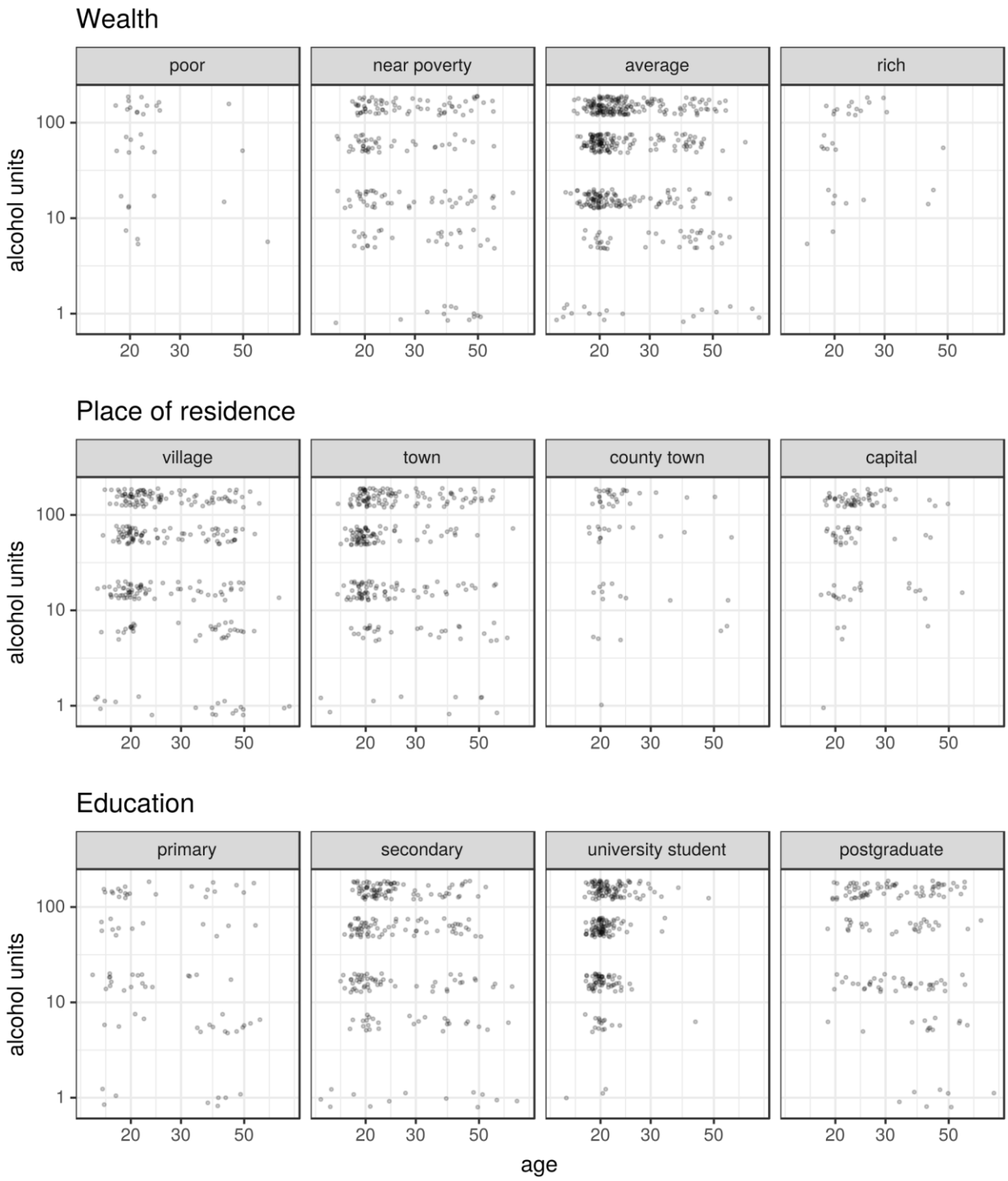

Figure 3. The effect of environmental factors on alcohol consumption

Alcohol units reflect the different levels of alcohol consumption (never=1; max 5; max 30; and above 100). Data points were jittered to avoid overlapping. Independence of alcohol units and environmental factors was checked by using $\chi 2$ test. Alcohol consumption was independent of the financial situation ($p=0.18$), while we have found a significant association between alcohol consumption and the place of residence ($p>0.05$) as well as alcohol consumption and education ($p>0.01$). Those who never drink alcohol, lived in villages and smaller towns, and there were only a few abstinents among university students.

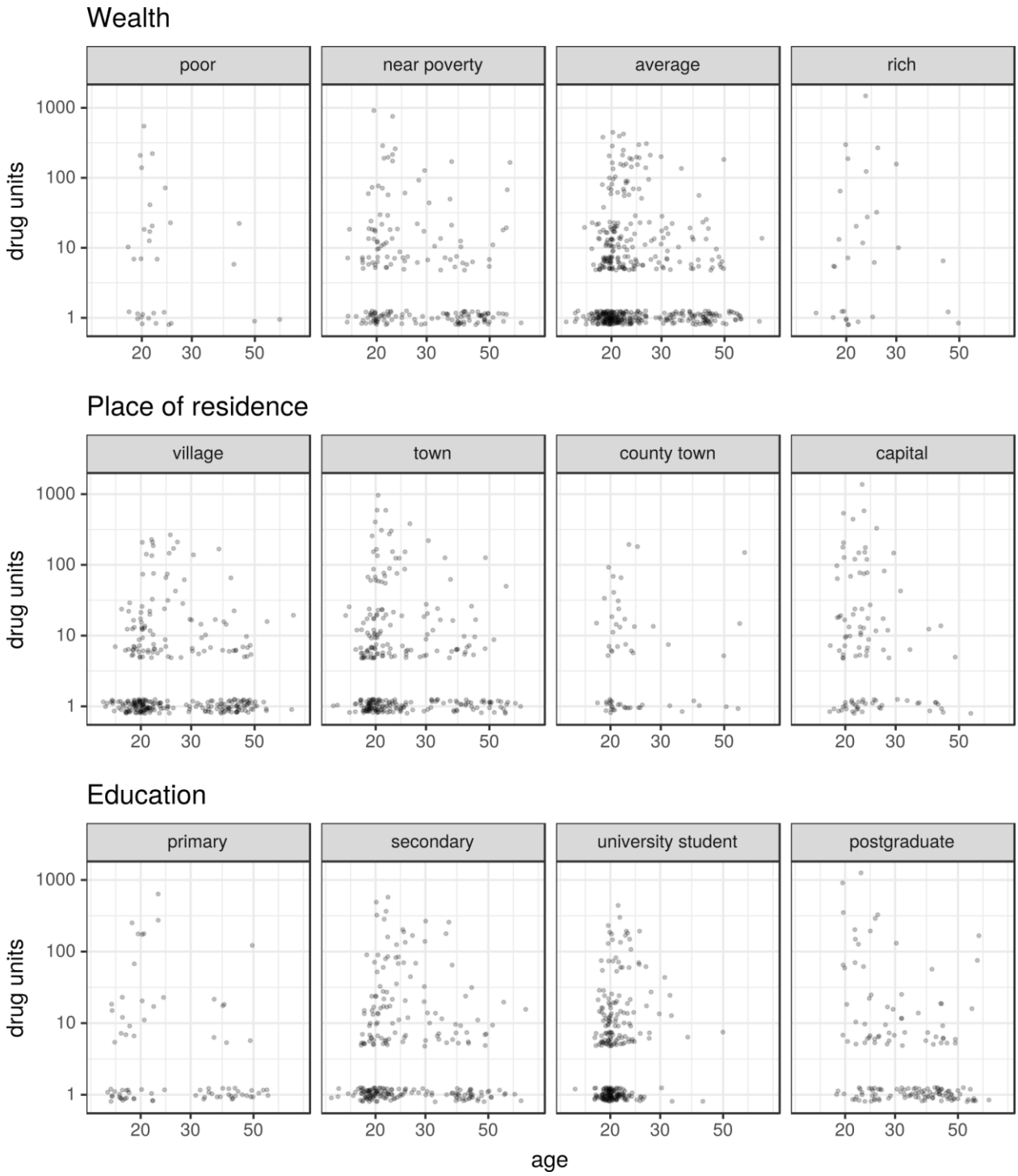

Figure 4. The effect of environmental factors on drug consumption

Drug units reflect the different levels of total drug consumption (never=1; max 5; max 30; and above 100). Data points were jittered to avoid overlapping. Independence of drug units and environmental factors was checked by using $\chi 2$ test. Drug consumption was independent of the financial situation ($p=0.28$), or education ($p=0.17$), while we have found a significant association between drug consumption and the place of residence ($p>0.01$). More participants in villages than in cities never tried any drug while more participants living in the capital than in smaller places used drugs more than 100 times.

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Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.67
http://doi.org/10.24368/jates.v9i1.67

Edutainment in the Magic Tower: Environmental awareness as a lifelong learning process

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Abstract

The type and nature of the environmental problems we are facing currently require an adaptive environmental education that is a lifelong learning process rather than a matter of formal schooling. The Magic Tower Science Career Orientation Center and Museum at the Eszterházy Károly University Eger has been committed since its foundation to promote lifelong learning, and establish, in general, an atypical, informal, and non-formal science educational culture in Northern Hungary. One of the target areas of the Tower are the current environmental issues faced by the humanity. In the recent years, the Tower has launched several self-paced and inquiry-based science programs that intended to raise motivation towards environmental sciences, and to create responsible individuals capable to identify environmental issues, engage in problem solving, and take efficient action. These programs were aimed at audiences of different age and education level, ranging from preschool children, through secondary school students, to parents and non-specialized researchers. In the present communication, we summarize some of these activities, along with their achievements.

Keywords: science centers; inquiry-based learning; lifelong learning; environmental education;

1. Introduction

Informal learning settings such as science centers and museums have been identified as opportunities to enhance students' knowledge and motivation in science, and to optimize the connection between science and everyday life (Martin, 2016; Salmi, 2016; Kárpáti, 2013). Such institutions are particularly successful in seeding and keeping alive environmental awareness that is more a matter of lifelong learning rather than of formal schooling (Vörös, 2016). The present study assesses the role of the self-paced informal environmental education programs - aimed at different age groups - in enhancing knowledge, self-efficacy, motivation and responsibility.

The stage of our educational programs is the Magic Tower of Eger, a functionally integrated unit of the Eszterházy Károly University, located in the former observatory tower of the 250 years old building. Because of the historical importance of the instruments and artifacts in its holdings, the Tower is part of the Hungarian cultural heritage, and it served as a place for local

history research over many decades. In 2006 however, Professor József Vida envisioned the opening of this historical site for the general public as an interactive, learning environment for visitors and students. With the help of his colleagues from the physics department, he founded a new interactive room, the Magic Room, and the tower has been opened as museum and science center with its name changed to Magic Tower (Vida, 2018). In contrast to the other science museums of the world, professor Vida designed programs that were aligned along the principles of *guided discovery learning*. He insisted that in each exposition room, a guide should present experiments and the functioning of the instruments at regular time intervals (10-minute presentations at every half an hour), after which the visitors were given enough time to explore alone the presented experimental setups and instruments (Vida, 2016).

Presently, the tower still works according to this principle as a Science Career Orientation Center, and plays important role both in informal learning in Hungary, and in directing students towards science careers. The mission adopted by the tower is to establish an atypical, informal, and non-formal educational culture in Northern Hungary (Benczik, 2017) that uses play and entertainment as tools of education (i.e. 'edutainment'). Self-paced, play- and inquiry-based activities, hands-on experiments, interactive experimental shows constitute the *edutainment* list offered by the tower.

In the recent years, the Tower has launched several science programs that intended to raise motivation towards environmental sciences, and to create responsible individuals capable to identify environmental issues, engage in problem solving, and take efficient action. Since the visitors of the tower come from very different age groups and different educational backgrounds, these recent activities were also differentiated according to the specific needs of the different age groups. In the present communication we will discuss some of our newest activities, namely:

- science playhouse and science family matinee series (Benczik, 2017)- offered to kindergarten and elementary school children and their parents;
- the online competition - organized for secondary school students (7'th grade in Hungary);
- scientific presentations and experimental shows - held for high-school students, adults, parents, university students, and non-specialized researchers.

2. Science Playhouse

The well-known disinterest of today societies towards science provoked serious reactions on all levels. The European Science Foundation called to life the Science in Society action (ESF, 2012), which keeps offering great financial support to STEM activities (EC, 2007; EC, 2014).

The Hungarian educational system is also changing by developing a science-as-practice national educational curriculum (TPI, 2016), and introducing alternative manuals - steps that are all aimed at school-aged children. The behavior of school-aged children observed in the Tower, however, suggested that middle school age and adolescence are too late for awakening fascination for science. These children show already a general resistance against learning, poor to moderate interest towards science, and a lack of thirst for new knowledge (Kos, 2016). Younger (5-6 years old) children in turn, are still driven by their inborn curiosity, fascinated by anything unknown, and extremely susceptible to every piece of knowledge about the world surrounding them. This observation motivated us to turn our focus to kindergarten age children, and launch a science playhouse program for them (Benczik, 2017).

1.1. Short history of the science playhouse

In 2016 November when I joined the ongoing activities at the Magic Tower, I proposed and organized a science playhouse program in the tower based on my German experiences. German kindergartens and elementary schools incorporate regular visits to different science centers in their educational agenda to promote scientific literacy among children. Besides the fact that such forms of informal learning raise motivation, promote creativity, and confer technical skills to children (Stannard, 2001), longitudinal studies have also proven their particular efficiency in keeping alive students' interest and belief in science matters on the long term (Suter, 2015). In Eger, such scientific sites are completely missing, in contrast to the numerous cultural opportunities for children that have a dominant presence in the life of the city. To fill the gap, my main idea was to build an appealing, family friendly scientific facility in the Tower where we can offer a program package according to a pre-determined schedule on regular time intervals. The program package consisted of free play with educational toys, combined with a 30-minute frontal experimental demonstration. Professor Vida supported the idea with full involvement. I interviewed a few parents about the topics they were interested in, and robotics, renewable energies, and construction kits came up in the first three places. The playhouse programs were launched in the Advent period preceding Christmas. Professors J. Vida and Z. Murányi (presently director of the Tower), colleagues G. Zoller, M. Madarassy, and J. Misz helped me out with the frontal experimental shows.

The first playhouse sessions took place in the afternoons as afterschool programs, and they were open both for classes and families. The attendance of these sessions was way below our expectations. The afternoon did not seem to be a convenient time neither for families nor for classes because of the variable school-day times at different schools, and the usually overloaded

schedules of the students. We also felt some skepticism coming both from parents and educators. Since in Hungary neither teachers nor parents were early childhood educated, they had difficulties accepting the concept of a playhouse as a form of education. We got, however, very positive feedback from those who attended the sessions. Almost all of our visitors, after learning what it is about, came back and attended all the other sessions without even missing a single one.

From January 2017 our playhouse sessions were offered only on weekends. To engage families and parents, we transformed it into an opportunity for multigenerational weekend programming. A 30-minute planetarium show was also added to the program package. In this way, we created the so called Science Family Matinee series in the form in which it runs (occasionally) until today.

1.2. Structure of the science playhouse.

We opened the playhouse in a big room of the tower where we installed several round tables so that the children could work in groups. On some tables, we displayed selected construction kits grouped by topics, along with manuals and instructions. On other tables, we provided play-based and hands-on experimental setups. The children could play independently in their own rhythm and experiment with the toys, but for those who preferred to be guided in their work, the manuals gave suggestions and clear instructions.

Figure 1 Two different models of wind turbines constructed in the science playhouse

- On the ***Renewable energies*** table we displayed the ***Wind Energy Science Kit*** (provided by Kosmos) that allowed construction of a miniature, but really working wind turbine. The turbine had two working modes: in one mode, it transformed mechanical energy (that of the wind, mimicked in our case by a simple vacuum cleaner) to electric power (demonstrated by a small LED lamp that lighted up). In the other mode, the turbine was

powered by batteries and produced mechanical energy (i.e. operated the wheel). The kit scored high points among our other kits for educational value and simplicity; it had an easy to follow experimental manual and assembly guide.

- The question ***How electric energy can power a car*** was addressed on the table with ***Brainbox Electronic*** kits. This kit has easy-to-handle and durable parts and it allows construction of a huge amount of electric and electronic circuits. Children can operate wheels, light up lamps, test magnetic sensors, build an alarm, produce spooky space war sounds by using only very few elements. For its high educational and motivational value and for enhancing creativity, in England the kit has been introduced in the Science National Curriculum, and it is widely used in formal schooling for grades 1 and 2.

Figure 2. Children and adults experimenting self-autonomously with the Brainbox Electronic kit in the science playhouse

- On the ***Green Energy*** table (***Green Energy*** kit provided by ***KidzLabs***), children can explore experimentally different ways to produce electric energy. The potato clock, for instance, introduces children to green science. A potato clock runs by converting chemical energy into electrical energy, which is then used to power a clock. The potatoes, in combination with zinc and copper strips act as a battery. Most people are not aware that this is possible, which is what makes it so interesting. The energy comes from the chemical change in the zinc when it dissolves inside the mild phosphoric acid content of the potato. The energy does not come from the potato itself. The kit also contains small

wind turbines and dynamos with little LED lamps attached to them that indicate immediately that mechanical energy has been transformed to electric current.

