

Knowledge about local natural monuments – ignorance or flaws of the education system?

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Summary:

The study presents the preliminary results of a survey examining knowledge about local natural monuments among students in different grades. We found that their knowledge is poor and critically needs to be improved. Since the students seem to rely mainly on the Internet and their smart devices, we propose that a type of outdoor class be held, which must be supported by multimedia. The study presented here was conducted in Zielona Góra, in 11 schools of four types or grades.

Key words: natural monuments, awareness, students, school, familiarity, Zielona Góra

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Introduction

According to Polish law, a natural monument can be a single or group of living or non-living natural objects that have uncommon traits and are valuable for nature, science, culture, history and the landscape, including native and foreign species of trees and shrubs, caves, and rocks, among others (Law on the Protection of the Natural Environment of 2004 with later amendments). This is in agreement with the definition given by the International Union for the Conservation of Nature (IUCN): „Category III – Natural Monument: protected area managed mainly for conservation of specific natural features. Area containing one or more specific natural or natural/cultural feature, which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance” (Davey, 1998). The list of Polish natural monuments is accessible from the website of the Regional Directorate of Environmental Protection or the Central Register of Forms of Nature Conservation (<http://crfop.gdos.gov.pl/CRFOP/>) (acronym CRFOP). The CRFOP is a database of all forms of nature conservation existing in Poland, which provides information about them. For example, a user interested in a local natural monument can learn about the types of the monument, species, age, location, size and all other characteristic features of the given object. Additionally, CRFOP is linked to Geoserwis (<http://geoserwis.gdos.gov.pl/mapy/>), a map service providing information about the environment, including forms of nature conservation and the „Natura 2000” network. However, CRFOP and Geoserwis are still incomplete or have erroneous data (for example, either no or the wrong pictures of natural monuments) (Tokarska-Osyczka and Pilichowski 2016).

The legal basis for education in Poland is in the Polish Constitution. According to this document, everyone has the right to an education, and it is compulsory for

every person under the age of 18. Education in public schools is also free. The Polish education system is governed by two Ministries. General and vocational education are managed by the Ministry of National Education and higher education is under the governance of the Ministry of Science and Higher Education. These two institutions are responsible only for the policies of the education system, while the administration of schools is decentralized. Pre-schools, primary schools and lower secondary schools are administered by local governments, upper secondary schools are administered by county authorities and higher education institutions are autonomous (Smoczyńska 2014).

Educating students about the environment and the forms of nature protection occurs in different grades and classes, however the common opinion of teachers is that the time spent on such issues is insufficient. According to the current core curriculum of primary school, issues on environmental protection and conservation should be covered by 4th grade students in science classes, in 7th grade in geography classes and in 8th grades in biology classes. There is also an attempt to link the content of the chemistry class with environmental issues. Hopefully, the new core curriculum will actually integrate the development of environmental attitudes with teaching. It is very important to shape the attitudes of young people due to the degradation of the environment occurring as the result of human activities. There is a hope that in the future, people will want to protect the environment and conserve biodiversity, but they need to gain an understanding of the problems during their school education.

Zielona Góra is a city located in western Poland, and is one of the two (together with Gorzów Wielkopolski) capitals of Lubuskie Voivodeship. On the first day of 2015, Zielona Góra became a larger city by fusing with another township. This fusion established two boroughs: „the City of Zielona Góra” (the city within its old

boundaries) and „New Town” (the area of the township) (Greinert and Drozdek 2015).

As Tokarska-Osyczka and Pilichowski (2016) stated, there were 53 living natural monuments in the area of Zielona Góra in its new borders. Most of the schools functioning in the city are located within less than one kilometer from a natural monument. In 2017, however, three new natural monuments were established, two lost their status due to decisions of the City Council, aimed at ensuring public safety since their condition deteriorated, and finally, one of the natural monuments collapsed due to Hurricane Xavier. Even though the number of natural monuments in Zielona Góra changed in 2017, we treated the two former natural monuments as still having the status of a natural monument because of the date of the survey study we conducted. We were interested in the overall knowledge of students about local natural monuments and thus we surveyed them by asking six questions. The aim of the study was to evaluate the understanding of the term “natural monument” among students of different ages, and to determine the extent of their familiarity with local natural monuments. We consider natural monuments as objects that are easy to observe and possessing countless educational values – starting with esthetic, landscape and tourist values and ending with environmental and ecological values. Showing such objects to students may raise their awareness and respect towards nature. According to our experiences, the overall knowledge about natural monuments among people is poor; however, we are not aware of studies concerning such issue that have been conducted with Polish students.

Materials and methods

The study was conducted from November 2016 to January 2017. The 11 schools chosen for the study (Tab. 1) were located within the borders of the „City of

Zielona Góra” (we will call it “Old Zielona Góra” and we will use “New Zielona Góra” instead “New Town”). Three primary schools, four lower secondary schools, three upper secondary schools and one vocational upper secondary school responded to our request and the school directors allowed us to conduct the survey among students in the final grades of each educational level. Our aim was to include 11 schools in three parts of the city, where different natural monuments are located and where schools of at least three educational levels exist. Unfortunately, we did not receive responses from several schools and thus, we were forced to choose new schools to perform surveys.

The survey consisted of six questions examining basic knowledge of the students about natural monuments:

- Q1: What can be considered a natural monument?
- Q2: How many natural monuments are located in today’s Zielona Góra?
- Q3: List five natural monuments that are located near your school and describe their approximate location.
- Q4: Would you like the teacher show you natural monuments as a part of the outdoor biology/science classes?
- Q5: Do you think that there should be more natural monuments in the city?
- Q6: Where can you check how many natural monuments can be found in the city?

The students were also asked to provide information about their sex and place of residence: in Old Zielona Góra (OZG), New Zielona Góra (NZG) (an area of former villages, now part of the city of Zielona Góra), a city with less than 100 000 inhabitants (we will call this a town) or a village.

