STUDENTS' "VIRTUAL HERBARIUM" – A RESEARCH PROJECT ON PLANTS AND SPECIFIC LIVING ENVIRONMENTS

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ABSTRACT

The "Virtual Herbarium" project was carried out during the seminars of Sciences and science didactics, in the second semester of the academic year 2020-2021 (in the context of the COVID-19 pandemic and the impossibility of field trips and the composition of classical herbariums), all the 45 students of the specialisation Pedagogy of Primary and Preschool Education (IF), Năsăud extension of the Faculty of Psychology and Sciences of Education, "Babeş-Bolyai" University Cluj-Napoca, being involved. Each group of students created a virtual herbarium with plants specific to a certain world environment. The professor provided them with details, working models, the criteria on the basis of which the evaluation is made. Each group presented their herbarium in front of their classmates, in the seminar organised on the Microsoft Teams Platform. At the end of the research, a questionnaire was applied to receive feedback from students regarding this activity.

Keywords: university seminar, online learning, online cooperation, ecological education, environmental education, COVID-19 pandemic

INTRODUCTION AND THEORETICAL FRAMEWORK

In the literature, the involvement of pupils and/or students in learning activities organised within research projects and in extracurricular activities carried out in the field, in which they have the opportunity to explore the environment and analyse its components, as well as the relationships between them is recommended (Conțiu & Conțiu 2009, 2011, 2013; Dulamă, 1996, 2004, 2010a, 2011, 2012; Dulamă et al., 2012; Dulamă & Buda, 2014; Ilovan et al., 2015).

The research project is part of the strategies and techniques that are based on problem solving, being a way of learning by doing, an activating interactive method and a complex tool for evaluating the activity (Dulamă, 2002; Dulamă & Roșcovan 2007).

Studies claim that teachers in Romania, aware, on the one hand, that ecological education is an education through geography that broadens the horizons and deepens knowledge (Conțiu & Conțiu, 2013), and on the other hand, that a significant part of pupils and students spend most of their time in front of the computer, on the Internet or social networks (Dulamă, Magdaș & Osaci-Costache, 2015; Dulamă, Vescan & Magdaș, 2016), are interested in environmental education and environmental protection (Dulamă et al., 2010), in activities with children in nature, in forests and national parks (Havadi-Nagy & Ilovan, 2013; Dulamă et al., 2016, 2017).

During the learning activities organised in the natural environment, the children's curiosity is stimulated and capitalised, in accordance with the paradigm of the open class, formulated by a famous slogan of American pedagogy: "*The child is born curious*" (Bîrzea, 1995). Children can observe plants and animals in their living environment, guided by their teacher through questions (Dulamă, 2010a, 2010b, 2011a, 2011b, 2012), through games (Dulamă & Fărcăşiu, 2010; Jucan & Chiş, 2013) and group activities (Dulamă, 2006, 2008).

The period of schools and universities closure, caused by the COVID-19 pandemic, forced education systems to find solutions so that the training of pupils and students can move on as distance learning, in the virtual environment. The transition from a traditional learning environment to digital platforms, video conferencing, groups on various social networks, have imposed the type of e-learning training (Vereş et al., 2020; Buzilă et al., 2017). Making a virtual herbarium is a creative solution to a problem faced by teachers and students who could not perform face-to-face activities in the field.

METHOD

Research stages. The "Virtual herbarium" project was achieved in the second semester of the academic year 2020-2021, within the seminars of *Sciences and didactics of the science field*, within the specialisation of

Pedagogy of Primary and Preschool Education (IF), Năsăud extension of the Faculty of Psychology and Sciences of Education, Babeș-Bolyai University Cluj-Napoca. The seminar activities (one hour per week) took place on the Microsoft Teams platform. Given the social and sanitary conditions during the COVID-19 pandemic, which characterised the implementation period of the project, it was not possible to make field trips to develop a classic herbarium. An innovative solution was chosen: the creation of a *virtual herbarium.*