Figure 3. The Green Energy kit contains dynamos, wind turbines, and potato clocks

- The free play in the playhouse was followed by a frontal, but ***interactive experimental presentation*** given by the teachers of the University. The presentations were adjusted to the specific needs of the young children (reduced time, simple explanations, attractive experiments presented in an exciting manner – sometimes framed as a fairy tale). The topics included environmental physics, effects of radiations, interesting properties of water and air, atmospheric pressure and vacuum, atmospheric currents and winds, phenomena driving the climate, and other concepts and phenomena that occur in the children's everyday life.

Figure 4. Prof. József Vida presenting phenomena in vacuum (left picture), and a demonstration by József Misz on damages caused by IR radiations (right picture).

1.3. Conclusions and achievements

We can conclude in general, that the activities offered in our science playhouse fulfilled the cognitive, behavioral, and emotional engagement needs of the children. Not only kindergarten children, but also older siblings, and even adults engaged in the constructions and experiments with full involvement. Children appreciated the opportunity to get a look behind the scenes of science (opportunity available only to older students so far), and developed immediately an aspiration to participate further in similar activities, - a point that shows that early childhood education is indeed needed and welcomed in Hungary.

The second observation underpinned the significant role of free play in education, and the fact that directed free time and directed programs cannot replace free play (Dewar, 2008; Stannard, 2001). The errors and mistakes made by children during experimenting with their own hands promoted I-can-do-it attitude, enhanced self-confidence, and most importantly developed cooperative behavior. Children who met for the first time in their lives helped each other with advices, instructions, and solving each other's problems.

We also noticed that planning and executing alone a task (that was needed in the playhouse) promoted intrinsic motivation and led to deeper engagement than simple listening to a presentation, or watching an experiment. For instance, we could compare children experimenting with our Bermuda cylinder (where they simply had to hit a button to operate the experimental setup, and observe passively what happens), to those children who made experiments with an alarm circuit (where they needed to design and build the setup prior to running the experiment itself). While children watched the first experiment only for a couple of minutes, they were engaged in the second activity for hours.

As for the sensitization of children on environmental issues, we noticed the following:

- The renewable energies section of the playhouse stimulated students' interest in environmental matters, it provoked quite often discussions about fossil vs. renewable energies, and awakened in children a noticeable aspiration to become responsible stewards of the Earth's resources.
- The wind turbine kit developed an understanding of the physical phenomena behind energy production; children acquired a thirst for more knowledge, and also developed an ability to pay attention to the happenings around them (for instance, to efforts to save energy at home, at school, and so on).

- We noticed gains in content knowledge recall (solar and wind power usage in energy production, concepts like pressure, vacuum, temperature, knowledge about air, currents, winds), especially after the frontal experimental demonstrations.
- We observed improvements in children's' beliefs that environmental issues are relevant to our everyday life, and an increased environmental awareness and motivation (towards selective material recycling, for instance) in those who attended the playhouse.

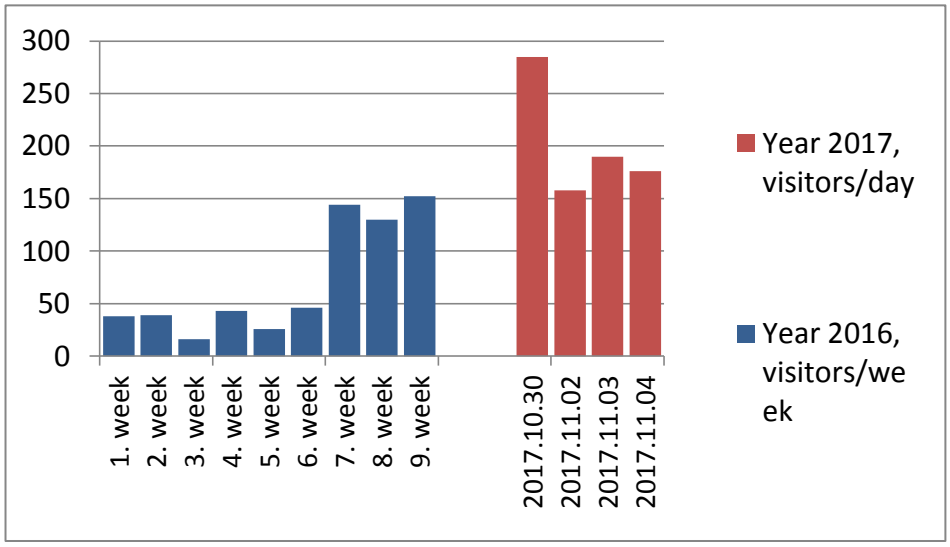

Figure 5. Evolution of the number of visitors from 2016 to 2017. Please note that blue columns represent weekly loads, while red columns show the daily traffic.

The benefits of the science playhouse were, of course, twofold. The museum also profited from them in what regards the number of visitors. After the first period of disinterest, the playhouse became very popular. Visitors enjoyed the lively and challenging experience offered by the playhouse, as compared to the sterile, passive and just visual inspection of the expositions, and started to plan their visits on those dates when the playhouse was also open. On these days the number of visitors grew very high, on some occasions approached the maximum capacity of the tower. The playhouse carried a highly attractive power, visitors found it easier to absorb the message transmitted by the museum when it was linked to manual activity and direct inquiry.

3. Online competition as an educational tool

E-learning and online materials represent a very good opportunity for disseminating environmental sensitivity on large scales. E-learning methods have got an overwhelming preponderance in education in the last decades, mainly because today's students have changed incrementally from those of the past, in the sense that they spend their entire lives surrounded by

and using computers, internet, instant messaging, cell phones, and other toys and tools of the digital age. Such digital natives (Prensky, 2001) accumulate easier knowledge from online sources than from the tried-and-true, age-old instructional techniques. Taking this into account, the opening of online communication channels with the students became one of the main priorities of the Tower.

The time to launch our online competition came in January 2018. We were disappointed with the earlier results achieved by students in the final round of the Magic Tower competition 2017 (which is a paper-based national competition organized by the Tower every year), and I insisted on launching a series of preparatory online tests prior to the final round of the competition, in order to guide and help participants in their learning process. Conceptually, the online competition was conceived as a series of five subsequent rounds of test problems that gradually increased in difficulty, and forced students to reach intermediate milestones in their preparation for the final round. In each online round, new test problems were published on an online interface for a period of two weeks, during which students had to solve them, and submit their solutions. After each online round, feedback on the correct answers was given to the participants.

The online questions were created in a way that encouraged learning through interactivity and action. Colorful pictures and graphics were added to the questions, partly to give a hint on the right answer, and partly to make learning fun. Several web-links were added to each question to teach students to search self-autonomously for information, and to provide, in the same time, guidance on how to use the internet in a meaningful way. Questionnaires were put together in four categories: *Astronomy museum* questions by Judit Vasné Tana, *Planetarium* by László Ujfaludi, *Science* by Gábor Zoller, and *Experiments* by József Vida.

Figure 6. Illustration as it appeared in the online competition related to the problem of sea ice loss (by József Vida: Experimental questions, Round 1.)

The *Science* and *Experimental* questions covered topics from physical, technical and environmental sciences. The experimental questions were actually some worksheets that led participants step by step through the problem, starting from purchasing the items needed for the experiment, through execution of the experiment itself, to the to-be-remembered conclusions and possible impacts of the experiment on our everyday life or environment. As an example, we present here briefly the first-round experimental question: ***What's causing sea-level rise? Land ice vs. sea ice***. The actual experiment was divided into two sub-tasks related to each other. First, (i) participants had to melt an ice cube that floated freely in a glass of water. In the second part, (ii) the ice cube was laid on a piece of wood immersed in the glass in such a way that the ice cube was elevated above the water level (supported by the wood, and not floating). The participants had to observe the rise of the water level after the ice cube has been completely melted. The surprising fact, that many people are not aware of, is that the water level will rise only in the second case, while in the first situation, the floating ice cube will not cause any change in the level of water upon melting. In the outreach part of the questionnaire the students were asked how the experiment was related to global warming. They had to find the correct answers from the following possibilities (multiple choices):

a) There is no connection between the experiment and global warming because one of them happens on the Earth, and the other in the glass.
b) The melting of icebergs that float in the oceans (sea ice) does not cause sea level to rise.
c) Only land ice or glaciers coming from mountains will elevate sea levels upon melting.
d) According to researchers, sea ice loss might be the cause of the drastic declines in the polar bear populations.
e) The 9/10 part of a floating iceberg is under water.

The take-home message is hidden of course, in the correct answers (b) and (c), namely that sea level does not rise when sea ice melts (Arctic ice is considered sea ice since it is not supported by land). Sea level rises when land ice melts (i.e. the Greenland and Antarctic ice sheets, along with smaller glaciers). The other two correct answers (d) and (e) were not based directly in the experimental observations, they needed additional calculations or search on the internet.

The theoretical questionnaires (Gábor Zoller: topic Science) were focused more on disseminating knowledge, on promoting directed learning and research using the internet. They were meant to confer digital skills to the participants, and develop critical thinking and responsibility towards our current environmental problems. Light pollution, solar energy, energy saving light bulbs are some examples of the environmental issues discussed in the test sheets.

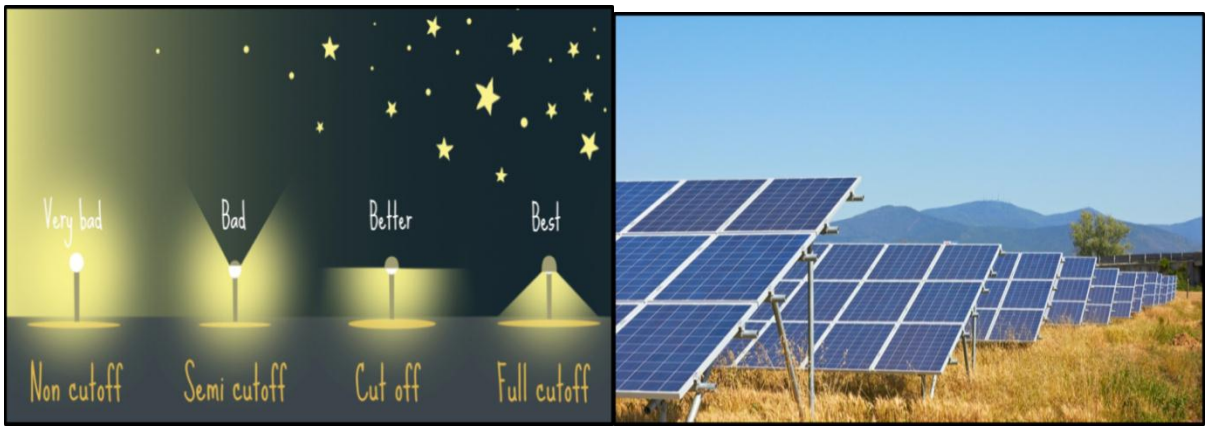

Figure 7. Environmental issues discussed in the online competition (topic Science by Gábor Zoller): solar energy (left panel), and light pollution (right panel).

Our online competition was one of the very few existing today in Hungary. Up to our knowledge, there are several online competitions running in subject like mathematics, languages, or history, but there is no one regarding physics and technical sciences. In addition, our online competition is one of the firsts that attempts to add interactive elements to the competition, and really focuses on hands-on experiments done self-autonomously by the competitors.

From point of view of the paper-based Magic Tower Competition, the results shown in Figure. 8. speak for themselves. The scores obtained by students in 2018 following the preparatory online competition increased in some cases with a factor of two as compared to the results obtained in 2017. The online competition provided a significant gain in content knowledge, and granted unbeatable advantage to those who attended it: no student managed to classify for the final round in the paper-based competition without going through the online rounds.

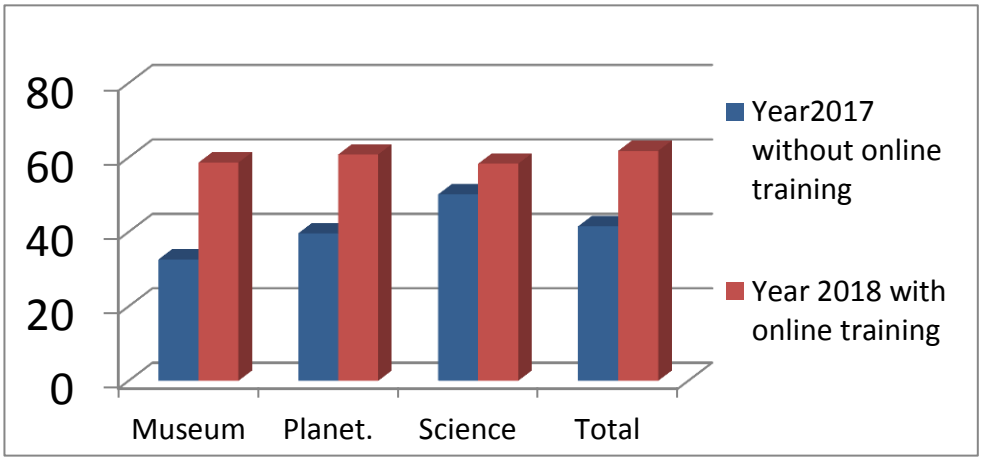

Figure 8. Student scores (measured in %) obtained in different topics in the Magic Tower Competition in years 2017 (without online training), and 2018 (preceded by online training).

4. Scientific presentations

Aligned both with the strategic guidelines given by our university that intend to increase the number of undergraduate students, and with the principles of the European educational policy that promote lifelong learning, we added to our educational curriculum also theoretical scientific presentations, which targeted university students, adults, parents, or teachers and researchers of the university specialized in other subjects. Apart from disseminating knowledge, these presentations were meant to familiarize the audience with the state-of-the-art research results, stimulate scientific research work and problem solving skills, and reinforce a scientific approach towards global problems. The talks were presented in an interesting manner, in a language that was different from that of the scientific literature, and thus, it made the message of the presentations more accessible and understandable to the general audience.

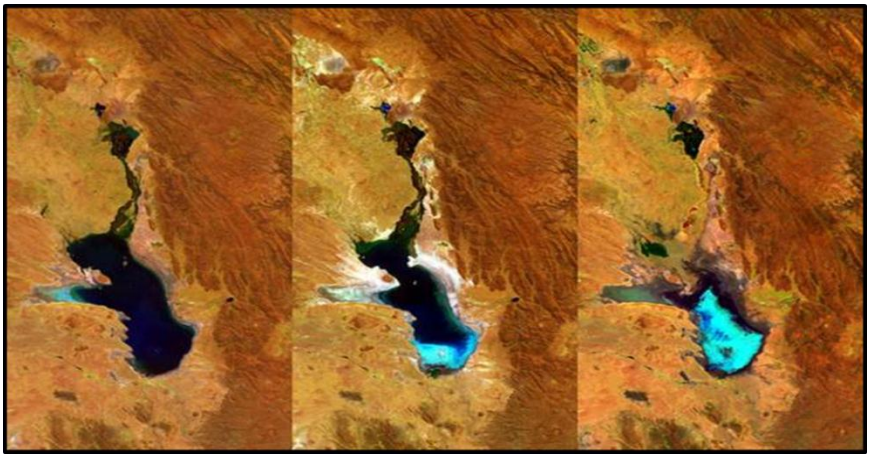

Figure 9. The dried out Poopo lake in Bolivia (satellite image credit ESA). Image taken from the presentation *Visiting the European Space Agency* by I.J. Benczik.

Unfortunately, some of the highly qualified professors and researchers find science dissemination events a waste of time, and they withdraw themselves from public presentations. To amend this situation, some important stakeholders, such as the National Science Foundation in the USA, requires each scientific proposal submitted for funding consideration to address the so called *Broader Impact* criteria which enforces principal investigators to link their research to societal impacts, and enroll in educational/outreach activities that benefit society. Researchers are increasingly reaching out to the general public as a means of raising awareness and increasing appreciation that science plays in the quality of everyday life. In Hungary, the National Science Foundation does not apply yet such motivational tools, but fortunately some

enthusiastic researches realize the importance of such activities, and volunteer to give presentations driven only by their intrinsic motivation. The teachers of the Physics Department and the staff members of the Magic Tower are the best examples of such volunteers.

Figure 10. The presentation *Chaos in our lives* by I.J. Benczik. The slide shows the Planet Simulator - an intermediate level climate model.

The Magic Tower participates intensively in such outreach activities, both at home (giving seminars on the level of the Department, in the Institute, or to the general public during open days or roadshows), and also at external sites, for instance in a thermal bath in Berekfürdő (Vida, 2018), or in the *Csodák Palotája* Science Center in Budapest. In the Tower, we also have a list of selected topics and presentations that we offer to interested groups or classes upon request. The verbal feedbacks about our scientific lectures are very positive; we keep getting more and more invitations to other universities, schools, and cities from all over Hungary.

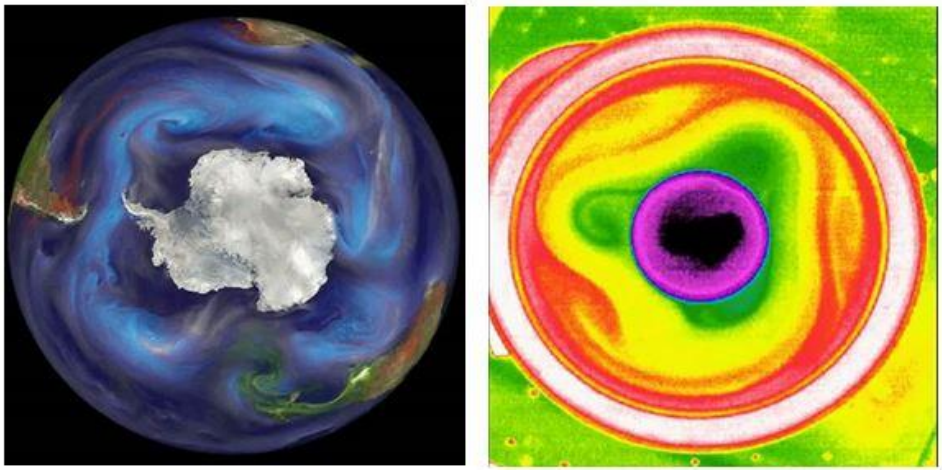

Figure 11. Experimental simulations of the warming climate in a tank (credit M. Vincze, ELTE). Image from the presentation *Climate change with the eyes of a physicist* by I.J. Benczik.