The surveys were printed and distributed to the students. The time needed to answer the questions was about 15 minutes. The authors conducted the surveys

personally in four schools, whereas teachers administered the surveys in the remaining seven schools. The school director of each school agreed to this and granted permission for conducting the survey. Since our study generated a large amount of data and we were able to categorize the answers only after obtaining the completed surveys, we decided to split the results into two parts. In this paper we will focus on questions: 1, 3 and 6, and analyze the answers of students to verify their understanding of the term „natural monument”. These three questions were chosen to be analyzed together because in our opinion, they reflect the familiarity of the students with local natural monuments. The results obtained for questions 2, 4 and 5 were presented during a conference that took place in Zielona Góra, on September 19-21, 2017 (XXI Krajowa Konferencja Dydaktyków Przedmiotów Przyrodniczych, University of Zielona Góra) and will be published in a separate paper.

The responses provided by the students were analyzed in relationship to educational level and sex. If the analyses showed no differences, the data were analyzed without discriminating between the type of school or sex. JMP 11.2.0 SAS Institute Inc. software was used for the statistical analyses.

Results

In total, 601 students answered the survey: 283 females, 286 males and 32 unidentified students. Most of them inhabited Old Zielona Góra (286). 90 lived in New Zielona Góra, 61 in towns, 94 in villages and 70 did not indicate their place of residence (Table 1).

Question 1. What can be considered a natural monument?

The students usually listed objects that may be considered natural monuments. 62 students (10.32%) did not answer this question or wrote „I don’t know”. 315

students (52.41%) named or described one object, while 159 students (26.46%) two, 56 students (9.32%) three, 7 (1.16%) four, one student (0.17%) five and finally one student (0.17%) named or described six objects which could be a natural monument (Fig. 1). The answers were grouped into nine categories as follows: I. Trees, II. Nonliving elements of nature, III. Other natural objects, IV. Parks and other urban green spaces, V. Man-made objects, VI. Unidentified, VII. Animals, VIII. Definitions, IX. Other. Examples of answers representing all nine categories are showed in Table 2. Eight students from one upper secondary school answered the question almost or perfectly by writing a definition of the natural monument (category VIII). The comparison of percentage of answers belonging to all categories among school levels is shown in Fig. 2. The most common answers were „tree” and similar (an old tree, a special tree, an oak, etc.): PS 47%, LS 46%, US 37% and VS 53%. Second, categories II and III taken together constituted respectively 37%, 26%, 41% and 37% of all answers. One tenth of students in lower secondary and upper secondary schools did not know how to answer this question (category IX). After excluding from the statistical analysis answers of students who did not indicate their sex, a contingency table was produced to search for relationships between sex and the number of answers provided by students (Table 3). The number of answers was treated as the nominal value. The results show that some differences exist between female and male students, especially in the categories of 3 and 4 answers (35 to 18 and 6 to 1 answers given by girls and boys respectively). Educational level had no impact on the number of answers.

Question 3. List five natural monuments which are located near your school and describe their approximate location.

Table 2. Examples of answers to the first question

The description of the categories is provided in the text.

I	an oak, the oak „Bartek”, a tree, a tree with a historical value, a group of trees
II	a stone, a rock, a lake, nonliving nature, a river
III	a valley, old plants, a nature’s work, an element of nature, plants, a grass, rare plants, an old bush
IV	a garden, a park, the „Piastowski” Park
V	a former building, monuments, an avenue, a landmark building, a statue, old buildings
VI	a very old object, interesting objects, a place, nature before extinction, old natural monuments
VII	an animal in nature, animals
VI	<i>Eight answers were classified as definitions of a natural monument. See the text for details.</i>
IX	I don’t know, almost everything, everything, everything if you want

Table 3. Contingency table showing the distribution of the number of answers to question 1 with differences between female and male students

To generate the table, the number of answers was treated as the nominal value. Data generated by students who did not indicate their sex were excluded from the analysis.

Count Total % Col % Row %	0	1	2	3	4	5	6	Sum:
female	21 3,69 36,84 7,42	143 25,13 47,35 50,53	77 13,53 52,03 27,21	35 6,15 66,04 12,37	6 1,05 85,71 2,12	1 0,18 100,00 0,35	0 0,00 0,00 0,00	283 49,74
male	36 6,33 63,16 12,59	159 27,94 52,65 55,59	71 12,48 47,97 24,83	18 3,16 33,96 6,29	1 0,18 14,29 0,35	0 0,00 0,00 0,00	1 0,18 100,00 0,35	286 50,26
Sum:	57 10,02	302 53,08	148 26,01	53 9,31	7 1,23	1 0,18	1 0,18	569

N	DF	-LogLike	RSquare (U)
569	6	8,6776192	0,0126

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	17,355	0,0081*
Pearson	16,047	0,0135*

In this question, students were asked to list five natural monuments located near their school and to describe their approximate location. This question generated a large amount of data. Among the answers, we found correct ones, almost correct ones (showing that a student possesses knowledge about some natural monuments but needs to clarify it), wrong answers and comments “I do not care”).

To analyze the percentage of answers classified within various categories, we did not include 8 persons who answered “I do not care”. Since we asked students to list five objects, we aimed to obtain 3005 answers (5*601 students), however after ignoring “I do not care” answers, we had 2965 answers (3005-8*5). It is striking that we obtained 2597 answers (88%) of “I don’t know” or left blank (Table 4). Correct answers constituted 3% of all answers, similarly – almost correct (3%), while

	PS	SS	US	Tech	SUM
Correct	31 (4%)	38 (4%)	8 (1%)	4 (1%)	81 (3%)
Almost correct	10 (1%)	26 (3%)	31 (4%)	12 (3%)	79 (3%)
Wrong	44 (6%)	86 (9%)	30 (4%)	48 (10%)	207 (7%)
I don't know	660 (89%)	830 (85%)	691 (91%)	416 (86%)	2597 (88%)
Total number of answers:					2965
I do not care	0	1	0	7	8

Table 4. The table shows the structure of the answers obtained to question 3 (*List five natural monuments which are located near your school and describe their approximate location*)

Numbers of answers and percentages (in parentheses) of the total are presented. The fifth category of “I do not care” is not included in the data set (see text for details).