Since the activities were particularly varied, they were structured in several stages (Dulamă, 2002). In *the stage preceding the implementation of the project*, the professor established the research field, the purpose, the structure of the activities, selected the materials and tools used. In the project implementation stage, she communicated the work tasks, discussed the project objectives with the students, the composition of the groups, the need for students to choose a leader of each group (who will finally present the research results), scheduling the work stages and sharing responsibilities. Nine groups were formed. Each group was given the task of compiling a virtual herbarium corresponding to a certain type of environment: equatorial / tropical humid (group 1), monsoon (group 2), subequatorial (group 3), Mediterranean (group 4), subtropical-humid (group 5), deciduous forests (group 6), steppe forests (group 7), coniferous forests (group 8) and tundra (group 9). Each herbarium had to include at least ten plants and the specific characteristics of that environment. It was requested that the information be structured concisely, according to the structure specified in the following model, the maps be correctly made, the visual materials (maps and photographs) be representative and undeformed, the bibliographic sources be specified in the texts and visual materials. The pre-structured model for composing the virtual herbarium included an example of a plant specific to a certain environment.

Virtual herbarium (extract)

Authors:
The subject: The specific plants in the environment ...

1. Location of the environment ... (location on the globe, distance or proximity to seas and oceans, latitude, landforms; add a map highlighting the type of environment);
2. The characteristics of the climate in the environment ... (average annual temperature, average annual rainfall, winds, seasons, other important information related to that environment – for example, average temperature in January or July);
3. The characteristics of plant associations in the environment ... (plant height, plant density, plant stratification, etc., their appearance in relation to each other, variety / biodiversity, biomass, etc.);
4. Specific plants (minimum ten, in total)
      4.1. Trees and shrubs
      4.2. Herbaceous plants
      4.3. Cultivated plants
For each plant you will mention the data according to the model below (plant file).

Example of a plant presentation (plant file):

Beech (*Fagus sylvatica*)

Appearance

Stem: It is an indigenous tree that can grow up to 40 m in height, and the stem can have a diameter of 1.5 m. The smooth bark is grey with whitish spots.

Leaves: The elliptical leaves, sharp at the tip and with serrated edges, have glossy, leathery faces and are 5-10 cm long. The leaves are very sensitive to cold, so at first frost they turn yellow, then take on the colour of bronze.

Flowers: The flowers are unisexual-monoecious. The male flowers are grouped in heads with long peduncles, and the female flowers are grouped in pairs in a cup. The beech blooms in April-May.

Seeds: Oilseeds are eaten by wild boars and bears.

Fruits: The fruits (beech nut) are achene with edges, have a length of 1-2 cm and are located one or two in a cup that, when ripe, unfolds into 4 valves. Isolated specimens of beech bear fruit at 40-50 years, and those in forests at 60-80 years.

Age: Beech lives 200-500 years.

Area of spread: The beech is spread from an altitude of 300 m to 1,400 m. In Romania, beech is the most widespread species among trees, and beech occupies 37% of the country's forest area. It prefers shade and humidity, but does not tolerate drought and wetlands.

The natural environment: deciduous forest environment.

The latitude: 40-55° N and S latitude.

Harvest period: it is not the case.

How to use / importance: Beech wood is used for timber, for prefabricated wood (plywood, veneer, fibreboard), for furniture, for fire. From beech tar, methyl alcohol, acetic acid, creosote are obtained by distillation, etc. Beech tar (*pix fagi*) is used in dermatitis, respiratory diseases, etc.