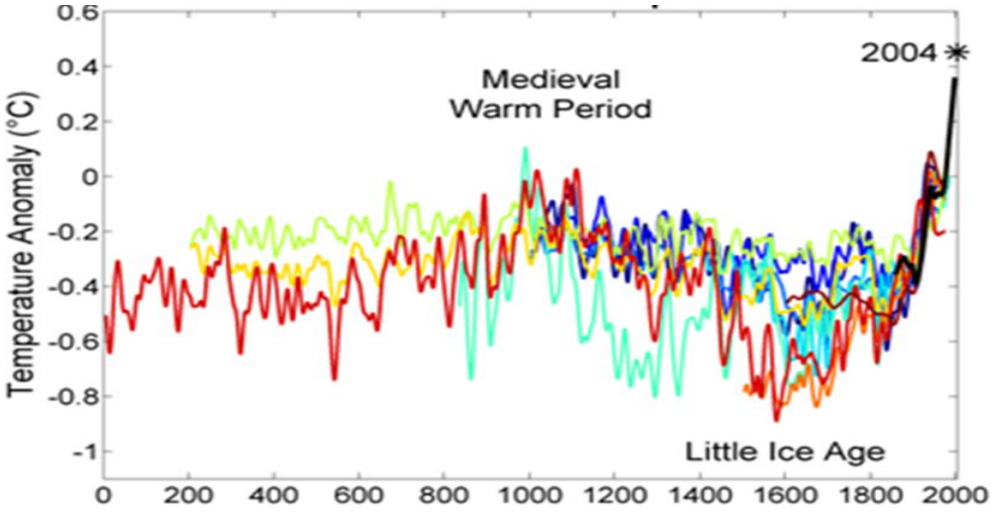

Figure 12. Illustration from the presentation *Role of the ice cover in climate changes* given by L. Ujfaludi in Miskolc. The figure shows the change of temperature in the past two thousand years. Values shown by the different graphs are based on data gained from dendrology, ice cover layering, coral growth, etc. estimations (Ujfaludi, 2018).

Conclusions

With its various informal and non-formal educational activities that range from early childhood education to activities that enable lifelong learning, the Magic Tower Career Orientation and Science Center of Eger wishes to establish a new, atypical educational culture in the city of Eger and in Northern Hungary. As neither parents nor teachers are familiar with these forms of education in this region, our efforts meet sometimes skepticism, doubt, and rejection. The international antecedents, however, are very promising, and we hope that Hungary will join the international trend as soon as possible, and informal schooling will get its well-deserved appreciation in the Hungarian educational system.

Acknowledgements

I would like to show my deepest gratitude to my colleague Professor József Vida who supported and guided me in all of my efforts in the Magic Tower. I acknowledge and highly appreciate the help coming from my colleagues Márk Madarassy, József Misz, Zoltán Murányi, József Vida, and Gábor Zoller with the experimental presentations in the playhouse. I also thank colleagues Judit Vasné Tana, László Ujfaludi, József Vida, and Gábor Zoller for preparing the online questionnaires, and Gábor Herenik for preparing the statistical data for the paper. I am also grateful to all the workers of the Magic Tower who assisted visitors during the activities. The activities were partially supported by the EFOP-3.4.4-16-2017-00024 4-Campus Program.

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Short professional biography

Izabella J. Benczik, PhD, works as associate professor at the Physics Department of the Eszterházy Károly University Eger, and as program coordinator at the Magic Tower Science

Career Orientation Center at the same university. She spent more than a decade as researcher in Germany and USA working in hydrodynamics, nonlinear systems, and chaotic systems, which are her main interests also today. In the last years, she has proposed and organized several informal educational programs in the Magic Tower, most recently the Magic Tower Online Competition 2018-19. She is also interested in innovative methods in teaching physics.

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Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.93
http://doi.org/10.24368/jates.v9i1.93

Borbala Nature Trail – Recovery potential for abandoned mining and industrial areas based on a planned nature trail

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Abstract

Learning means a lot more than meeting the school curriculum. Only a small part of it can be done in classrooms, it includes lots of additional activities outside of school. Present-day Hungarian public education is traditionally knowledge-driven. Learning normally does not include field activities, even though these extracurricular field activities are the ones giving the pupils a chance to observe the natural phenomena in their natural place and to understand what they learned through their experiences. In some areas that are particularly important in today's educational system, like environmentally conscious education or sustainability education, the field activities would be especially important. They are also needed to understand the connections, the problems and the possible solutions between nature and society. For this purpose institutions and devices that are able to aid the learning process are needed. Borbála nature trail that we designed presents the industrial history of the once thriving industrial city, Salgótarján and it is a perfect place for field activities. The theme of the nature trail can be inserted into the curriculum at several places, including environmentally conscious education at the topic of man-made environment and it can also be found among the topics of sustainability education.

Keywords: Salgótarján, nature trail, industrial history, interactive booklet

1. Introduction

In the Hungarian public education field activities can rarely be found, lexical knowledge is in the focus. The teachers are too focused on the curriculum and that puts unnecessary pressure on the students. This so-called upward-looking pedagogy does not take into account the characteristics of certain age groups and is classroom-based (Makádi 2015). But learning is so much more than what can be included in a lesson (Vásárhelyi 2010). The extracurricular activities out of the classroom provide the students the chance to observe phenomena and natural processes in their natural place and evaluate their experiences (McPherson et al 2014, Makádi 2015). On certain topics like environmental consciousness and sustainability, out-of-school activities are particularly important (Johnson 2014). For example, the point of environmental consciousness is to make the students develop a sense of individual responsibility towards the

environment (natural and man-made) and that is impracticable solely in school (Schróth 2004). And for this exact reason environmentally conscious education is like a catalyst for field activities in schools. The National Curriculum and the curriculums of the science subjects both provide the opportunity for out-of-school activities, but in many cases it still doesn't happen (110/2012. (VI. 4.) Government Regulation, 51/2012. (XII. 21.) EMMI Regulation). The amount of field activities in a school depends solely on the principal and the teachers. The institutions often support knowledge-driven education because of the traditions and the expectations of the parents (Siegmar 2017). Other significant problems are the overloaded teachers and the lack of time and money (Vásárhelyi 2010, McPherson et al 2014).

The nature trails are the essential, well-known showrooms of education. It connects the visitors and nature, it shows the phenomena and natural processes in their real spot (Kollárics 2015). Their goals are for example the independent gaining of knowledge, developing the visitors environmental awareness, demonstration of new aspects, information-based cognition, showcasing a specific area. Typically the knowledge can be gained at the stations, it is systematic, special guidance is not needed so the visit is independent (Kiss 2007). Thereby the trails are suitable for both school trips and family trips and are especially important in environmentally conscious and sustainability education (Sever et al 2018).

Since the 2000s more and more nature trails are established in Hungary. It is not easy to determine the concrete number of them, because not only organizations but individuals are able to create them and new ones are constantly opening. The nature trails of Hungary on average are 4.1 km, they have 10 stations and it takes 1-3 hours to complete them (Kiss 2007). Based on two databases: Data Base of The National Parks Directorate and tanosveny.info most of the Hungarian nature trails showcase natural assets and not the man-made environment, and based on these two databases there is no nature trail in Hungary that is industrial history-themed (Fig.1.).

On the Fig. 1., we visualized the themes of the Hungarian nature trails by counties. The trails called special are the ones that are individual in the country or there are only a few of them, for example architectural, ethnographic and religious-themed trails.

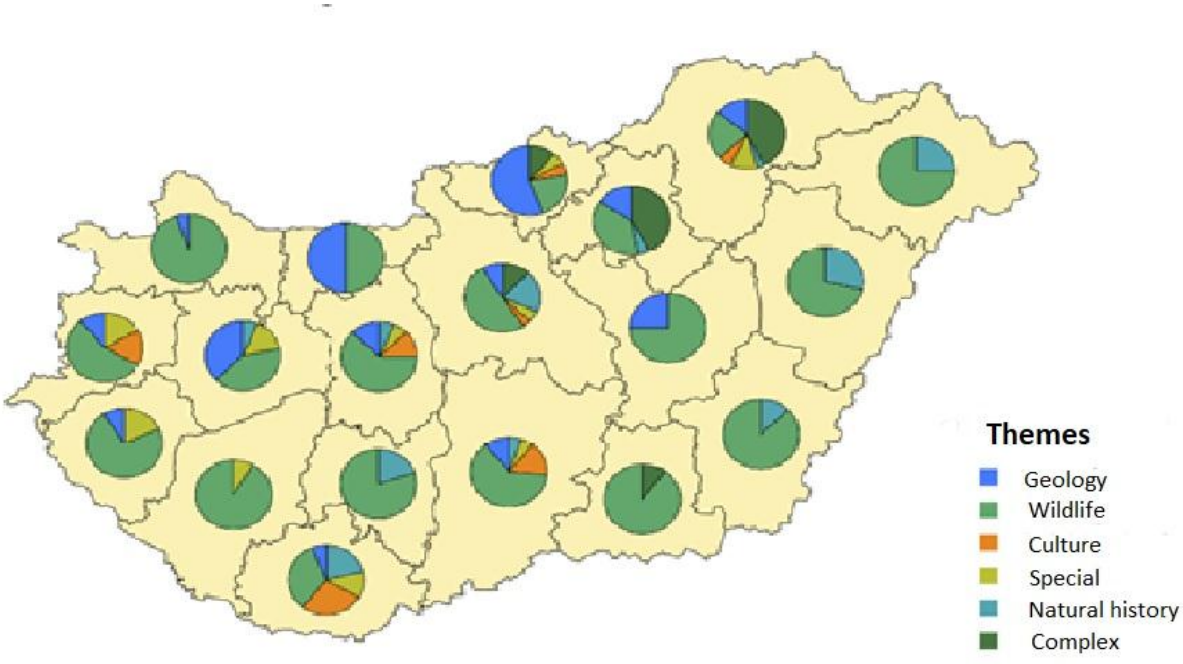


Fig.1. Themes of Hungary's nature trails (sources: tanosvenyek.info)

The nature trail that we designed would be unique in the country and with that, it could help the environmentally conscious and sustainability education. The themes to be presented can be found in these educational areas, they display complex social-economic relations. It connects the natural environment with society, it connects the visitor with their environment. Among its themes, power generation and mining are ones that can help with the understanding of the need to change resources for energy production. It shows the impact of nature on society and society's impact on nature. It showcases how we use and use-up our natural resources through the regional change of usage of brown coal. Understanding this helps us understand the need for changes. The showcased themes can be found in the curriculum of several school subjects: geography, nature studies, chemistry, physics, and history. Ergo it can be inserted into the curriculum at several places. The teachers can use it to raise the student's attention on a topic by showing it to them in the everyday world. It can be useful as a repeating or summarizing class because it presents the connections in the knowledge. It is a ready-made knowledge so it requires less preparation from the teacher. The nature trails provide interesting facts and new information for all age groups.

2. Presentation of the area to be processed

The nature trail is based in Salgótarján and in its surroundings. The town originally was an agricultural settlement, it became a city in the 19th century when the brown coal was found (Gajzágó 1962). The first tunnel, the Ó-Mária-tunnel was opened in 1848. They started the

exploitation of the good quality 2-2,5 m thick coal seam here (Sebestyén & Szvircsek 1992). In 1867 the Hungarian National Railway came to Salgótarján allowing it to become the provider of brown coal for the industry of the capital city (Szvircsek 2000). The founding of Salgótarjáni Kőszénbánya Ltd. in 1868 was the beginning of large-scale mining, leading to the industrialization of the county. They provided 32% of the coal extraction of the country at the turn of the century and in the 1900s the steel-making was the 1/3 of the national production (Szvircsek 2000). The power structure change of 1956 caused regression. Mining lost its leading role in the area (Sebestyén & Szvircsek 1992). After the change of regime they closed the mines, the industry degraded because of the unfavorable natural conditions and because of the termination of state subsidies. The unemployment rate and migration increased. The former industrial buildings, the cinder cones and all the other remains of the once thriving industry can still be found there.

3. Results

Borbála nature trail would showcase Salgótarján's industrial history. It will include mining, transportation, the power generation, the manufacturing, and the generated waste. And the connection between these and the geological condition of the area and their social aspects. The goal is to be interesting for all age groups, for tourists, students, and locals. There are 2 years for the planning and we are halfway through with it.

When we planned the route, we consulted a geologist who knew the site well. Several filed walks were also made together him. He shared a lot of interesting information with us and he has shown us places that are closely related to the subject. Based on these, we have marked the route on the map.

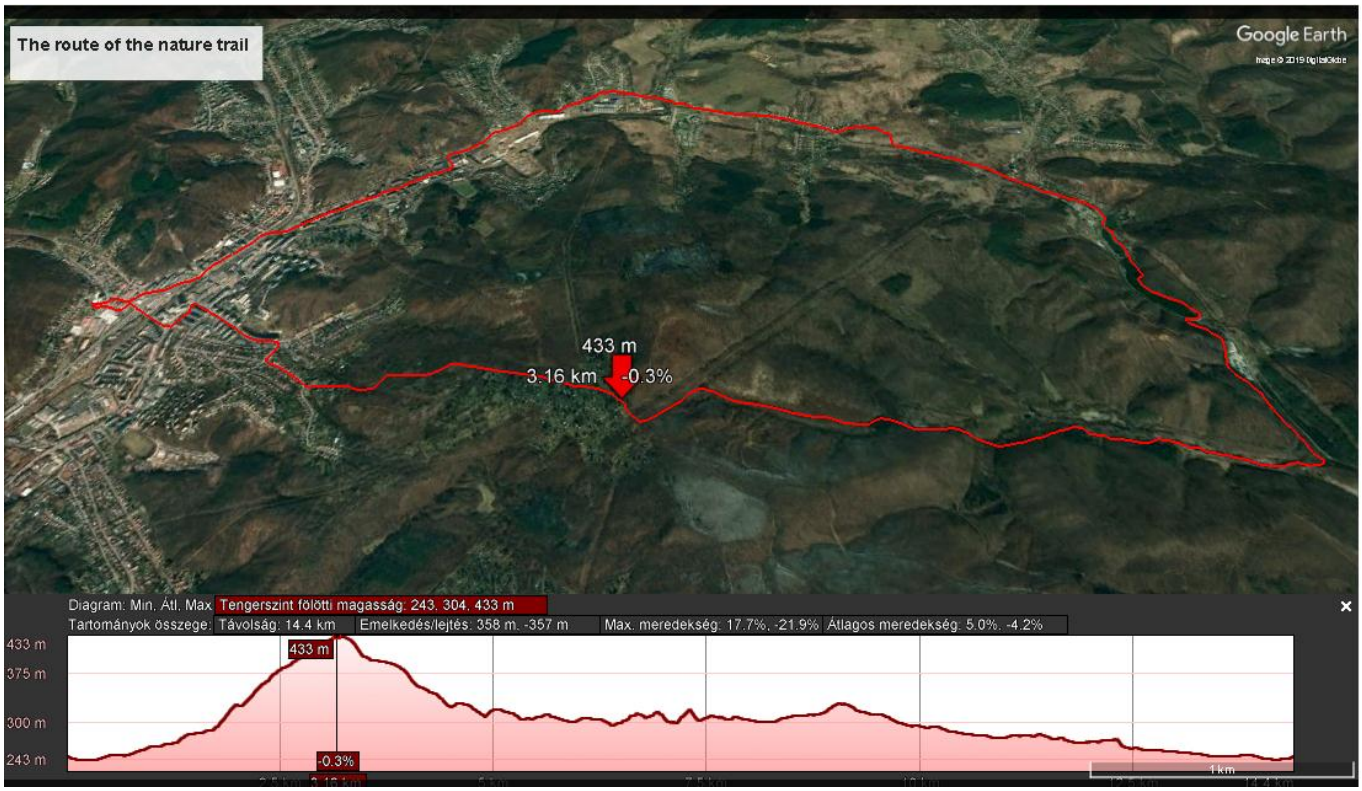
The Borbála nature trail includes the industrial history of the city. It was named after the patron saint of miners, Saint Borbála (Saint Barbara in English speaking area). The local miners believed that the saint would protect them at the dangerous work (Szvircsek 2000). The sign of the nature trail (Fig.2.), which includes the silhouette of the steel factory and a tram that symbolizes the mining, will be painted on the full length of the trail.

Fig. 2. The sign of the nature trail

The route measured on a field survey (Fig.3.) makes a full circle. It's starting and ending point is the Mining Museum in Salgótarján. We took into account that the trail is for all age-groups so there are no significant height differences (Fig.3.).

During the field survey, we determined where the stations will be and what we want to showcase at certain stations. They include all the information that can be interesting for the visitors on the topic (1st chart). The route has a natural flow both in reality and in the topics. It starts with mining and through energy production, it ends with industry. In closing, it presents the life of miners and industrial workers.