Fig.1. The number of examples of objects that may be natural monuments (0-6) presented as percentages of the total sum of answers to question 1

For example: 52.41% of surveyed students listed only one object that could be a natural monument and 9.32% listed three various objects.

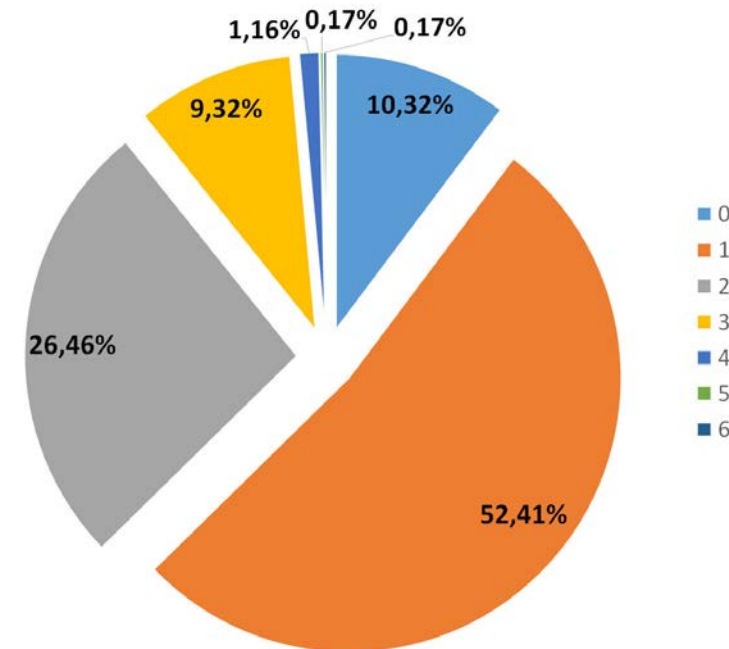
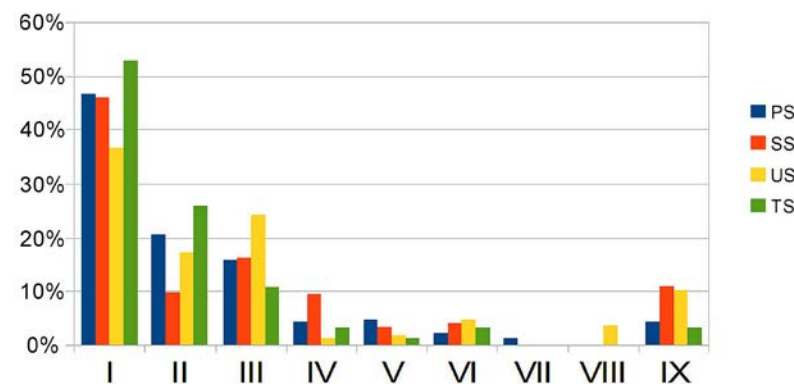


Fig. 2. Percentage of answers to question 1, representing various categories, grouped by educational stage. PS – primary school, LS – lower secondary school, US – upper secondary school, VS – vocational upper secondary school

Categories I-IX are explained in the text. Number of students: PS 149, LS 197, US 152, VS 103. The figure illustrates the total percentage of answers – the number of answers (901) was higher than the number of students since surveyed students proposed none, one or up to six objects which could be a natural monument.



7% gave wrong answers. Examples elucidating the categories are provided in Table 5. Correct answers were acknowledged all those indicating natural monuments found in Zielona Góra, independently of the distance between the school and the object. The categorical response analysis performed in JMP 11.2.0 (SAS Institute) showed that the frequency counts of answers within populations (educational levels) are homogenous.

Question 6. Where can you check how many natural monuments can be found in the city?

In this question, students were asked to write where information about the number of natural monuments of Zielona Góra can be found. We decided to group answers into ten categories (Table 6). 601 students provided 886 sources of information. 53% (475) of the answers belonged to category VI, with 450 answers „in the Internet”. 130 (15%) answers were classified in category IX (various media, press, publications) where „books” were the most common answer (48; 5% of the total). A comparison of the percentages of grouped answers is presented in Fig. 3.

Discussion

Students’ knowledge about natural monuments was assessed as poor. They were barely able to name objects which could be a natural monument, rarely knew its definition and could not identify precisely where information could be found about the number of natural monuments existing in Zielona Góra. What is really concerning is that there are, in general, no differences between educational levels, sex and place of residence in relation to the answers provided, however, female students listed 3 or 4 objects that can be considered natural monuments more often than boys (Table 3). We presume that this general lack of differences is the

Correct	1) The beech tree growing in the Piastowski Park. 2) The yew trees growing next to the Post Office on Sienkiewicz Street.	The object and location are correct.
Almost correct	1) The yew tree growing on Kupiecka Street. 2) A tree growing next to the Church of the Holiest Savior.	1') The tree is growing on Kopernika Street, which is next one to Kupiecka Street. 2') There are a few natural monuments near the church.
Wrong	1) A forest next to the High School number 4. 2) The Piastowski Park. 3) <something> next to Nursery School No. 27. 4) The botanical garden. 5) The oak tree.	1') The object and location are wrong. 2') Parks and forests are not natural monuments. 3') There is no natural monument close to Nursery School No. 27. 4') The botanical garden is not a natural monument and there are no natural monuments there. 5') Insufficient answer.

Table 5. Examples of answers to question 3, which were classified in three categories: correct, almost correct and wrong.