Other information: *A beech produces 1.7 kg of oxygen in an hour, purifying 4,800 m³ of air,* that is *the daily requirement for 64 people.*

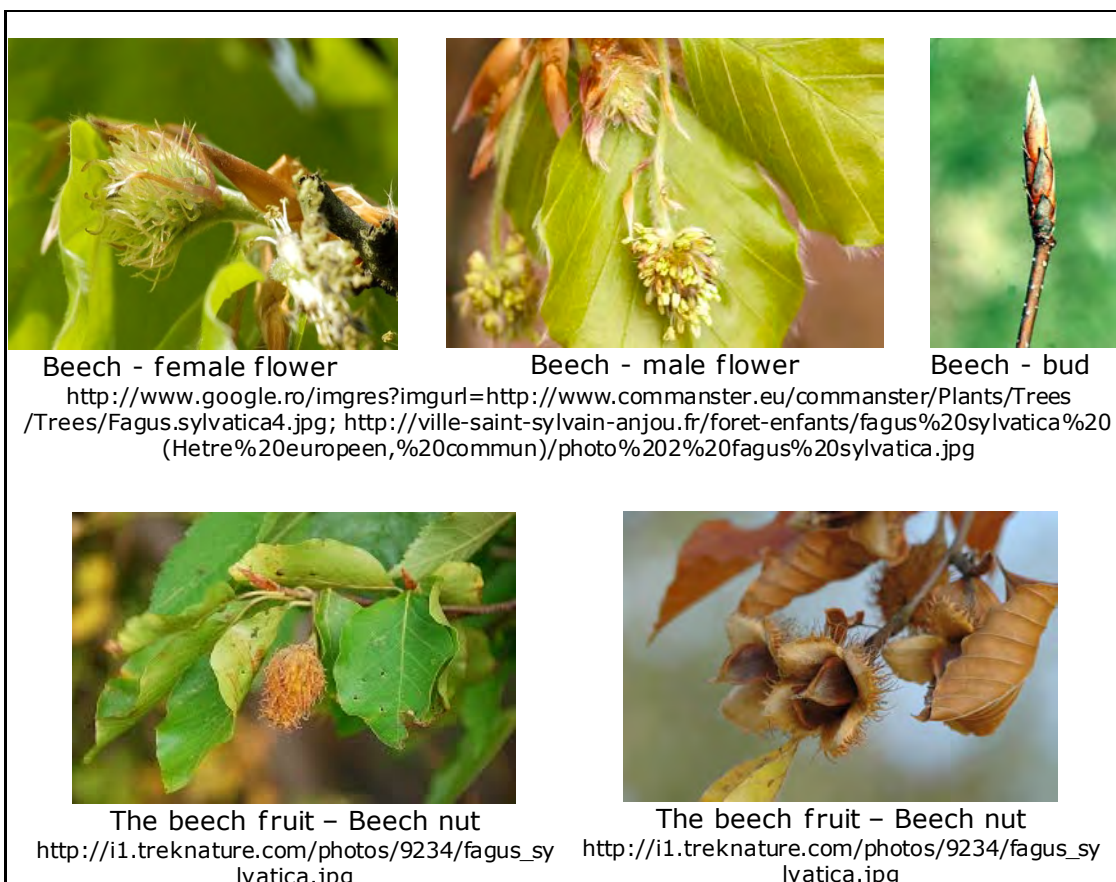Data source: Dulamă, 2010a.

Beech (*Fagus sylvatica*)
http://www.google.ro/imgres?imgurl=http://
upload.wikimedia.org/wikipedia/commons/2/2a/
Illustration_Fagus_sylvatica0.jpg

Beech (*Fagus sylvatica*)
http://www.google.ro/imgres?imgurl=http://
www.commanster.eu/commanster/Plants/Trees
/Trees/Fagus.sylvatica4.jpg

Beech - female flower   Beech - male flower   Beech - bud
http://www.google.ro/imgres?imgurl=http://www.commanster.eu/commanster/Plants/Trees
/Trees/Fagus.sylvatica4.jpg; http://ville-saint-sylvain-anjou.fr/foret-enfants/fagus%20sylvatica%20
(Hetre%20europeen,%20commun)/photo%202%20fagus%20sylvatica.jpg