The whole route is 17km with 27 stations and it can be completed in 6-7 hours. To make the trail available for all age-groups the only significant height difference, Pécskő (542 m) will not be part of the trail but will be an alternative for the interested. The visitor can read about the curiosities of the place at Novohrad-Nógrád Geopark on an information board. The goal of the



station called View (6th) at the beginning of the trail is that in good weather the visitors can see the whole city from here. On the starting board, there will be a well usable map (Fig.3.) with the whole route, the stations and the relief of the area.

Fig.3.: The route of the nature trail and the terrain profile of the nature trail

We previously mentioned that the nature trails in Hungary are 4 km on average with 10 stations. The longer ones can be done with bicycles or cars instead of walking (Kiss 2007). So Borbála nature trail as a walking route is really long. We want it to be available for all age-groups so we divided the trail into 3 big parts: mining, energy production and industry (Fig3 and Fig.4.). Transportation can be found in all of them. This way the visitors can decide which topic is the most interesting for them if they don't want to complete the whole trail or if they don't have enough time. At the connecting points, there are bus stations and parking places. The stations are interesting and understandable separately too. The visitors are informed about the 3 sections, their goal, and theme at the starting point. Every section has its own color, which helps with orientation. The information boards and the signs are both this color and the color is displayed on the maps too (Fig.3. and Fig.4.).

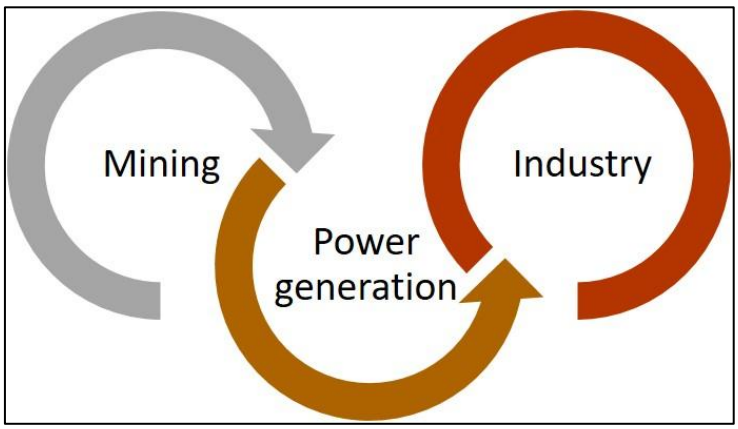


Fig.4. Thematic units of the nature trail

The trail will have informational booklets. Their goal is to be informational and interesting just like the boards. There are different kinds and for the Borbála nature trail, we want to guide booklets that have little tasks and games that can be completed during the hike. They also have additional information and explanations for children (Kiss 2007). These booklets are normally A5 size, their length varies. They can be found at the trail or in the area or on the internet. If the booklets are on the internet normally you can use QR codes to find the right ones for the station.

The main goal of Borbála nature trail is to be a good experience for all age groups, particularly for children. It is important to draw and keep the attention of children. The booklets provide different tasks for different ages especially for children in elementary school. Industrial history is a topic that is basically not interesting in itself for children. The smaller ones don't even understand it, the older ones' attention can't be kept with the written form of it. But if instead of textbooks we use pictures, illustrations and tasks on a field trip its easier for them to find parts

that are interesting for them. For example the children have to queue the production process from mining to power plant use or the children can see the degradation of the landscape by the dumps on “before and after pictures”. And it also helps them connect the things they study to their everyday life.

On the first few pages of the booklet, there will be basic information about the nature trail with a map and pictures. After that will be the rules. There could even be a task about them. The remaining part of the booklet is additional information, explanations, pictures, tasks and games for each station. Some games will be in the booklets, but some of them could be played at the stations.

The booklet should be available for visitors at all times. It would be ideal if the visitors could get it somewhere near the starting point for example in the Mining Museum. Besides we want to make it available online, so families can download it at home. Another solution would be using QR codes at the stations, so people can easily connect to them on their phones even if they come across the trail when hiking in the area.

4. Conclusion

The Borbála nature trail will be an interactive, walking route presenting the industrial history of Salgótarján. We already planned the route of the nature trail and the place of the stations. We have the information that will be presented. The starting board, the maps, the pictures and the first pages of the interactive booklet are ready. We still have to design the remaining boards, finalize the information that will be presented at the stations, finalize the route and finish the booklet. The nature trail has a website which will be available for the public after all necessary information has been uploaded. We plan to go to the route with the children of different ages and based on this we will modify and improve the tasks.

Acknowledgements

We would like to thank the Council of Salgótarján, the Novohrad-Nógrád Geopark and the tender of ELTE/7124/569(T-62) 2015 for their help.

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www.jates.org

Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.87
http://doi.org/10.24368/jates.v9i1.87

Effect of industrial sludge-soil mixtures on germination of white mustard and wheat

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Abstract

Many industrial process produce different kind of sludge as by-product. Those various sludge-types can contain heavy metals or other valuable or reusable elements (as rare-earth metals). Our aim is to determine the accumulation rate of these elements in the plant-tissues and establish the phytoremediaton potential of the plants. Laboratory experiment was conducted in seedling growth tests with various mixtures of red mud, converter sludge and different soil-type-peat mixtures. White mustard *(Sinapis alba)* and wheat (*Triticum aestivum)* seeds were applied for the experiments. According to these tests we determined that among the mixtures the most capable ones were the red mud mixed with slightly saline or slightly acidic brown forest soils. In case of the converter sludge, mixtures with chernozem and loess soil showed the best results for germination. The presence of the used sludge-types could stimulate the germination of seeds and the growth of plumules of plants, however the results are highly depends on the type of the soils. The results highlight the importance of seedling tests in determining the phytoextraction possibility when using industrial waste materials, such as the tested sludge-types.

Keywords: red mud; converter sludge; plants; germination; bioremediation

1. Introduction

Industrial factories are fighting with the problem of disposing produced by-products nowadays. These by-products, industrial sludge-types are generally stored in huge dumps as hazardous wastes. The dumps might create huge risk for the environment. The sludge on the other hand can contain reusable or valuable elements not only toxic components. Due to the valuable elements (e.g. the calcium) the sludge alternatively might be used for improving soil quality *(Újaczki, 2013).* Aim of our research is to decrease the harmful components of the tested sludge-types of using potential phytoextraction methods. It is known that many plant-types are applicable, such as the *Thlaspi*, *Alyssum*, *Sebertia*, *Berkheya* …etc. *(Simon, 2004)*, which can tolerate the harmful elements, or they can hyperaccumulate them in their biomass. Seedling

growth tests were used to decide which concentration of sludge might be adequate for planting. For this test, converter sludge and red mud were chosen.

Converter sludge is produced during the steel making process. This sludge is the by-product of the wet cleaning technology of the converter gas. It contains heavy metal oxides (e.g. zinc oxide, lead oxide) and other oxides according to the used scrap iron quantity of the raw material. Zinc concentration can be 0.67–5%, and the total annual production of this element can reach 1185 ton/year *(Márkus, Grega, 2011)*. The used samples were produced by ISD-Dunaferr Ltd. in Dunaújváros.

Red mud is the by-product of the alumina making process. This kind of sludge is a highly alkaline (pH>12) waste product *(Lockwood, Stewart, Mortimer, Mayes, Jarvis, Gruiz, Burke, 2015)*. The risks of red mud are its highly caustic nature and its fine particle size. In spite of these harmful properties, red mud has also potential benefits. It can be used for critical raw material recovery (e.g. Ga, V, rare earth metals), carbon sequestration, and used as a soil ameliorant *(Mayes, Burke, Gomes, Anton, Molnár, Feigl, Ujaczki, 2016)*. But the high sodium (Na) content and fine structure of this waste can deteriorate soil structure. The salinity and alkalinity of red mud can affect plant growth. For example, low red mud concentration could stimulate the barley root elongation and the trace elements concentrations in plant shoots increased with increasing the ratio of red mud in soil mixtures *(Ruyters, Mertens, Vassilieva, Dehandschutter, Poffijn, Smolders, 2011)*.

In case of red mud of Ajka, two main types, the wet and dry were used. Wet type was produced with the wet technology before 2011. Dry type was produced with dry technology since the end of 2011. The main mineral sources of red mud are ferric oxides and hydroxides, aluminium-hydroxides and sodium silicates, calcium carbonate, quartz and gypsum. Additional compounds are TiO_2 (4-6%), V_2O_5 (0.2-0.4%), P_2O_5 (0.5-1.0%), Ga, and Ge, as well as rare-earth metals can be found in it. *(Feigl, Újaczki, 2014).* The used samples were produced by MAL Ltd. (Hungarian Aluminium Production and Trading Company).

2. Materials and methods

Seedling growth test was made by using white mustard seeds *(Sinapis alba)* and wheat seeds *(Triticum aestivum)* as test plants according to MSZ 21 976-17:1993 Hungarian standard. For these experiments, dried red mud and converter sludge and their mixtures with different kinds of soils were calibrated into Petri dishes. The mixtures of the sludge and soils were used at the rates of 20-, 40-, 60-, 80 and 100%. In each Petri dish 20 seeds were dispersed. Three series for each mixture were prepared. After setting the moisture content the samples were covered and

incubated for 72 hours in a dark place. At the end of the experiment the number of the germinated seeds and the length of radicles and plumules were counted (Fig. 1.).

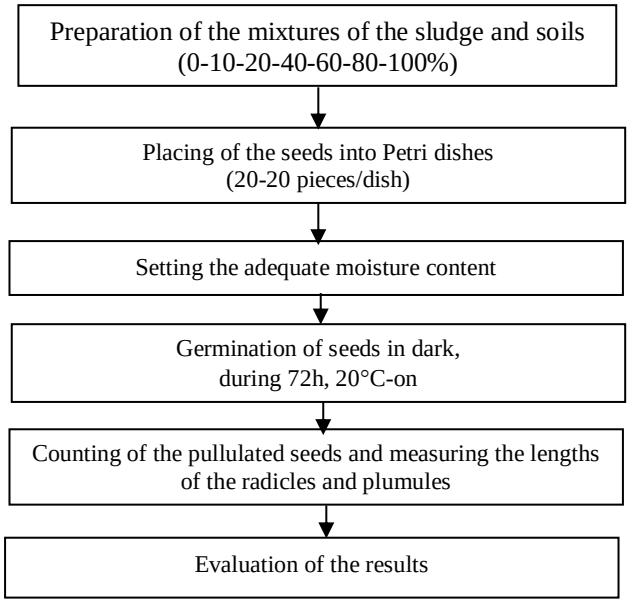

Fig. 1. Steps of the seedling growth test

3. Results

3.1. Industrial sludge mixtures with different soils affected for seed-germination

First of all, we wanted to compare the effect of 100% industrial sludge on the germination of white mustard seeds. Three kinds (old, wet and dry type) of red mud and converter sludge were used. Old type red mud (oRM) was deposed about 15 years ago into the 5th spoil-dump and it was produced from Hungarian bauxite by MAL Ltd in Ajka. Dry type red mud (dRM) had been taken from the 7th, wet type (wRM) sample had been collected from the 8th spoil-dump of this company.

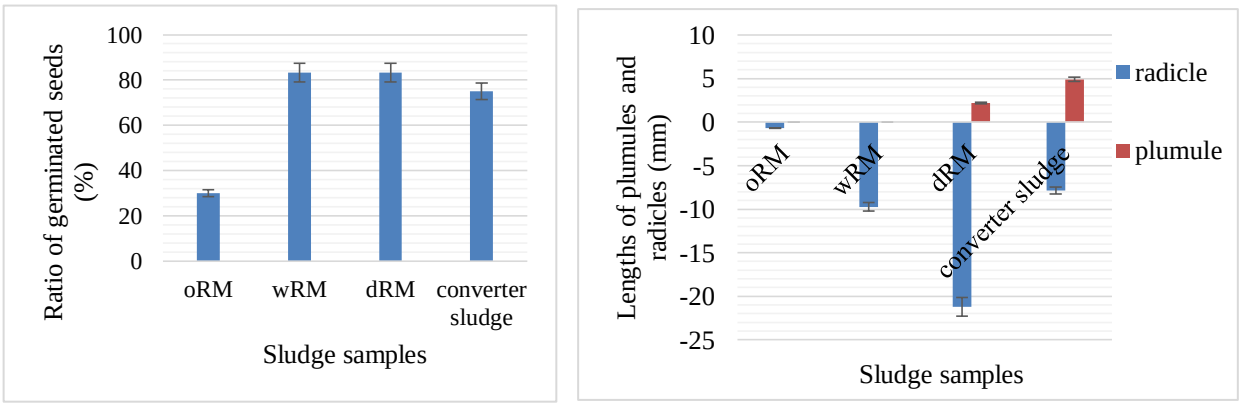

Fig.2. (a) Germinated ratio of white mustard seeds on 100% red mud and 100% converter sludge; (b) Results of germination parameters of white mustard seedlings

We can see on Fig. 2., that the white mustard seeds began to germinate 83% in the case of wet (wRM) and dry (dRM) type of red mud samples. In spite of the high ratio of the germinated seeds, longer radicles and plumules were observed on the dry red mud than on the wet red mud. The highest plumules grew from the converter sludge. The efficiency of the germination was the lowest in the case of old red mud.

Seedling growth tests were also made with mixtures of industrial sludge and soils. Among soils four kinds were used: 1) acidic brown forest soil, 2) chernozem soil, 3) loamy soil and 4) saline soil. Brown forest soil was collected in Sopron Mountain, chernozem and loamy soil samples were taken in Dunaújváros and saline soil was collected from Kiskunság. The mixture rate of the sludge was 20-40-60-80-100%. We also made this test on 100% soils as controls. The pH values of the test soils are shown in Fig. 3. We tried to include soils with low pH, due to the high alkalinity of used old type red mud. Between the test soils the acidic brown forest soil had the lowest pH value. On the basis of the germination results it is possible to decide which mixtures can be adequate for future phytoaccumulation experiments.

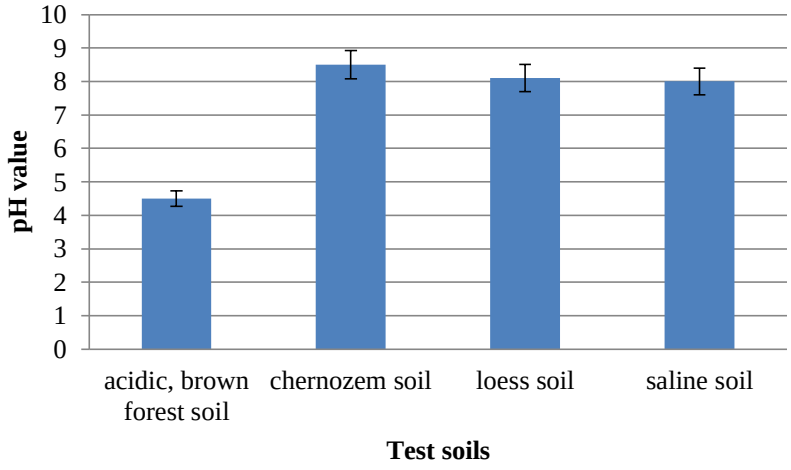

Fig.3. pH values of the tested 4 soil-types

Germination results of the white mustard seeds showed that in the case of old type red mud the mixtures of the acidic brown forest soil and the saline soil represented the best results. When these two kinds of soils were mixed to red mud, the ratio of the germinated seeds were higher (Fig. 4.) and longer radicles and plumules were also observed (Fig. 5.). When the ratio of old type red mud was increased in the mixture, the lengths of radicles and plumules were decreased.