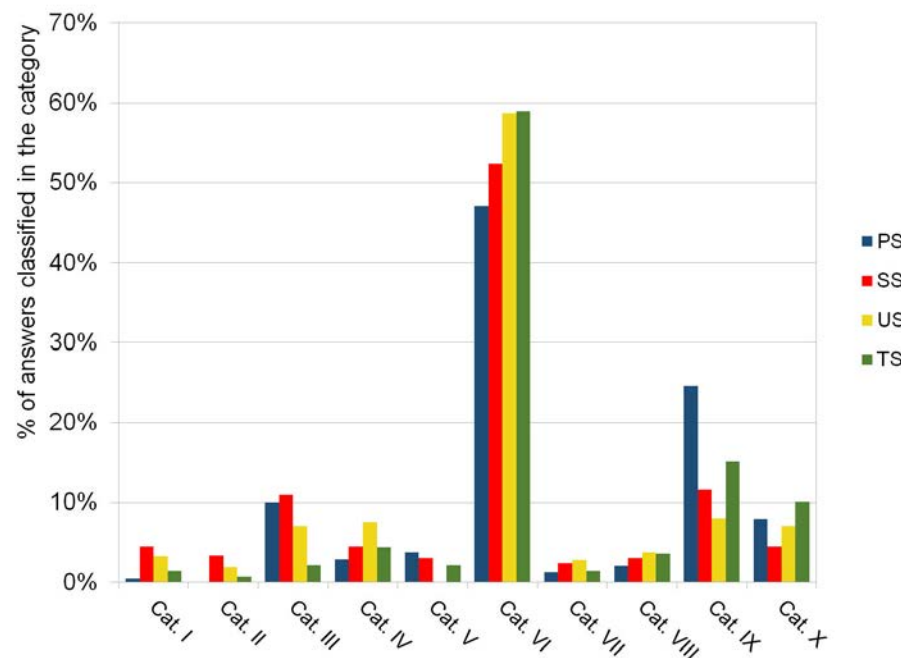
Category	Examples
I. Public administration, agencies	The city website, City Hall, the township office
II. Foresters	The website of the State Forests, foresters
III. School	School books, school lessons, a teacher, school
IV. Tourism	A tourist information centre, a city map, a book about Zielona Góra, excursions, sightseeing
V. Family, people from surroundings	Adults, grandmother, citizens, family, parents
VI. Internet and devices	The Internet, Google, the city website, smartphone, Facebook
VII. Materials and reports about natural monuments	Conservation Office, registers of natural monuments, special maps, the city website about natural monuments, labels on protected objects, publications about natural monuments
VIII. University, specialists	A library, the local University, botanical garden employees, botanists, biologists
IX. Media (press, radio, TV, publications other than in VII.)	By reading, journals, an encyclopedia, a nature atlas, books about nature, press, TV, maps
X. Others	“I don’t know”, from life

Table 6. Sources of information about the number of natural monuments listed by the surveyed students and classified in the presented categories.

result of several factors: 1) Lack of outdoor lessons with teachers; 2) Lack of time spent outdoors with family and friends; 3) Insufficient marking of natural monuments by City Hall; 4) Poor information campaign – unclear sources of information for students; 5) Not enough time in the core curriculum devoted to issues concerning nature protection; 6) Limited knowledge of teachers about local natural monuments. Fig. 4 shows the location of schools participating in the survey (1, 2, 3 – primary schools; 4, 5, 6, 7 – lower secondary schools; 8, 9, 10 – upper secondary schools; 11 – vocational upper secondary school) and natural monuments within borders of Old Zielona Góra (triangle – a living natural monument; circle – a non-living natural monument). The circles around schools indicate a distance of 0.5 km (the diameter equals 1 km), so it can be clearly seen that each school is able to organize an outdoor activity and visit at least one natural monument during the time of a regular lesson. The core curriculum obliges teachers to teach about forms of conservation, including natural monuments, in early education classes, science classes, biology classes and geography classes in primary school (current core curriculum). During the secondary stage of education, pupils are taught various issues in biology classes, however, there is too little time spent on environmental issues and the conservation of biodiversity. Thus, the knowledge of Polish pupils and students about nature is poor (The State Council for Nature Conservation 2016, Zawada 2016). As Falkiewicz-Szult (2014) wrote „It is worth mentioning that the leading role in the environmental education of children is played by a teacher” and it is up to teachers to organize the educational process and stimulate the curiosity of students and awaken their sensibility towards nature. Of course, teachers must be supported by the education system, school equipment, school environment, parents and students (Baker et al. 2002). Also, teachers should be

Fig. 3. Percentage of answers to question 6 classified in ten categories

Different colors indicate four levels of education: PS – primary school, LS – lower secondary school, US – upper secondary school, Voc – vocational upper secondary school.



encouraged to organize outdoor lessons, since they may fear going outside and encountering many questions from their students (Dillon et al. 2006). Moreover, they may be concerned about health, safety and the fears of their students (Dillon et al. 2006), which cannot be ignored, since students can behave unpredictably. We consider it alarming that pupils of all school levels find it difficult to define a natural monument. In fact, most of them described it correctly as a tree (Fig. 2, category I). Some of the students defined it as non-living objects (rocks, waterfalls) which is promising, because they understand that not only trees and other living objects of nature can be considered natural monuments. Nonetheless, they listed monuments, buildings, parks, statues and animals as such objects. Fig. 1 presents how

students imagine natural monuments – they mostly see them as a single-type object, even though we expected the students to list several objects or provide a definition. Unfortunately, we were positively impressed only with eight answers of students from a particular upper secondary school. These were valuable definitions of a natural monument, for example: „a priceless object of nature, important for scientific, historic and cultural reasons” or „a specific object of nature – living or non-living – which is special (because of age, rarity)”. We suspect that this task would be easier for pupils who have outdoor classes and visit nearby natural monuments, since environmental education can be positively influenced by visiting green spaces (Wolsink 2016).

Since the majority of the natural monuments found in Zielona Góra are trees, they can play a great role in teaching dendrology in addition to environmental issues. Linking both aspects (teaching dendrology and environmental protection) in a single outdoor class increases the chance of shaping environmental attitudes. The ultimate question is how to awaken and strengthen respect towards nature. In our opinion, the most important aspect is showing students biodiversity, starting with local examples of common and rare organisms and their relationships. The monument trees in Zielona Góra are commonly inhabited by ants, sometimes they are infected with fungi or house xylophagous species and birds. Those trees are usually much taller and have wider trunks than other trees in the neighborhood. Moreover, they manifest species-specific capabilities, starting with flowering and fruition to reaching a respectful size and age in the end. The rarity of similar trees occurring in urban spaces, agricultural landscapes and forests well serves as proof of the progressing negative impact of humans on the environment. The revised Nature Conservation Act and changes to the Forest Act, which came into force on 1 January 2017, partially lifted the requirement for a permit to cut trees or bushes. Private landlords were able to remove trees or shrubs on their property without permission unless these objects were natural monuments. Similarly, cutting down trees and bushes to restore land to agricultural use did not require permission as well. Fortunately, after few months, the Nature Conservation Act was amended and removing trees from private land without permission is prohibited once again.