The beech fruit – Beech nut
http://i1.treknature.com/photos/9234/fagus_sy
lvatica.jpg

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lvatica.jpg

In *the actual stage* of the project, each group of students made up the virtual herbarium, meeting online, in their free time, at the initiative of the leader of each group, according to a freely chosen programme, depending on needs. The professor monitored the stages and the appropriate completion of the worksheets by asking questions and answering students' questions, organising, where appropriate, additional online meetings. *In the project evaluation stage*, the leaders of each group presented the research results, and the professor, using the evaluation grid of virtual herbaria (based on the criteria she had previously developed) (Table 1), noted each project. In *the final stage*, we collected a feedback survey from the students, to make them aware of the didactic complexity of carrying out a project with the students, the targeted competences, what skills can be developed, etc. and to deepen some methodological aspects.

Participants. All the 45 students coordinated by Prof. Dr. Andreea Conțiu who participated in these seminars, were involved in the research.

Data collection and analysis. Data were collected by the method of systematic observation during the seminar activities. We collected other data through the evaluation grid of the virtual herbaria (Table 1).

For data collection we used a questionnaire developed and applied using the Microsoft Teams platform (Microsoft Forms application) (Appendix 1). The questionnaire was structured in three parts: general elements (age and teaching experience), questions related to the achievement of the

virtual herbarium and questions regarding a hypothetical classical herbarium (advantages, disadvantages, time required). The last task was open-ended: "If you would like to add something, please write in the box below." The questions were varied, giving the respondent the opportunity to answer concisely, but also creatively. We opted both for closed-ended questions, at choice, ranked, multiple, and for open-ended questions. The answers to the questionnaire were subjected to quantitative and content analysis.

Table 1. Virtual herbaria evaluation grid

	Category of aspects	Evaluation criteria	Scores
Virtual herbarium (written content)	**General aspects**	Framing in time (four weeks)	1
		The appearance of the project (page framing, image resolution, etc.)	1
		Specifying the bibliography	1
	Locating the type of environment on the globe	The latitude	1
		The distance or proximity to seas and oceans	1
		Location within the relief units	1
		The map	1
	Climate characteristics	Climate type	1
		Average annual temperature	1
		Average annual rainfall	1
		Winds	1
		Seasons / seasons	1
		Other important information for that environment, for example, the average temperature in January or July	1
	The characteristics of the environmental plant association	Plant height, plant density, plant stratification, etc., their appearance in relation to each other, variety / biodiversity, biomass, etc.	3
	Specific plants-presentation	The correct name of the plants	1
		The treatment of all elements mentioned in the plant file	1
		Appearance (stem, leaves, flowers, seeds, fruits)	4
		The age	1
		The area of spread	1
		The natural environment	1
		The latitude	1
		The harvest period	1
		How to use / importance	1
		Other information	1
		The data source	1
Project presentation		Time framing (15 minutes)	1
		Information structuring	2
		The scientific language	2
		Answers to questions/ asking questions	1
Ex officio			4
Total			40

The research material. It consisted of the observations from the seminar, the content of the virtual herbaria made by the students, the answers to the questionnaire.

RESULTS AND DISCUSSIONS

The analysis of the activities within the "Virtual Herbarium" project

The project started with an explanation of the objectives and competences: identification and analysis of environmental components and their relationships, awareness of the role of each plant studied and anthropogenic influence on biodiversity, optimisation of communication skills, analysis, synthesis, comparison, encouraging the educational use of digital media, etc. To accommodate students with the subject, the professor introduced the types of environments on the Earth, using specific audio-visual equipment (Power Point presentations, teaching films, digital images, graphics, .doc files, and .pdf). The students were organised in teams of 4 (three groups), 5 (four groups), 6 (one group), and 7 people (one group); they chose the leader of the group, they shared their tasks and responsibilities, they discussed how to work, etc. The requirement to be 5 members in a group was not fully met, only four groups with 5 members each (groups 2, 4, 7 and 8); three groups had 4 members each (1, 3 and 9), group 6 had 6 members and group 5, had 7 members.