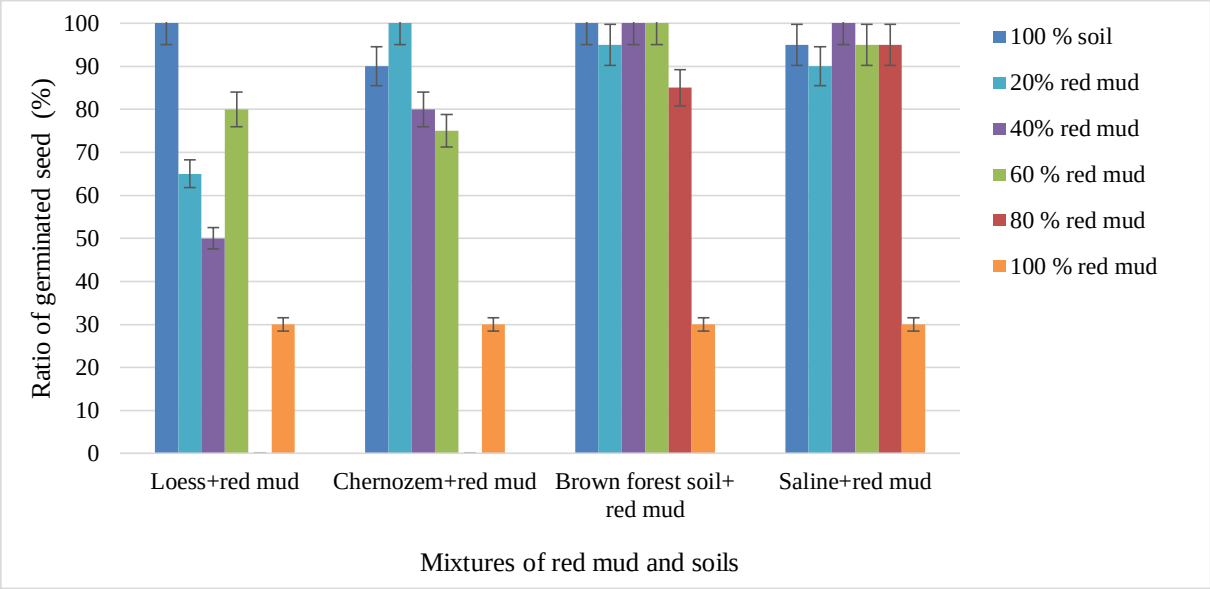

Fig. 4. The ratio of the germinated seeds on the mixtures of red mud and different soils

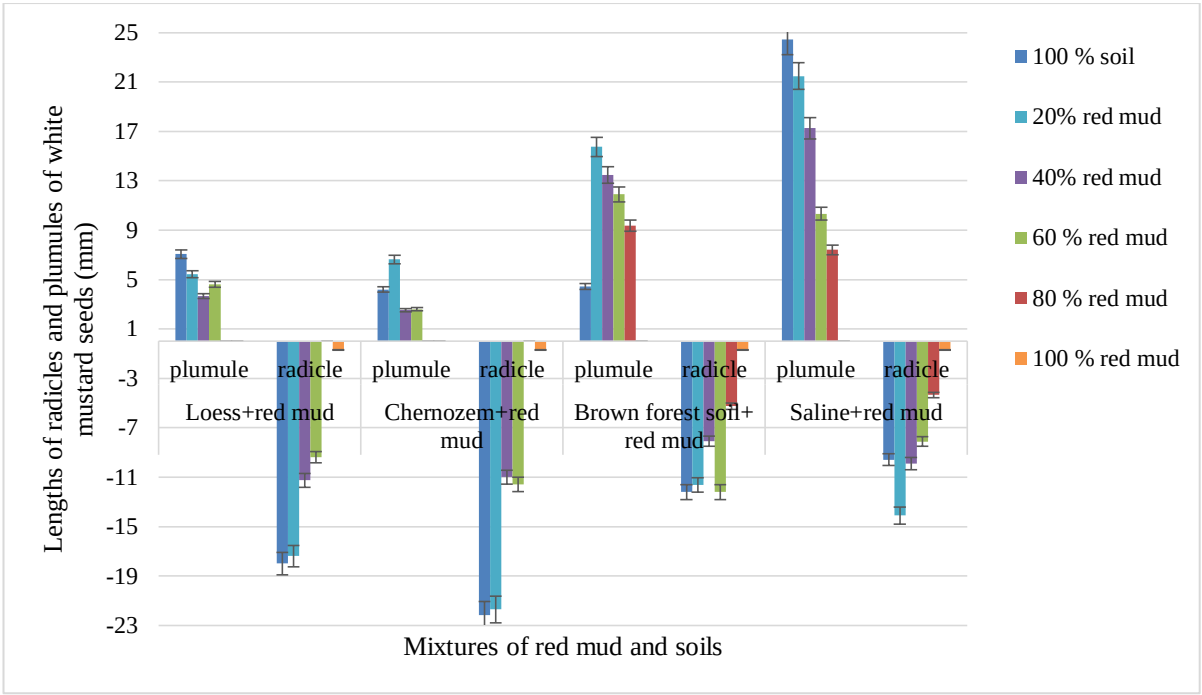

Fig. 5. The length of radicles and plumules, germinated on the mixtures of red mud and soils

The germination results of the mixtures of converter sludge and soils showed that between the four kinds of soils, loess and chernozem soils were the most effective. When these two kinds of soils were mixed to converter sludge, the ratios of the germinated seeds were higher (Fig. 6.) in the case of 20- and 40% mixtures. Longer radicles and plumules were observed in these mixtures (Fig. 7.). When we compared the controls to their 20% mixtures with converter sludge, it can be determined that the presence of this sludge could stimulate the growth of the seedlings.

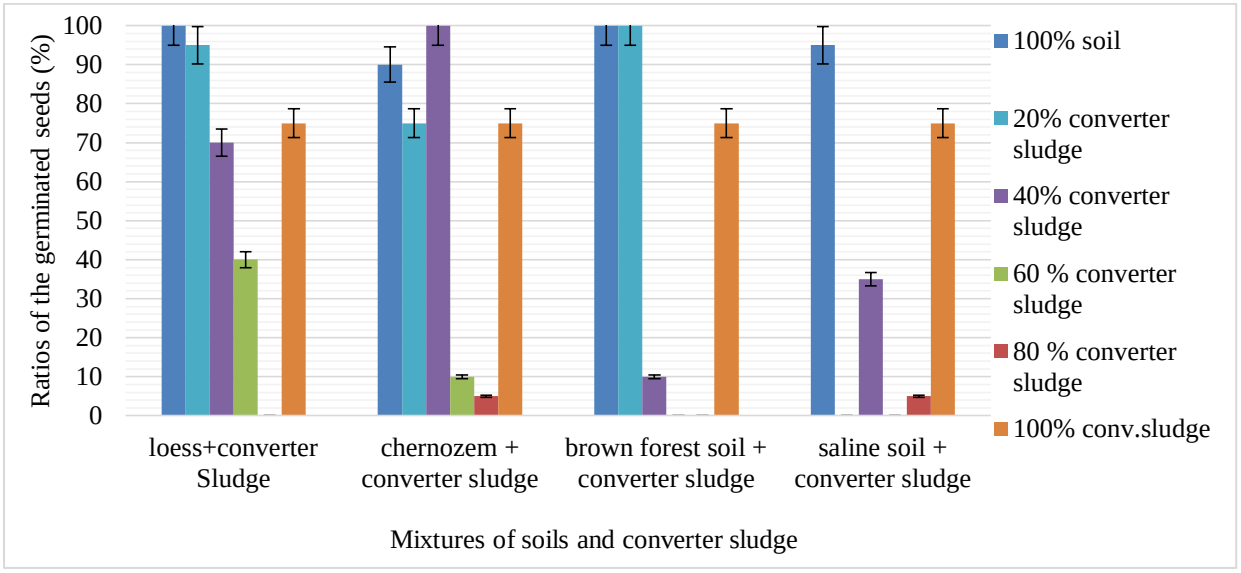

Fig. 6. The ratio of the germinated seeds, grown on the mixtures of converter sludge and soils

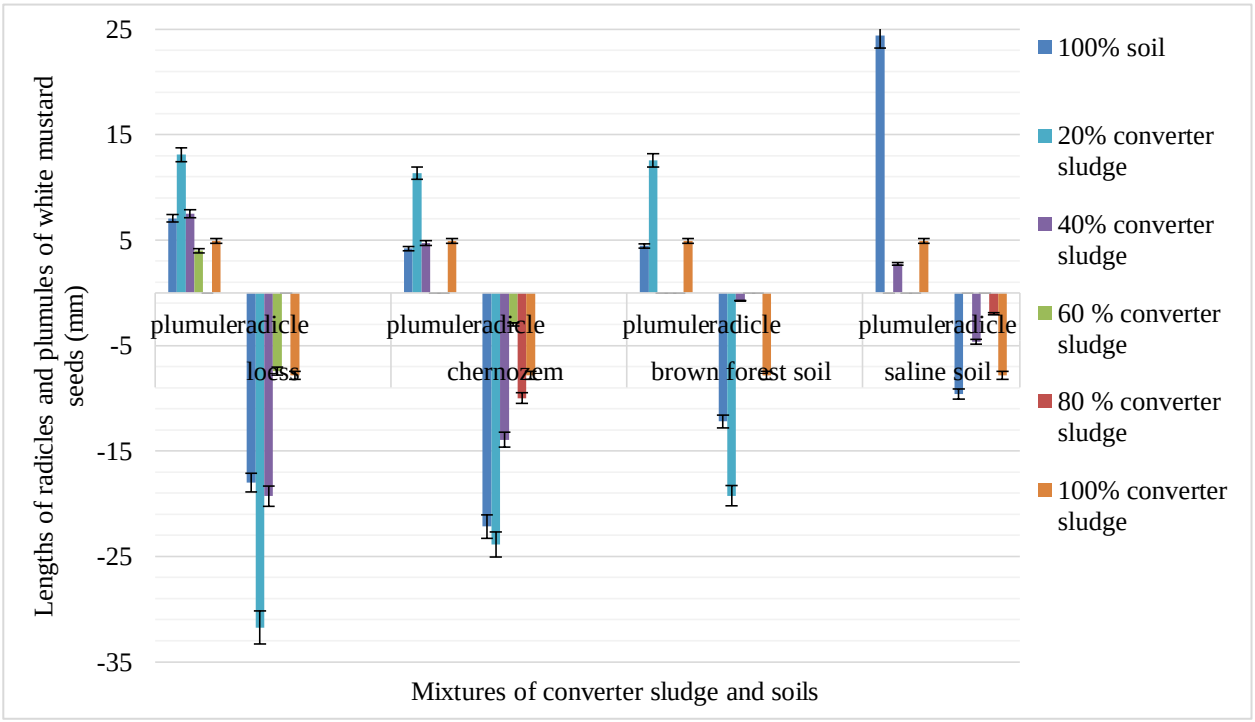

Fig. 7. The length of radicles and plumules, when the seeds were grown on converter sludge - soil mixtures

3.2. Effects of red mud on the germination of white mustard and wheat seeds

Beside the soils, peat was also used for the seedling growth tests, because we tried to compensate the high alkalinity of red mud. The pH value of the peat was around 6. Longer radicles and plumules were measured on the dry red mud sample (dRM) than the wet red mud sample (wRM). Wheat seeds could germinate better than white mustard seeds (Fig.8.).

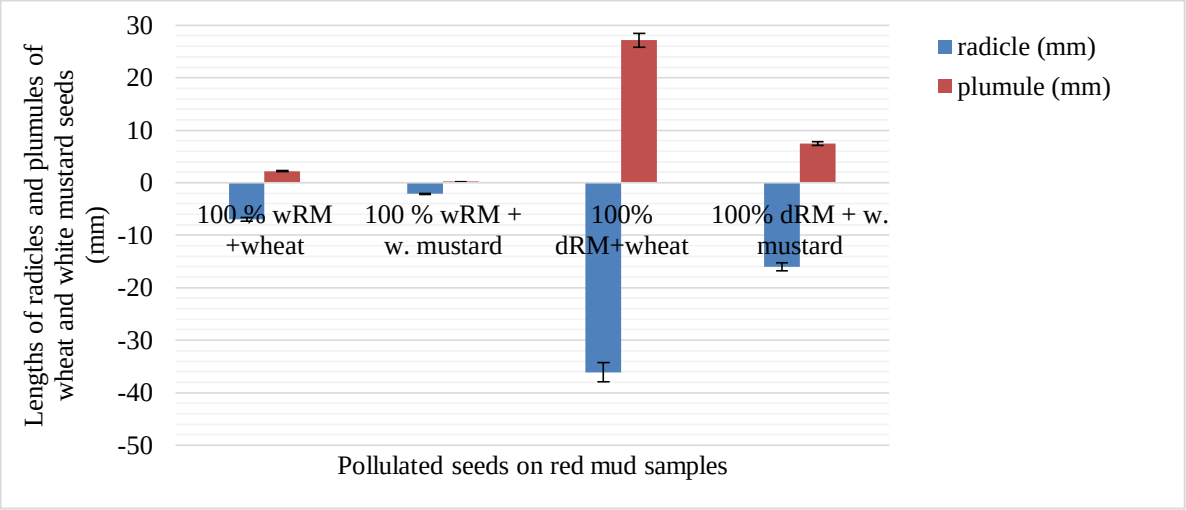

Fig. 8. The germination results of white mustard and wheat seeds, grown on dry (dRM) and wet (wRM) red mud.

When the ratios of the germinated seeds were compared, it can be seen that the 80-100% of the seeds have begun to germinate (Fig. 9.).

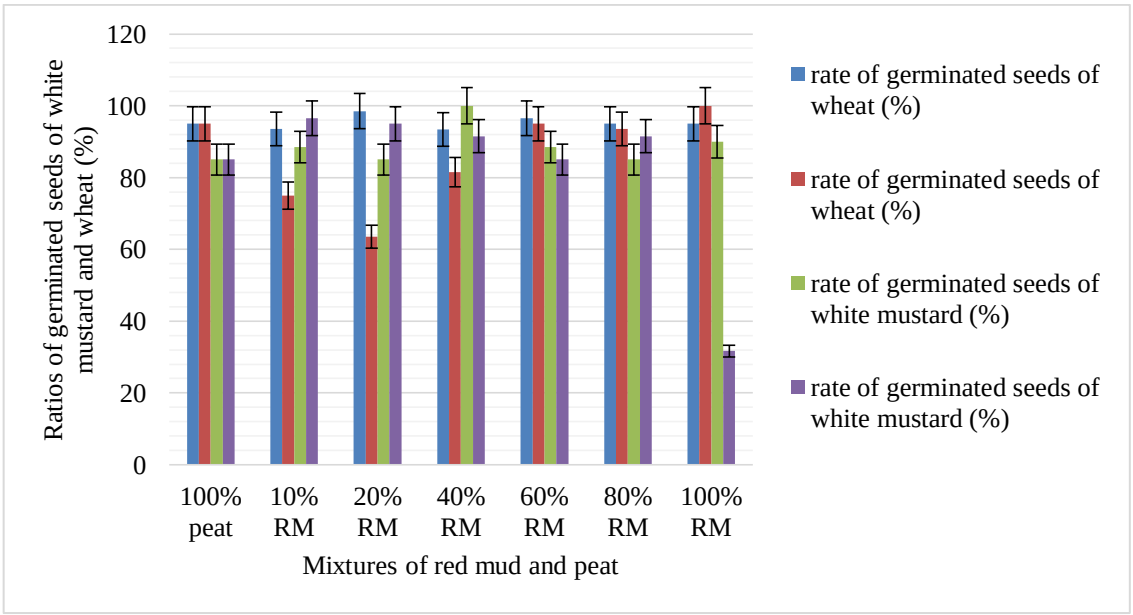

Fig. 9. Ratios of the germinated seeds in the mixtures of red mud and peat

In Fig. 10. it can be seen that increasing of the ratio of red mud a higher negative effect develops on the lengths of radicles and plumules of white mustard seeds. Inhibition was observed in the germination when the ratio of red mud was higher in the mixtures. Between the red mud samples wet type (wRM) was more effective.

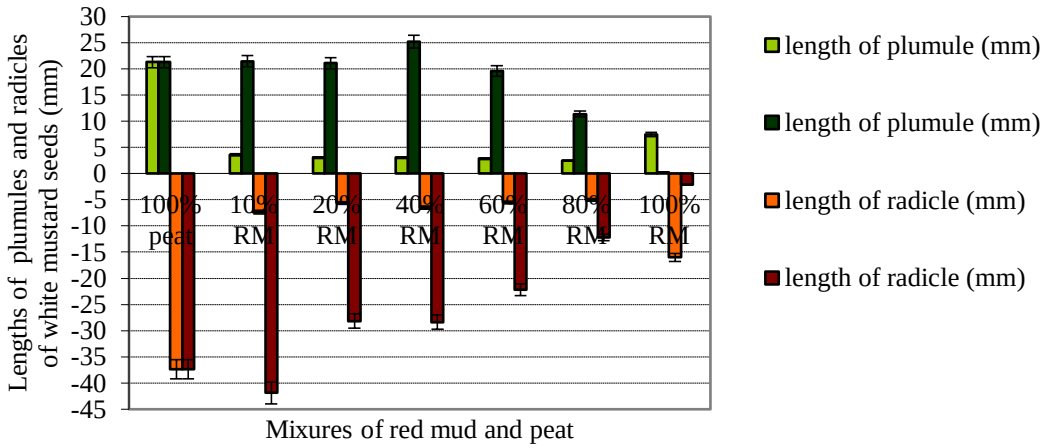

Fig. 10. The length of radicles and plumules of white mustard seedlings, grown on the various mixtures of red mud and peat

In the case of wheat seeds the mixtures of dry type red mud (dRM) were more effective. The higher ratio (60-80%) of dry red mud had a positive effect (stimulation) on the growth of radicles but has a negative effect (inhibition) on the growth of plumules (Fig. 11.).

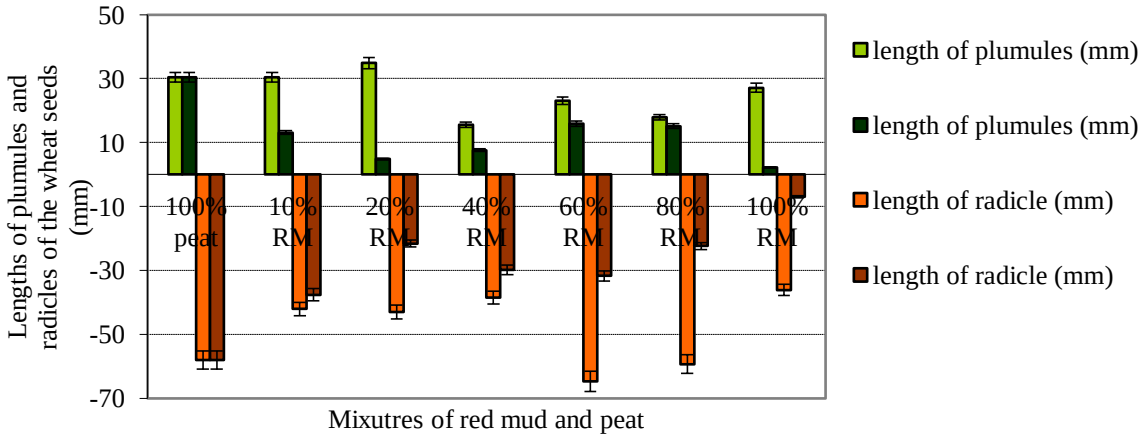

Fig. 11. The length of radicles and plumules of wheat seedlings, grown on the various mixtures of red mud and peat

According to the data of the lengths of the radicles and plumules in the mixtures and the controls, the inhibition of growth *(Milinki, 2013)* was also calculated with this equation (1):

$$X = \left(\frac{K-M}{K}\right) * 100 \quad (1)$$

Where:

X: Inhibition of the growth of radicles or plumules (%)

K: The lengths of the radicles or plumules in the controls (mm)

M: The lengths of the radicles or plumules in the mixtures (mm)

We can see in Fig. 12. that in the case of white mustard the inhibition of the growth of plumules and radicles was low in the 10-20-40% wet red mud (wRM) mixtures. The inhibition was higher in the mixtures of dry red mud (dRM).