No one, however, is able to provide reliable statistics showing how many trees were removed from private properties, but by observing our own neighborhoods, the scale of the cut is huge. Not only did single trees disappear, but whole squares and rows of trees. Due to these

changes, an enormous number of trees were removed from the landscape, which may result in the future in an important age gap between current monument trees and young ones. No one can exclude that after removing old trees, there will be any candidates of appropriate size and age to become new natural monuments.

Carmi et al. (2015) see the complexity of environmental issues and compare them to a vast forest where each tree is different and requires an individual approach. This may be true, nonetheless, a single object, such as a natural monument, exhibits individual traits and problems which can be extended to other similar objects, including those existing in the non-urban environment. Probably environmentalism and biology courses are examples of the few domains that must be taught in accordance with a core curriculum that includes contact with nature. So they should not, or even must not be dominated by new technologies, rather they should cooperate with them. In Appendix I, we propose a form of outdoor activity that includes visiting a natural monument. This approach provides the opportunity to conduct a lesson and have the students gain new experiences based on using various senses. This is for the benefit of both the teacher and students, since being active supports memorizing (Chawla 1999), working in groups and social development, also, the relationship between a teacher and students may improve (Barker et al. 2002, Męczkowska & Rychterówna 1923) As Męczkowska and Rychterówna (1923) wrote almost a century ago: „Conversations between a teacher and students during a walk should not be limited only to environmental issues. Indeed, a teacher is supposed to talk with students about off-topic subjects to make the outdoor lesson more friendly”.

Today, students expect to find any information they need in the Internet by using their smart devices (smartphones, tablets, etc.) or computers (Fig. 3.). This

issue should not be ignored. Schools and the education system have to adapt to this and design new methods of teaching and providing knowledge to meet the expectations of students and keep up with the era of digital technology. We do not mean to replace handwriting, reasoning and many other skills with devices. We simply encourage teachers to let students use their smartphones in class or during outdoor activities to achieve learning goals. Such information, as the number and detailed parameters of natural monuments, should be clear and easy to find in the Internet. We presume that if teachers could easily obtain the proper information, they would eagerly share it with students. The second source of information listed by students were various media (e.g. TV, radio, press) (Fig. 3.). Using the Internet and other media as a source of knowledge is unavoidable. However, teachers should emphasize the value of other sources that do not require electricity and are listed in Table 5. According to Polish law, a natural monument has to be properly labelled to inform everyone that a given object is protected and is valuable for a variety of reasons. Unfortunately, some natural monuments in Poland, including in the Zielona Góra area (Tokarska-Osyczka and Pilichowski 2016), have no labels of their status, which is a negligence of the local governors. Similarly, the CRFOP commonly lacks significant data (such as species, trunk diameter, age), making this register useless in many cases. Furthermore, the Geoserwis is incomplete and does not show the positions of some natural monuments on the map, especially those recently established (Tokarska-Osyczka and Pilichowski 2016). In the opinion of The State Council for Nature Conservation (2016), the system of gathering and providing information about conservation issues should be drastically improved. It is challenging to offer to children and youth an attractive presentation of natural monuments and other natural objects, then draw their

attention to these objects and make them understand the importance of respecting nature. So, in our opinion, public information systems should be designed not only to provide basic information, but also to supplement this with original materials, for example, infographics, podcasts and stories connected to natural objects, national parks, etc. It is worth considering producing infographics with students after visiting natural monuments and publishing them on the Internet. The use of infographics improves teaching (Alshehri and Ebaid 2016) and is interesting for students (Kos and Sims 2014). By using innovative methods of teaching, students' achievements can be improved (Cachia et al. 2010, Fidelis 2017), together with their scientific understanding and reasoning (van den Broek 2012).

Conclusions

Knowledge about local natural monuments among surveyed pupils is very poor. Furthermore, they have a weak understanding of what can be protected as a natural monument. In general, such knowledge does not differ between the four studied educational levels and between male and female students.

Internet is a promising source of that knowledge, however, it does not offer sufficient and clearly accessible data. Local governors should think of designing an interesting and attractive website concerning natural monuments and other forms of conservation.

References

- Alshehri M. A., Ebaid M. (2016). The effectiveness of using interactive infographic at teaching mathematics in elementary school. *British Journal of Education* 4(3): 1-8.
- Barker S., Slingsby D., Tilling S. (2002). Teaching biology outside the classroom. Is it heading for extinction? A report on biology fieldwork in the 14-19 curriculum. Field Studies Council/British