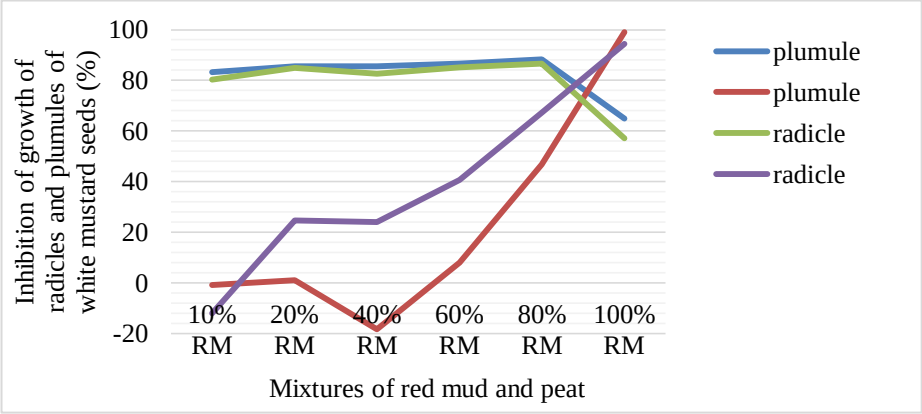

Fig. 12. The inhibition of the growth of radicles and plumules of white mustard seedlings, grown on various mixtures of red mud and peat

Fig. 13. shows the results of inhibition of growth by using wheat seeds in the mixtures. The results represented that the inhibition in the mixtures of wet red mud (wRM) was higher than in the mixtures of dry red mud.

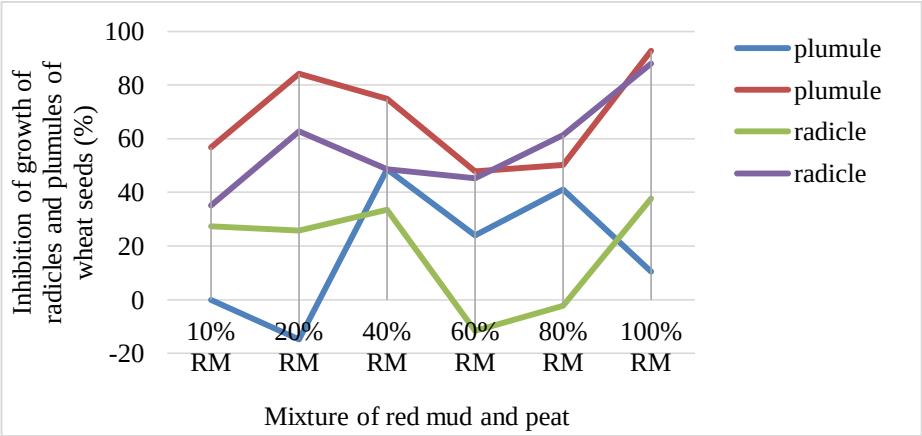

Fig. 13. The inhibition of the growth of radicles and plumules of wheat seedlings, grown in various mixtures of red mud and peat

Beside the above measurements the number of the radicles of wheat seeds were also counted during the seedling growth tests. In the case of wet type red mud (wRM), the mixture of 60 and 80% showed better results (Fig. 14.). In these mixtures, wheat seeds grew more than three radicles. In most of the mixture wheat seeds grew 3 pieces of roots.

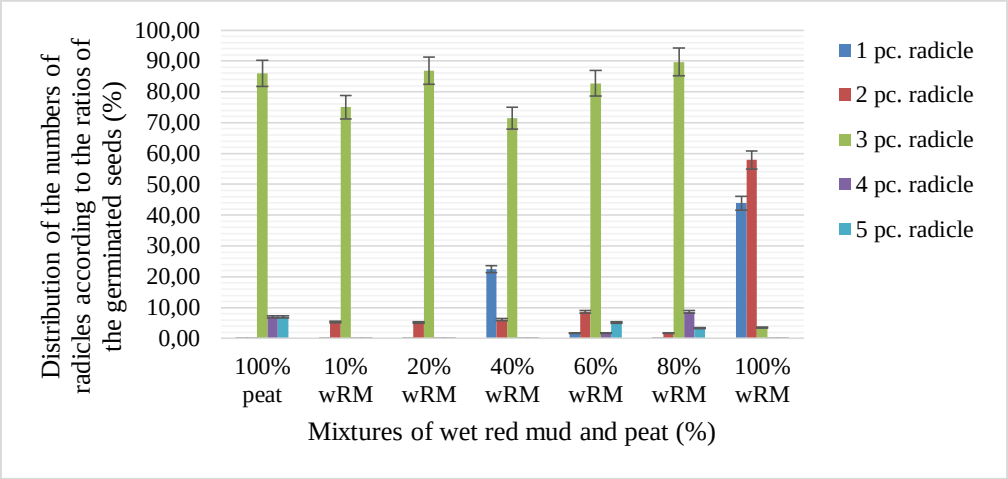

Fig. 14. The distribution of the numbers of the radicle of wheat seedlings, gown on the mixtures of dry red mud (wRM) and peat

In the case of dry type red mud (dRM), the smaller ratio (10-20%) of red mud were already effective. In the mixtures of the dry type red mud, 3-4 pieces of radicles appeared at almost every mixture (Fig. 15.). Dry red mud stimulated the growth of radicles.

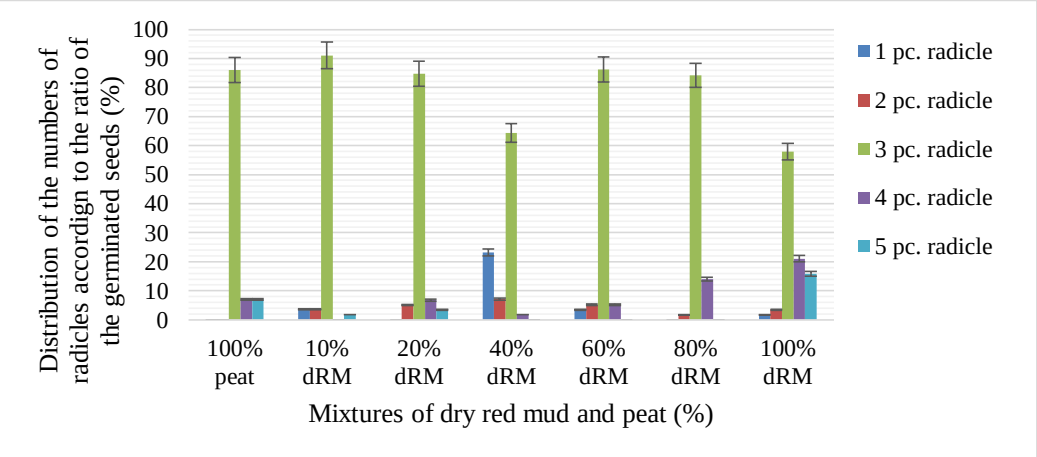

Fig. 15. The distribution of the numbers of the radicle of wheat seedlings, gown in the mixtures of wet red mud (dRM) and peat

According to the results of the mixtures of the industrial sludge-types and soils, the lengths of the wheat plumules were measured a month later. Among the mixtures loess and converter sludge, saline soil and brown forest soil and red mud mixtures were used for this experiment. In the case of the control sample (100% loess) wheat could grow smaller plumules than the mixtures of converter sludge (Fig.16.). Stimulation were observed in these mixtures, perhaps because for example zinc is an essential element for plants. The highest plumules were measured in the 15% and 25% mixtures.

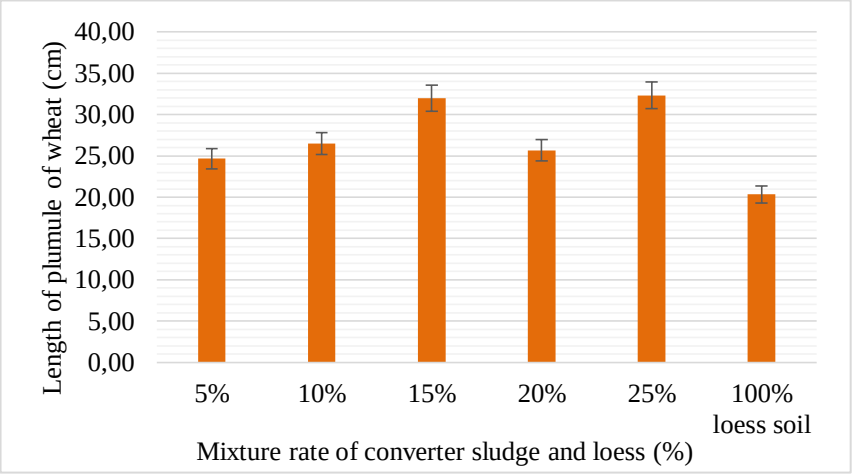

Fig. 16. The length of plumules of wheat seedlings, grown on various mixtures of converter sludge and loess

Fig. 17. shows the results of the red mud and soil mixtures. In the mixtures of red mud and saline soil the lengths of plumules of wheat were higher than in the control (100% saline soil). The highest plumules were measured in the 5% mixture. Small inhibition were observed when the ratio of red mud increased in these mixtures. In the case of the mixtures of acidic brown forest soil and red mud the 5% mixture showed the best result. In the other mixtures small inhibition was observed. Comparing to the controls the mixtures with saline soil showed better results.

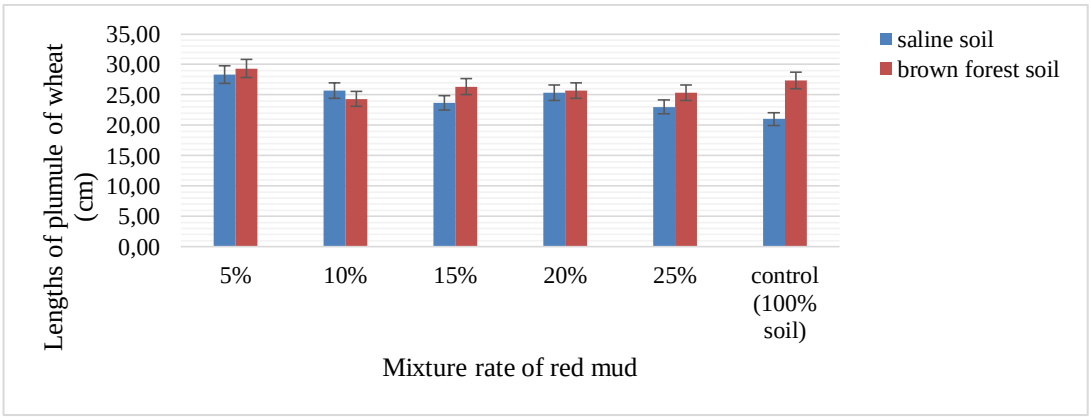

Fig. 17. The length of plumules of wheat seedlings, grown on the mixtures of red mud and saline soil or acidic brown forest soil

4. Conclusions

According to the seedling growth tests of the industrial sludge-types it can be determined that red mud (dRM) showed the best results, when testing the germination of white mustard seeds.

Red mud and soil mixtures could support seed-germination better on saline soil and on acidic brown forest soil. In case of converter sludge, the mixtures with chernozem and loess soil

produced longer radicles and plumules. According to the ratio of the sludge-types in soils, we will use the 40-60% mixtures of red mud and saline or acidic brown forest soil and 20-40% mixtures of converter soil and loess or chernozem, regarding the further laboratory experiments.

The result of the red mud and peat mixture was that white mustard seeds preferred the wet red mud, on the other hand wheat seeds preferred of the dry red mud for the germination. The number of the radicles of wheat seeds was higher in dry red mud mixtures.

According to the measurement of the length of plumules of wheat we can determine that in the case of saline soil, the presence of red mud stimulated the plant growth. This can be told about the experiment of converter sludge and loess soil, where the 15% and 25% mixtures showed the best results.

We observed that the components of converter sludge and red mud were able to stimulate the germination of seeds and growth of plumules, however its value is highly dependent on the soil-types, used.

5. Acknowledgements

The authors are grateful for the support of EFOP-3.6.2-16-2017-00018 „*Produce together with the nature – agroforestry as a new outbreaking possibility*" project.

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Endre Kiss, PhD, professor of Physics, Heat and fluid dynamics, and Environmental protection, graduated at the University of Szeged, and made PhD degree at the same university. His research fields are decomposition of hazardous gas content of exhaust and flue gases using fast electric discharges, utilization of red mud using bio-mining methods, and treatment of plastic and metallic surfaces by silent electric discharges.

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Journal of Applied
Technical and Educational Sciences
Engineering, Vocational and Environmental Aspects

ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.66
http://doi.org/10.24368/jates.v9i1.66

Water as theme in the Hungarian educational system

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Abstract

There is no life without water on the Earth. With the climate change the water cycle will also change. Some regions will be affected seriously. Although Hungary is a water rich country, we have to be aware of our water resources, as most of them is not renewable. Facing to the global warming we recognized the anomalies in the precipitation of the last decades. As, a geography teacher we have several themes during our course in which we can speak about water related problems. But we must prepare and sensitize our student regarding their water usage. Water will be more precious in the closer future. We examined how the water appears in the thematic lessons during the Hungarian geography courses from the elementary to university level. We found a lot of themes in which we can introduce them to become environmentally conscious. Regarding water related problem we found that water footprint is a good tool to involve our students into challenges. On its website www.waterfootprint.org, where is a lot of educational tool as well. Our pupils found it very interesting and useful.

Keywords: water, Hungarian education, geography, water footprint; Introduction

1. Introduction

Hungary is situated in Central Europe, in the Carpathian Basin. Due to its location and geological situation, our country is rich in water, not also in rivers and streams, but we have a lot of groundwater capacity as well. As the geothermal gradient is higher than the global average, in Hungary, the groundwater is often thermal water, as well. But, in the last decade some changes were observed in the precipitation regime, not only in its amount, but also in the seasonal distribution. So, as a consequence of climate change in the future, Hungary will face some challenge regarding water, for example: torrential rain, flashflood, drought, etc. Our purpose is to show some ways of adaptation to the changed circumstances.

1.1. The Hungarian educational system

In Hungary, the public education system is composed of primary school and, subsequently, secondary or vocational school. The general school mostly takes 8 years (grades 1-8), but a part

of the children can attend to general secondary school after 4 or, 6 years, as well. Secondary schools always request an entrance exam.

So, secondary school can be 8, 6 or 4 years long (i.e. mainly grades 9-12, but possibly also grades 5-12 or 7-12). Beside secondary schools, vocational schools also exist in our country, starting after the 8th grade. In these vocational schools pupils learn basic courses, like Hungarian literature, history and mathematics, together with the selected vocational courses and practices.

At the end of the 12th grade every student needs to pass a final exam called matriculation, or baccalaureate. It is obligatory in mathematics, literature and grammar, one chosen foreign language, history and a freely chosen course of science (e.g. geography, biology, chemistry etc.). In vocational school, some vocational courses are parts of the baccalaureate. The results of these exams are counted at the entrance points to any university and college.

Figure 1 comprehends the educational system in Hungary. It shows that besides the secondary general schools there are so called vocational secondary schools. These types give a more specific knowledge about a vocation chosen for example: forestry or water management. So the pupils in vocational secondary school have special courses regarding their future profession.

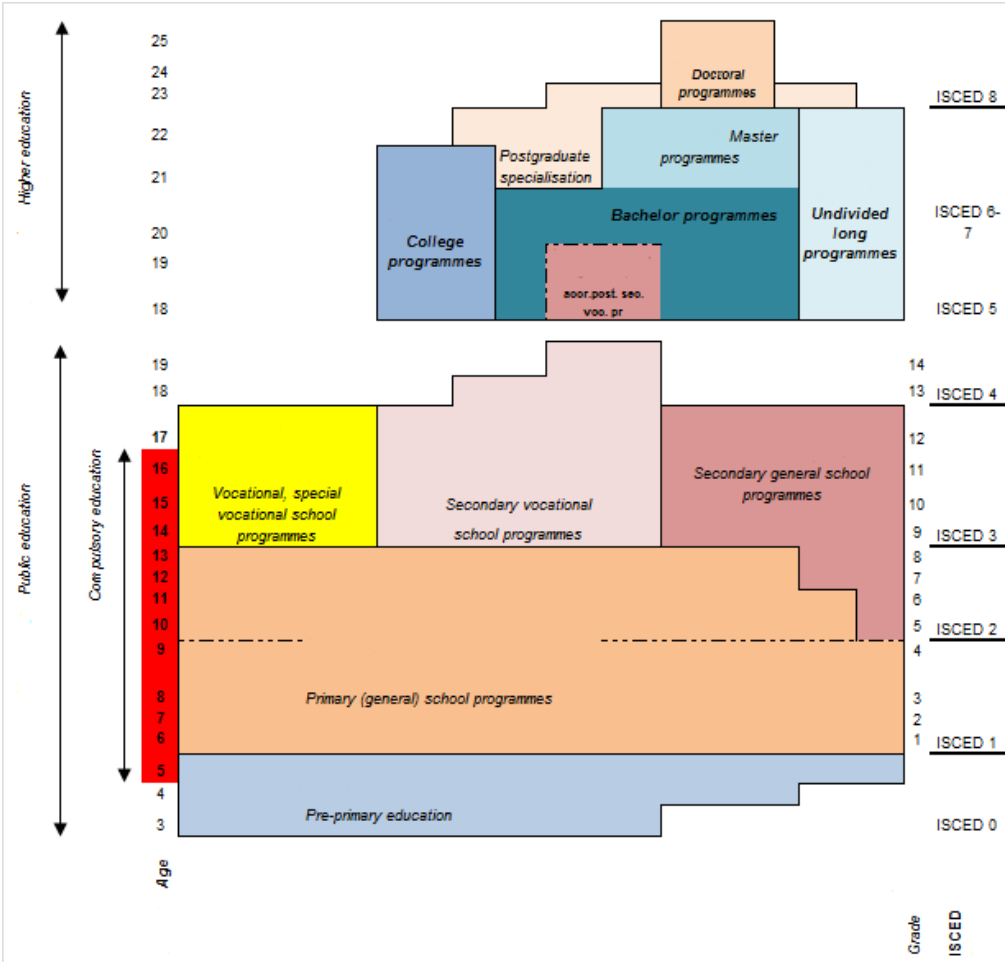

Figure 1. Structure of the Hungarian education system by age, grade and by ISCED-2011level (Csécsiné Máriás E. ed. 2015)

On figure 1 the International Standard Classification of Education (ISCED) can be seen also. According to UNESCO this is a framework used to compare statistics on education systems all around the world.

2. Water as theme in geography

2.1. Environmental studies

In the 1-4 grades, pupils do not have any course of geography, but they learn environmental studies. According to the National Core Curriculum (NCC 2012), the aim of this course is that the children get acquainted with the objects and phenomena happening in their narrow or wider environment. But, it is not an aim to describe them deeply, or to emphasize any scientific necessity. At the same time, it must insist that the complex issues seem to be interpreted using simple models, in line with the age specific characteristics of the pupils. It means that in this early age the pupils get to know the casual relationships. In the context of environmental knowledge, the aim is to develop related conceptual schemes and provide an emotional background for open observation and questing.

In the frame of this course pupils meet some water related topic such as shown in Figure 2.

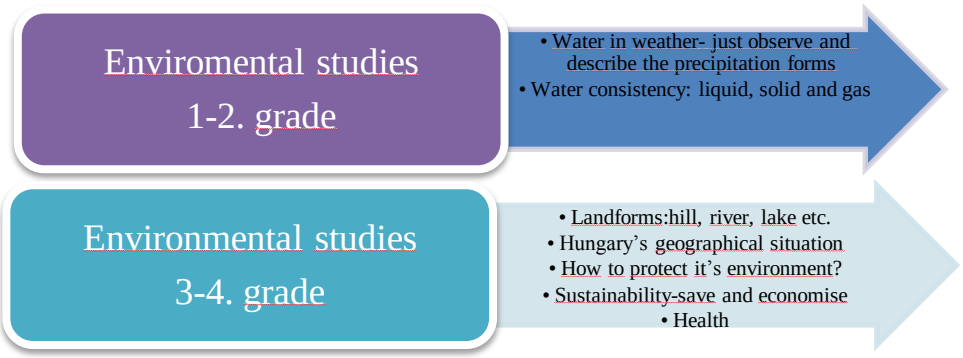

Figure 2. Water related topics in environmental studies during the 1-4 grade in Hungarian elementary schools

These topics are shown very basic level for our students. They learn to take some observation in their environment and also the water is obligatory for the life on Earth. But they do some project work also linked to World Water Day, or Birds' and Trees' Day. It could be a presentation or a poster about problems in environment.

2.2. Natural Sciences in grades 5-6.

In the next stage some new courses are introduced for elder students such as natural sciences, in which they have some introductory lessons from biology, geography, chemistry and physics. The aim of this course is to maintain students' interest in nature. Based on previously acquired

knowledge and skills, he develops the ability to observe the natural phenomena, highlights the need to explain the observed phenomena, prepares the methods of natural science cognition and establishes natural science subjects starting from the 7th grade: biology, physics and chemistry, as well as geography learning. The natural science subject, in keeping with the holistic worldview of 10-11 years old students, presents, as far, as possible, the phenomena, processes and interactions of the living and inanimate world. During the cognition, based on the elemental knowledge gained primarily through experiential learning, the students' natural sciences conceptual system gradually evolves and their abstraction knowledge is developed. The natural science subject plays an important role in the acquisition of cognitive methods, in the foundation of scientific thinking, in the formation of positive attitude towards nature. Figure 3 shows the most important topics related to water.

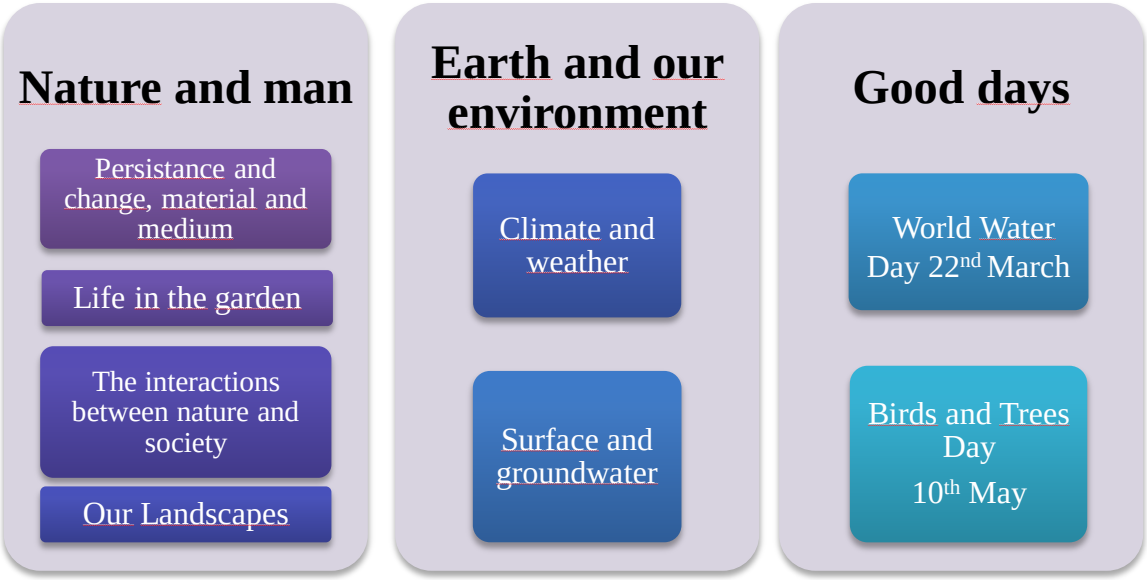

Figure 3. The water related topics in natural sciences

In the lessons of persistence and change, material and medium students learn about the evidence of the volume increase of water at freezing, its consequences in the environment (collecting examples, e.g. crushing rocks, freezing water pipes). They also deal why is water, air and soil indispensable for living beings? So the pupils meet the properties of soil, air and water and also their role in the life and in human's life (concrete examples).

Our students have lessons about the different type of water: surface and groundwater from which the humanity can get the drinking water supply. Some water related challenge is mentioned in these lessons, such as inland water on the crop fields, inundations, and how we can defend our home or cropland.

Regarding surface water they learn about the most standing waters and rivers of Hungary. They meet such concepts as catchment area, waterway, streams and rivers etc.

In this age, and course we teach them some environmental problems as well such as what it waters pollution, what are the signs of water contamination. What damage can floods and inland waterways cause? What threatens our drinking water supply in Hungary? What are the properties of healthy, good drinking water? How can we save drinking water at home and in school? In this way they can form own conceptual models about water and its environmental issues.

2.3. Geography in grades 7-9

In the last decades the weekly number of geography lessons decreased slowly. Nowadays a student of grades 7-9 has only 1 or 2 hours every week (Ütőné Visi, J. 2002). Geography teaches students the basic tools and methods that help them to understand natural, socio-economic and environmental characteristics, processes in the narrower and wider environment. Its focus is on the natural, socio-economic and environmental processes, phenomena, their interactions, and the economic and environmental events of today. The geography course, in addition to natural and social geography and regional science, represents a number of geosciences in public education, integrating geological, atmospheric, hydrological, soil and planetary knowledge. The subject of the subject is the lower level environmental knowledge, and 5-6. in the grades of science, so it is based on the requirements of which it implies. Continue with steps 5-6. integrated knowledge acquisition in the classroom and the development of a unified natural science approach. It looks at the apparent contradiction of constancy and change, the systems of systems, the relationships between structure and function, material, energy, and various forms of information in their regional appearance. It always links their socio-economic use to natural features, and adapts social and economic elements together, thereby rejecting the foundations of social science. In order to understand the natural, environmental, and socio-economic processes of our ever-changing and globalizing world, we need continuous information and information, and open thinking. Therefore, acquiring content is unimaginable without the learner's increasingly independent information management activity. Thus, in the teaching-learning process, emphasis is placed on the development of information acquisition and the processing of information, in particular the use of the opportunities offered by the experience and the digital world. Because geography is a task for students to become familiar with their local, regional, and global environments and reality is changing rapidly, students are forced to constantly update their knowledge (EMMI 2012a). Figure 4 shows the main topics in which children meet the theme of water, or water related challenges. It means the learn that there are several region of the world

where the water is abundant, but also meet the concept of desertification, and water shortage regions (Sahara and Sahel, Iran, and near East, some region of India).

Figure 4. Some topics of geography in the Hungarian education

During these lessons children have discussions about world disaster, tsunamis, floods, ocean world sea, main rivers, seas, etc. Hungary's natural and cultural values. In this last theme we say a few words about the water cyanid pollution of the Tisza river in 2002.

2.4. Water in grades 9-10.

According to EMMI (2012b), geographic content is processed by the students' geo-environmental thinking, local, regional and global perspective. They understand that nature is a unified whole, the Earth is a unified but ever-changing system in which one lives as a natural and social being, and that requires a sound management of resources. The field of art presents all phenomena and processes in spatial and temporal changes and continuous transformation, showing their causes and possible consequences. Consequently, the responsible behavior of students in a narrower and wider natural and social environment can gradually develop. By evaluating globalizing economic, social and environmental processes, it is possible for students to become familiar with the nature transformation of humanity across the globe and the resulting global natural and social problems, so that they can also provide useful points for the future directions of these problems for the coming decades. Figure 5. shows some main topic in which our students learn about water.

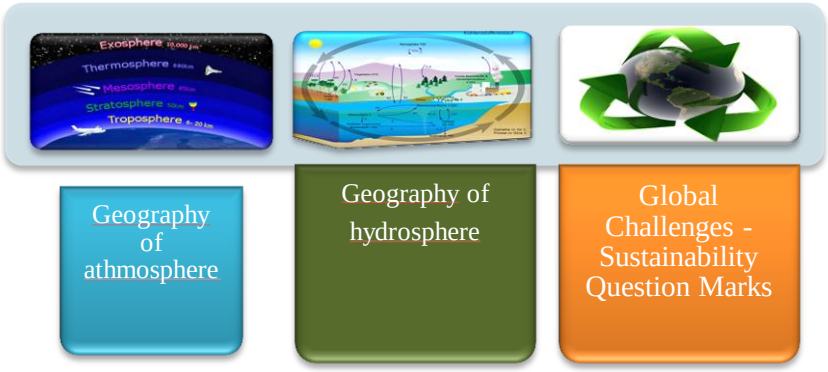

Figure 5. The 3 main topic at grade 9-10 in which student meet the water at geography courses (the source of photos ClipArt of Word)

Presentation of the effects of the atmosphere as system processes on the Earth as a whole. Creating a demand and capability for attractive, responsible environmental behavior by presenting the effects of human activity on atmospheric processes, identifying the need for personal responsibility and action.

Recognizing the socio-economic consequences of processes occurring in the water cycle. Developing thinking by changing changes in increasing production and consumption in the hydrosphere, seeing the other fate of humanity.

Understanding that preserving the balance between natural and socio-economic processes, the principles of eco-conscious production and consumption are essential for the future of our planet. The local process - in the sense of a global consequence principle - recognizes the responsibility of the individual and local communities. Creating a demand for continuous orientation on environmental issues, developing the need to know the environmentally friendly products, processes, and critical information about the topic in the media.

This gives us more connection point to global water crisis. At this age the pupils have already some self-thought about the humanity and environmental problems and also they are very critical about the steps did toward the sustainability. After this level the students have the possibility to take their baccalaureate exam.

2.5. University level

In our Institute, we have two basic formations: at BSc and MSc levels we train geographers and at master level we deal with geography teacher trainees, as well. In these two forms we have several courses about environment, sustainable development, ecosystem services and hydrology. For those who are interested in water and its role we offer a special course named water as resource and risk. In the frame of this course students have deep scientific lessons about floods

and inundations, the effect of dams, water as renewable energy, and also they have discussions about water crisis, sustainable development goals.

During this course, use of the water footprint concept is initiated. This concept was introduced by Hoekstra (2003). It works like the ecological footprint, which is used widespread. Water footprint can be calculated for a nation, a product, or an individual. During our courses we took the example of tea and coffee consumption of Netherlands as it is seen in Figure 6.

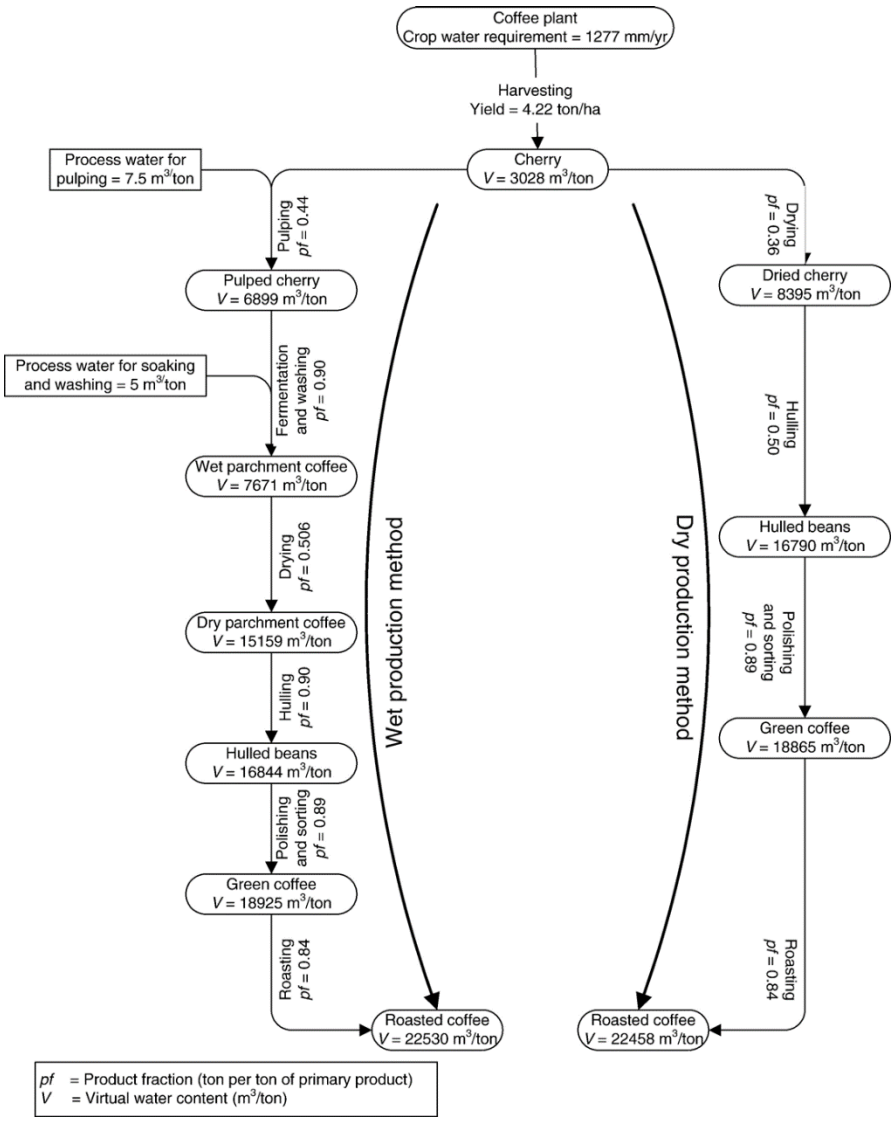

Figure 6. Steps in the calculation of the virtual water content of coffee under the different production methods. The numbers arefor Brazil.. (Chapagain, A.K., Hoekstra, A.Y(2007.))

Depending on the Fig.6. the virtual water was also introduced, and green, blue and grey water. This is the water amount, which was used for the transportation, or packaging of the product. We also use the webpage of water footprint. This page offers for teachers a lot of tools and examples for educational purpose.

For our students this concept was really new. They have never heart about water footprint. As we look after other datas in this topic on the webpage, we saw several ineteresting datas. It

shcoked our students and they started a discussion about how they can change their water using habit to decrease the received amount.

3. Consequences

Although, our educational system is a bit repetitive, our students do not have interested and responsible attitude towards the environment. It seems that the information learned in primary or secondary school, are not enough to create this attitude. The situation is better in the "ecological" schools, where there are several possibilities. During the school-year there are various programs and projects for environmental and nature protection.