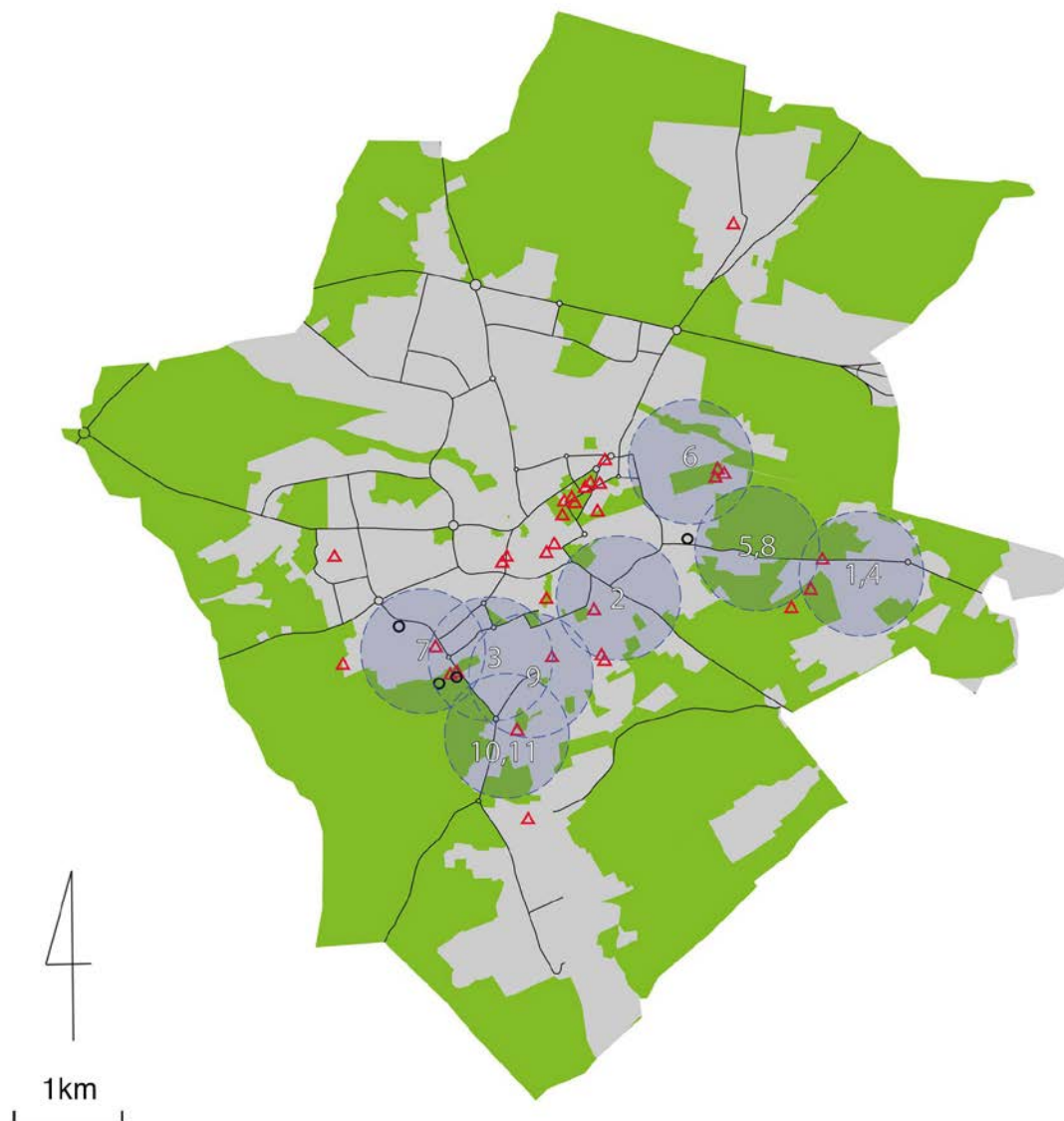


Fig. 4. The map shows Old Zielona Góra (OZG), the surveyed schools and all natural monuments occurring within the OZG borders

Living natural monuments are marked by red triangles and non-living natural monuments by black circles. The numbers 1-11 indicate the surveyed schools and the area surrounding the schools was marked by a diameter equal to 1 km.

- Ecological Society, 16 pp.
- Cachia R., Ferrari A., Ala-Mutka K., Punie Y. (2010). Creative learning and innovative teaching. Final report on the study on creativity and innovation in education in the EU Member States. JRC Scientific and Technical Reports. ISBN 978-92-79-18974-6, ISSN 1018-5593. 58 pp.
- Carmi N., Arnon S., Orion N. (2015). Seeing the forest as well as the trees: general vs. specific predictors of environmental behavior. *Environmental Education Research* 21(7): 1011-1028.
- Chawla L. (1999). Life Paths Into Effective Environmental Action. *The Journal of Environmental Education*: 31(1), 15-26.
- Davey, A.G. (1998). National System Planning for Protected Areas. IUCN, Gland, Switzerland and Cambridge, UK. x + 71pp.
- Dillon J., Rickinson M., Teamey K., Morris M., Choi M.Y., Sanders D., Benefield P. (2006). The value of outdoor learning: evidence from research in the UK and elsewhere. *School Science Review* 87(320): 107-111.
- Falkiewicz-Szult M. (2014). Environmental education of children in early education from the perspective of modern challenges and threats. The work in a nursery school in aid of sustainable development. *General and Professional Education* 2/2014, 15-22.
- Fidelis I. (2017). Learning environment as correlate of students' academic achievement in junior secondary school integrated science. *International Journal of Education, Learning and Development* 5(4): 48-54.
- Greinert A., Drozdek M.E. (ed) (2015). „Zielona” Zielona Góra. Strategia rozwoju terenów zieleni w mieście Zielona Góra. Zielona Góra, 11.
- Kos B.A., Sims E. (2014). Infographics: The New 5-Paragraph Essay. In 2014 Rocky Mountain Celebration of Women in Computing. Laramie, WY, USA. 5 pp.
- Męczkowska T, Rychterówna S (1923). *Metodyka przyrodoznawstwa. Wskazówki praktyczne dla nauczycieli seminariów, szkół powszechnych i średnich.* Wydawnictwo M. Arcta. Warszawa, 214 stron.
- Rozporządzenie Ministra Edukacji Narodowej z dnia 14 lutego 2017 r. w sprawie podstawy programowej wychowania przedszkolnego oraz podstawy programowej kształcenia ogólnego dla szkoły podstawowej, w tym dla uczniów z niepełnosprawnością intelektualną w stopniu umiarkowanym lub znacznym, kształcenia ogólnego dla branżowej szkoły I stopnia, kształcenia ogólnego dla szkoły specjalnej przysposabiającej do pracy oraz kształcenia ogólnego dla szkoły policealnej (Dz.U. 2017 nr 0 poz. 356).
- Smoczyńska A. (ed) (2014). *The system of education in Poland.* Warszawa.
- The Nature Conservation Act (Ustawa o ochronie przyrody). 2004. Dz.U. 2004 nr 92 poz. 880, with further changes.
- The State Council for Nature Conservation (Polish: Państwowa Rada
- Ochrony Przyrody) (2016). *Opinia w sprawie najpilniejszych wyzwań dotyczących ochrony przyrody w Polsce, w roku 2016.* Warszawa, 14 kwietnia 2016. PROP/2016-04, 8 pp.
- Tokarska-Osyczka A., Pilichowski S. (2016). Ocena zagrożeń i aktualizacja rejestru pomników przyrody ożywionych Zielonej Góry w jej nowych granicach. *Zeszyty Naukowe Uniwersytetu Zielonogórskiego. Inżynieria Środowiska* 162 (42), 102-128.
- Wolsink M. (2016). Environmental education excursions and proximity to urban green space – densification in a ‘compact city’. *Environmental Education Research* 22(7), 1049–1071.
- van den Broek, G. (2012). Innovative Research-Based Approaches to Learning and Teaching. *OECD Education Working Papers* 79, OECD Publishing. 31 pp.
- Zawada, Z. (2015). Poziom znajomości ssaków wśród dzieci i młodzieży dawniej i dziś – w oparciu o badania ankietowe. *XIX Konferencja Dydaktyków Szkół Wyższych i Nauczycieli Przedmiotów Przyrodniczych.* 17 -19 września 2015 – Słupsk.