As we can see, the water related lessons are on wide range, and it depends on the teacher what methodology, or tools are used during the class. But we see at the university that the students have not so big environmental awareness. They do not own the slogan: "Thinking globally, doing locally!". To make them more conscious water user, we forced them to calculate the water footprint to see how much water they use in average. The numbers were shocking for them and they tried to think and live their everyday life in a different way.

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Lívia Kürti is working at Eszterházy Károly University, Department of Physical Geography. She is assistant lecturer, and she teaches courses from 2014: physical geography, karst morphology and also Water as resource and risk. Her PhD research topic is karst water, mainly karst sources and anthropogenic effect on karst hydrological system in the Bükk Mountain. She has MSc of geography and also teacher of geography degree. She is member of the Hungarian Society of Geography.

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Journal of Applied
Technical and Educational Sciences
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ISSN 2560-5429
Volume 9, Issue 1

doi: 10.24368/jates.v9i1.81
http://doi.org/10.24368/jates.v9i1.81

Biodiversity knowledge elements in Biology education: the base of critical thinking

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Abstract

While people need to have significantly growing scientific knowledge about plants, there has been a decrease in student education about and interest in botany over the same period. According to the state of the world plant 2017 report from 2016, 1730 plant species are new to science and one from five plant species is endangered with extinction (See the State of the World's Plants Reports, Kew). Considering these facts, it is clear that the botanical knowledge in dynamic learning and teaching topics as well as the critical review of the knowledge elements are very important for the young generation. Within environmental education the elements in school materials (textbooks, experimental textbooks) are examined, which develops plant recognition skills and local or global botanical knowledge. In this article the results of a content analysis are summarized, which extends to the exploration of plant species in the currently most frequently used textbooks, in the 7th, 8th, 10th, 11thor in the 12th Hungarian primary and secondary school classes. This work also demonstrates the value of the plant species appeared in these applied textbooks, and even the rate of the categorized elements most importantly the protected species. Earlier works: The history of methods teaching Biology from the early childhood, The emergence of biodiversity concepts or concept related elements in the Hungarian Biology curricula.

*Keywords:*plant species; textbooks; Biology education

1. Introduction

Nowadays people are facing a drastically changing environment and a variable biotic factor on Earth: biodiversity. The spread of invasive alien species (Weber, 2017) and the rapid decrease of the spread of invasive alien species and the rapid decrease of the number of known living plant species continuing to be one of the major threats to habitats and their species diversity. (Cooper, 2008) Invasive alien species are actually non-native species, brought into new regions by human activities, and exhibiting negative impact on natural habitats and their communities due to their population growth. Such species are found in all groups of life forms e.g. plants (Link-Perez et al., 2018). The major causes for the establishment of species outside their natural ranges are the

increasing trade volume around the planet, the continuing habitat destruction and the pollution. Invasive plant species can have various impacts on the invaded plant or even on the animal communities. The losers are not only native plant species but may also include insect species dependent on these and bird species dependent on the insects. Thus, invasive alien plants may affect all trophic levels in an ecological community. (Weber, 2017)

In order to have this interpreted by the rising generation, educators need to teach them obviously which plant species are native, invasive or other in their natural habitat, the examples of which need to be discovered. (Drea, 2011)

This paper provides details about all the plant species that currently occur in the most frequently used textbooks from grade 7^{th} to 12^{th} together with the list of their information.

2. The applied methods

This work aimed to list the plant species that appeared at least once in the most commonly used experimental Biology textbooks published by the OFI (Hungarian Institute for Innovation in Education) from primary 7^{th} classes to the 12^{th} secondary school classes. Reading through each text content of each book word by word the emerging plant names are listed, indicating its value and also that the given species belongs to the native(n), invasive(i) or cultivar(c) category. After each table, a diagram signifies the rate of the appearing plant types.

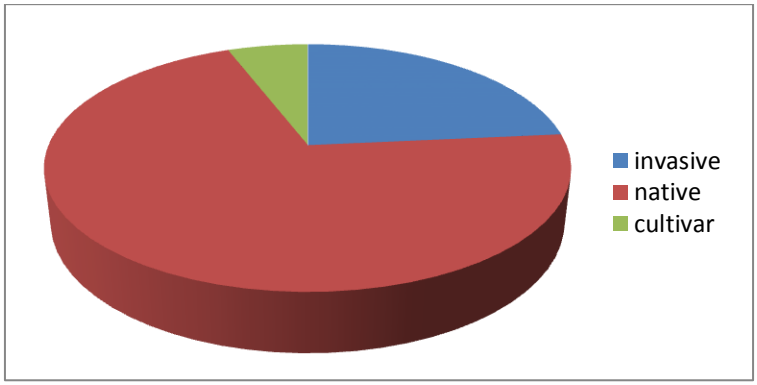
2.1 Species occurance in the New generation textbook (class 7) published in Kropog& Németh (2018)

Table 1. Species occurance in the New generation textbook (class 7)

Species Latin/English	**Native/invasive /cultivar n/i /c**	**Value**
Nepenthes/ Pitcher plants	i	insect consumer
Corydalis cava/ Coridalis flowers	n	distributed by ants
Allium ursinum/ Wild garlic	n	edible
Rosa canina/ Rosehip	n	wild medicinal plant
Crataegus sp/ Haw	n	wild medicinal plant
Quercus cerris/ Turkey oak		forest element
Stipa sp./ Porcupine grass	n	**protected**
Echinops ritro subsp. ruthenicus/ Echinops	n	insect attraction
Alkanna tinctorial/ Alcanet	n	salt indicator
Matricaria chamomilla/ German chamomille	n	medicinal plant

Robinia pseudoacacia/ Acacia robinia	i	bee food, invasive species
Triticuma estivum L./ Common wheat	c	cultivated food plant
Calamagrosti sepigeios/ Rostite	n	invasive
Ambrosia artemisiifolia/ Ambrosia	i	invasive
Convolvulus arvensis/ Convolvulus		weed
Cichorium intybus/ Chicory		medicinal plant
Arctium lappa/ Greater burdock	n	big weed
Plantago major / Fleawort	n	medicinal plant
Ailanthus altissima / Tree of heaven	i	invasive
Carpinus betulus / hornbeam	n	forest element
Fragaria vesca / Fragaria	n	wild edible plant

Table 1.1 Species occurance in the New generation textbook - diagram (class 7)



There are 17 plant species mentioned in the 7th class experimented textbooks out of which there is only 1 protected. 13 species are native in the list, 4 invasive while 1 represents the cultivar category.

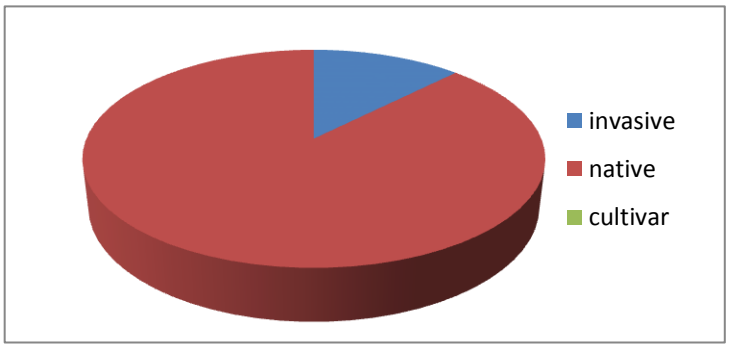
2.2 Species occurance in the New generation textbook (class 8) published in Kropog& Németh (2018)

Table 2. Species occurance in the New generation textbook (class 8)

Species Latin/English	**Native/invasive sp. (n/i)**	**Value**
Gingko biloba / Kew tree	i	Taxonomical example
Malus domestica / apple	n	cultivated
Orchis purpurea / Lady orchid	n	**protected**

Trollius europaeus /Globe flower	n	ice age relict, **protected**
Osmunda regalis / Royal fern	n	**protected**
Sphagnum sp. / Peat moss	n	**protected**
Lemna sp / Common duckweed	n	-
Quercus petrea / Sessile oak	n	Forest element

Table 2.1 Species occurance in the New generation textbook – diagram (class 8)



There are 8 plant species mentioned in the 8th class experimented textbooks out of which there are 4 protected. All the mentioned plant species are native except for one, which is invasive and cultivar category is not represented.

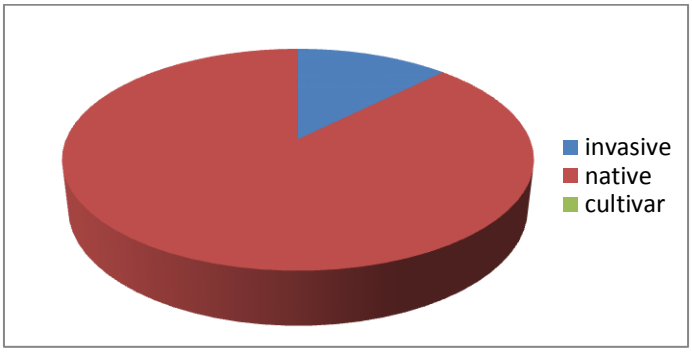
2.3 Species occurance in the New generation textbook (class 10) published in Mándics&Molnár (2017)

Table 3. Species occurance in the New generation textbook (class 10)

Species Latin/English	**Native/invsive sp. (n/i)**	**Value**
Mycrasterias sp. / Green algae	i	Taxonomical example
Polytrichum formosum / Wood-moss	n	taxonomical example
Marchantia polymorpha / Liverwort	n	
Pulsatilla grandis / Greater pasque flower	n	**protected**
Sempervivum marmoreum / Common houseleek	n	special adaptation
Lycopodium annotinum / Clubmoss	n	**protected**
Dryopterisfilix-mas / Fern	n	**protected**
Equisetum arvense / Common horsetail	n	taxonomical example
Dicksonia antarctica / Fern tree	i	**protected**
Taxus baccata / Yew-tree	n	toxic
Ginkgo biloba / Kew-tree	i	iceage relict
Lilum martagon / Martagon-lilly	n	**protected**
Rubusidaeus / Raspberry	n	edible wild

Acer pseudoplatanus / sycamore-maple	no data	forest element and cultivated
Fagus silvestris / Common beech	n	forest element
Solanum sp. / Nightshade	i	toxic or cultivated
Yucca / Yukka	i	cultivated

Table 3.1 Species occurance in the New generation textbook – diagram (class 10)



17 plant species appear even in the 10th class experimented textbooks out of which there are 5 protected. 11 species are native in the list, 5 invasive while none of them represents the cultivar category.

2.4 Species occurance in the New generation textbook (class 11) published in Mándics&Molnár (2017)

Table 4. Species occurance in the New generation textbook (class 11)

Species Latin/English	**Native/invasive sp. (n/i)**	**Value**
Daucuscarota subsp. sativus / Carrot		Cultivated
Cucurbita pepo / Courgette		Cultivated
Prunus armeniaca / Apricot		Cultivated
Citrus sinensis / Orange		Cultivated
Allium cepa / Red onion		Cultivated
Solanum tuberosum / White potato		Cultivated
Solanum lycopersicum / Tomato		Cultivated
Brassica oleracea var. capitata f. rubra / Red Cabbage		Cultivated
Triticum / Bread wheat		Cultivated
Capsicum annuum / Cherry pepper		Cultivated
Papaver rhoeas / Oil - poppy		Cultivated
Glycine max / Soy		Cultivated
Allium ursinum / Bear leek		Cultivated
Brassica oleracea var. capitate /		Cultivated

Turnip	
Phaseolus vulgaris / Chard	Cultivated
Pisum sativum / Green pea	Cultivated
Cucumis sativus / Cucumber	Cultivated
Lactuca sativa / Lettuce	Cultivated

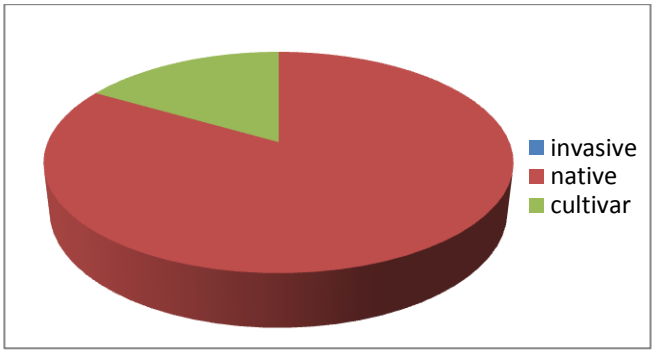
18 plant species are referred in the 11th class experimented textbooks and all of them are cultivated while none of them represents the native or the invasive category.

2.5 Species occurance in the New generation textbook (class 12) published in Mándics&Molnár (2017)

Table 5. Species occurance in the New generation textbook (class 12)

Species	**Native/indigenous sp. (n/i)**	**Value**
Antirrhinum majus / Snapdragon	n	Cultivated
Pisum sativum / Green pea		Cultivated
Dryopteri scristata / Crested wood fern	n	**protected**
Ferula sadleriana / Spear	n	Glacial relict, **Protected**
Aconitum moldavicum / Monkshood	n	**Protected**
Stipa capillata / Feather grass	n	**Protected**

Table 5.1 Species occurance in the New generation textbook - diagram (class 12)



In the 12th class merely 6 species names could be listed. 4 of the elements are protected, 1 is a glacial relict and 2 are cultivated.

3. Results

Biological invasions are widely acknowledged as a major threat to global biodiversity. Considering that there are not much documented examples of either native, invasive or cultivated plants species and that many plants are poorly studied (Thomas, 2017) in this paper, the number, the value and the appearance rate of the mentioned species taught today in one textbook series are accurately signified.

According to the diagrams and the collected data it maybe asserted that Biology books applied in primary or even in secondary schools contain relatively a few representative plant species.

Although it is taught that in the 10th class, there are 1,8 million species (Mora, 2011) in class 7, only 21 plant species, in class 8 only 8, in class 10 merely 17, in class 11 only 18 species appear and in class 12 only 6 representatives of plants are mentioned in the textbooks. It is surprising because in class 10 students comprehensively learn the most about plants, classes or subclasses, the structure of the plants or even the photosynthesis process. Perhaps, it would be more significant to show them the best examples of the plant categories to make it easier to interpret at that age.

Nature conservation is taught in class 12th, without having no clear example of what creatures need to be protected on Earth.

There are only a few protected plants species in the experimented textbooks. In class 7 there is only 1. In class 8 the number of protected plants is 4., in class 10 there are 5, while in class 11 there are no protected species at all. In class 12 there are again only 4 emphasized representatives.

It would be equally important to young people to get to know more about those species that are marked in the learning material or what surround them in the reality but the texts in general simply mention a plant and very often there is no other reference to it (pictures, illustrations, data or practices that brings it closer to the learners).

The other problem is that if the facts are far from reality sooner or later it makes the students uninterested. There are no references where the actual events or state of species would have mentioned about the plants.

School books used nowadays should even be close to the digital world being full of references to each and every plant species. Without it, teachers could not involve the students in the tasks. and they could not digest the actual material easily. There are no references to it at all.

Another perspective is that students must be taught out of school for species because indeed there are only some native and protected species in their textbooks. They also get additional information about the commercial use or conservation state of the species. A great variability of

projects could be run of which the main subjects are taxonomy, plant conservation, plant physiology, horticulture and methods of teaching Biology and environmental education (Pénzesné, 2017) using the garden plant databases or seedbanks. The diverse collection of plant forms would attract the younger generation, too.

These plant species are mentioned in the textbooks but what about the rest of the species information? The distribution, or if they are invasive or alien species, the labeling of the native or indigenous ones or their natural habitat. Evaluating the rate of these characteristic features can also be significant (e.g. how many species are there in medicinal plant categories). This is what diagrams serve as an indication, but it is clear that most of the time the relevant information is missing. How can a young child learn about creatures in the classrooms if he or she doesn't have an example in front of them? How can we expect them to identify and save them in the nature? We teachers would have more opportunities if newer methods or smarter material such as some good practices of teaching materials about the MÉTA program could be integrated in the textbooks.

Analyzing more source of information (curricula, exercise books such as Mozaweb series) or by presenting some concrete idea to improve the practical work of teachers regarding teaching plant species would be urgent and eligible.

4. Conclusions

Species are fundamental building blocks of nature and ecology. Without the continued survival of many of their number, the goals of ecosystem and biosphere management are unattainable. Species are also fundamental units of the evolutionary process, and their increasing loss due to the anthropogenic causes represents an irreversible depletion of genetic material upon which evolutionary potential can work in future. Hence, extinctions arising from man's influence are the events that the conservation movement aims to prevent. (Entwistle 2000)

The real conservation of our nature starts with the acquired up-to-date knowledge that is used by the upcoming generation when a species appear. In schools when textbooks are applied students need to find updated information about the world surrounds them in order to provide sustainability effectively. To achieve this it is worth quantifying species content of the current Biology curricula. Whenever a species is mentioned on the pages it is needed to examine whether the value, the habitat or even illustrations about the species are labelled or not. Even if species diversity loss is one of the most threathening factor to human nature, some textbooks species content is not much.

As far as the plant species richness is concerned this current work contains information obtained from one of the most wildly used textbook series edited by the OFI. From classes 7 to 12 these books contain examples of plant species however very often the real purpose of the presence of them are not necessarily up-to-date and lifelike. The number of the indicated examples are also worthy of consideration as well as the illustrations and description of them.

The education of plant diversity should focus on more the habitat, the appearance or the practical application. Is it really the best direction towards the sustainable future?

Acknowledgement

I would like to thank Erika Pénzesné Dr Kónya PhD, the Dean of the Faculty of Natural Sciences for her comprehensive assistance and helpful comments.

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