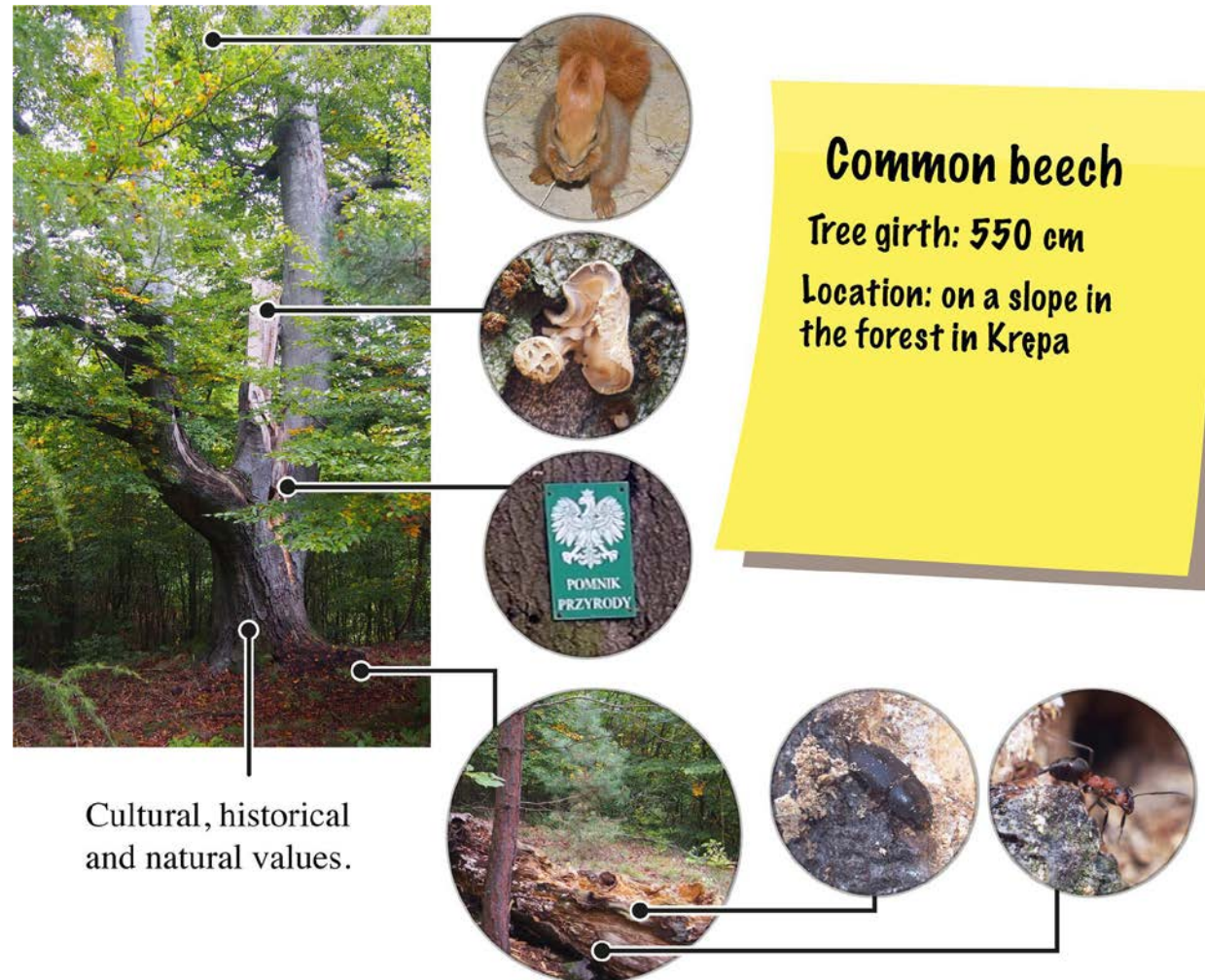
Appendix I. Exercises for students (ISCED level 1, 2A, 3A)

Take a photograph of a natural monument you visited during the outdoor class. Pay attention to its appearance, its condition, especially damage and to the organisms inhabiting it. Note all your observations. Take photographs of details, e.g. leaves, fruits, holes in the tree trunk, lichens, mosses, insects crawling on its surface. If you observe a tree, you can measure its girth at breast height (1.3 m from ground level). In the case of rocks – you can measure their height and width. If possible, find trees of the same species in the neighborhood and also measure their girth at breast height. Compare the measured girths with the natural monument. To measure tree height, you do not need advanced tools. Ask your colleague to stand next to the tree. Walk out so you can see the whole tree – the top and the base – without moving your head. Remember to stand at the same ground level as the tree. Take a photograph of the tree and your colleague standing next to it. Measure your friend's height and estimate the tree height in the photograph.

Find information about the visited natural monument in the Internet. Did you find it easily? Was the information you found clear and detailed? Would you like to change/add something?

Create an infographic about natural monuments. As an illustration and example, use the natural monument you visited during the outdoor class. Describe your work to your colleagues. See the exemplary infographic in Appendix II.

Appendix II. An exemplary infographic



Cultural, historical and natural values.

Appendix III. WebQuest – Natural monuments in Zielona Góra (ISCED level 2A, 3A).

1. Introduction

According to Polish law, a natural monument can be a single or a group of living or non-living natural objects that have uncommon features, valuable for nature, science, culture, history and the landscape, including native and foreign species of trees and shrubs, caves, rocks and other things.

Do you know how many natural monuments are in your neighborhood?

After these exercises you will know. Well, do it!

2. Tasks. Part I

Group 1

1. Use the Register of Natural Monuments of the Lubuskie Voivodeship, write down the number of living natural monuments in Lubuskie Voivodeship.
2. Look at the map available at the Geoserwis map service, write down how many natural monuments there are near your school. What are they?
3. Choose five living natural monuments in Zielona Góra from among those listed in the Register. Then use the Geoserwis map service, find them and compare their location with Google Maps. Write down the coordinates of the chosen natural monuments.
4. Save all your results in a spreadsheet program (e.g. MS Excel).

Group 2

1. Use the Register of Natural Monuments of the Lubuskie Voivodeship, write down the number of

Fig. 5. The exemplary infographic shows a natural monument – a common beech tree growing in Krępa, which is part of Zielona Góra

The tree has a variety of traits that can be observed by students, for example seeds which can be eaten by squirrels, a proper sign on the trunk, fungi present on the rotten wood, as well as a third trunk lying on the ground and inhabited by ants. Students can also measure the circumference of the tree at breast height.

non-living natural monuments in Lubuskie Voivodeship,

2. Look at the map available at the Geoserwis map service, write down how many natural monuments there are near your school. What are they?
3. Choose five non-living natural monuments in Zielona Góra from among those listed in the Register. Then use the Geoserwis map service, find them and compare their location with Google Maps. Write down the coordinates of the chosen natural monuments.
4. Save all your results in a spreadsheet program (e.g. MS Excel).

Group 3

1. Use the Register of Natural Monuments of the Lubuskie Voivodeship, write down the number of living natural monuments in Zielona Góra.
2. Look at the map available at the Geoserwis map service, write down how many natural monuments there are near your school. What are they?
3. Choose five random natural monuments in Zielona Góra from among those listed in the Register. Then use the Geoserwis map service, find them and compare their location with Google Maps. Write down the coordinates of the chosen natural monuments.
4. Save all your results in a spreadsheet program (e.g. MS Excel).

Group 4

1. Use the Register of Natural Monuments of the Lubuskie Voivodeship, write down the number of non-living natural monuments in Zielona Góra.
2. Look at the map available at the Geoserwis map service, write down how many natural monuments there are near your school. What are they?

3. Choose five random natural monuments in Zielona Góra from among those listed in the Register. Then use the Geoserwis map service, find them and compare their location with Google Maps. Write down the coordinates of the chosen natural monuments.
4. Save all your results in a spreadsheet program (e.g. MS Excel).

3. Tasks. Part II

Use the data saved in the spreadsheet program file and count the ratio of the number of living and non-living natural monuments in Zielona Góra to the number of living and non-living natural monuments registered in the Lubuskie Voivodeship, respectively, as well as to the total number of natural monuments registered in the Lubuskie Voivodeship. Express these relationships as percentage ratios.

Produce a pie chart that will show the ratio between the counts of living and non-living natural monuments registered in the Lubuskie Voivodeship and in Zielona Góra. Compare them and comment.

4. Step by step

Task 1 (all groups)

- a) Start with: <http://bip.gorzow.rdos.gov.pl/inne-rejstry-publiczne>.
- b) Download the Register of Natural Monuments of the Lubuskie Voivodeship.
- c) Open the file and look for the information you need.
- d) Open a spreadsheet program file and save the results of your work.

Task 2

- a) Start with: <http://geoserwis.gdos.gov.pl>

- b) Find the menu in the top right corner and switch the map mode to the Google orthophotomap.
- c) Then select the option „natural monuments” (*pomniki przyrody*) from the menu on the right.
- d) Scroll the mouse to zoom in and locate Zielona Góra, then find your school.
- e) Count the number of natural monuments in the neighborhood of your school.
- f) If you want to obtain detailed information about a chosen object (e.g. natural monument) click with the mouse on the letter „i” in the menu on the left. Then click on the object.
- g) Write and save the results in the spreadsheet program.

Task 3 (all groups)

- a) Open the Register that you downloaded in Task 1.
- b) Choose five objects according to the task you were given.
- c) Find them in the Geoserwis map service (look at the Task 2).
- d) Open the Google Maps website and find the objects you have already found in Geoserwis.
- e) When you find the locations of the chosen natural monuments, click on them with the left mouse button. You will see coordinates expressed as Decimal Degrees (DD) at the bottom of the map. To obtain coordinates in the DMS system (Degrees Minutes Seconds) click on the DD coordinates – the DMS coordinates will be shown on the left.

5. Sources

- <http://bip.gorzow.rdos.gov.pl/inne-rejstry-publiczne>
- <http://geoserwis.gdos.gov.pl>
- <http://crfop.gdos.gov.pl>

6. Evaluation and the role of the teacher

Before giving the tasks to the students, the teacher must learn how to use Geoserwis. The teacher should also be familiar with Google Maps and the configuration of the Register of Natural Monuments of the Lubuskie Voivodeship. Otherwise it will be difficult to help students and obtain the expected results. Since the tasks presented here may be difficult for students, especially young ones, the teacher should pay attention to the effort made by students to solve the tasks. Only students who refuse to take part in WebQuest may be rebuked, however, since WebQuest is designed to develop skills and increase the knowledge of students; they should be encouraged to participate. It is advised for the teacher to prepare some type of reward for taking part in WebQuest and solving the tasks.

7. Summary

The goals of the tasks are as follows: 1) using digital technologies to find information, 2) increasing awareness of the natural monuments existing in the neighborhood and region, 3) inducing curiosity about interesting natural objects, 4) increasing knowledge about sources of information on natural monuments and other forms of nature protection, 5) social development of students working in groups, 6) diversifying teaching methods.