They worked both individually (online documentation holding a leading place in the pandemic context) and in groups. They met online whenever needed. The ambiguities and some more difficult problems were solved together with the professor during the seminar classes and, in some cases, during additional, punctual, online meetings. From the discussions at the seminar, the students from some groups communicated better, this fact being reflected in the organisation and quality of the research: homogeneity, efficiency, completion of projects in a shorter time, fulfilment of work tasks in compliance with all requirements, consistent, accurate results, presented synthetically, etc.

After making the virtual herbarium, the students presented them to their groupmates and the professor on the Microsoft Teams platform, during three weeks (three teams per week), hardly being within the time allocated to each group: 15 minutes. Two groups expanded even to 25 minutes presentations, having difficulty in being synthetic. These groups acknowledged that they communicated the hardest during the seminar discussions and their free answers given to the questionnaire. Most groups opted for Power Point presentations (four groups), using Word documents (four groups), .pdf (group 6).

The professor and students asked questions about the basic characteristics of living environments, the role of relief and climatic conditions in the spread and development of plants, types of plants and their use by individuals, possibilities of adapting plants to other types of environments than those specific, etc. The students had difficulties in correctly identifying and delimiting the types of geographical environments, recognising the types of plants specific to a type of environment, defining geographical concepts, the veracity of data and online sources, etc. They were most affected by communication difficulties, partly justified by the pandemic context and the constraint of online activities.

Analysis of compliance with time requirements and grouping

To give a certain numerical balance, each group had to include 5 students. Of the nine groups, only four met the requirement related to the maximum number of people that can make up a group (Table 2), on the one hand due to personal matching (friends, common previous research experiences), and on the other hand due to a more difficult online organisation. Some groups have hardly chosen a leader, and in some cases, during the project, due to the insufficient involvement of the leader or the greater desire to involve some members, the presentation of the project was made by other students. However, this fact did not influence the grading, the professor mentioning this shortcoming during the seminar hours, during the presentation of the projects, discussing with the students and trying to identify the causes. All teams were within the time allotted for compiling the virtual herbaria and completing the project: four weeks.

Table 2. Compliance with requirements in the composition of groups and time

	Group								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Compliance no. of 5 students (std.) per group	no (4 std.)	yes	no (4 std.)	yes	no (7 std.)	no (6 std.)	yes	yes	no (4 std.)
Time framing T (composition of the project)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Defining the project authors	yes	yes	yes	yes	yes	yes	yes	yes	yes

Written content-analysis of the virtual herbarium

The project had an imposed structure regarding the following: location of the type of environment, characteristics of the climate, characteristics of plant associations specific to a particular type of environment, presentation of specific plants (at least ten) (see above, worksheet). Along with these, there were other mandatory requirements: specifying data sources (text and images), non-distorting maps and images.

Each project was graded following certain criteria (Table 1). These criteria focused on the scientific contents, on elements related to the general aspect and on the way of supporting work. The errors regarding the scientific language, which existed in the written project, were corrected during its presentation. A remarkable fact was that, many times, students made mistakes and tried to correct those themselves, by further explanation.

The first group did not locate the studied environment (equatorial environment), but it was satisfied only with the rendering of a general map (Physical map of the world) (Table 3). Regarding the climate, they did not

specify it correctly, making confusions between the type of climate and the climatic zone, and in the category "winds", they miswrote, as specific to the equatorial environment, both the equatorial calms and the trade winds and monsoons. They also added elements of soils and hydrography to the "climate" – a mistake that is common in both the university and the pre-university educational environment. The aspects related to plant associations and their presentation were almost complete.

The second group sometimes had an imprecise scientific expression, with some confusions regarding the climatic elements, and the characteristics of the vegetal association presenting them briefly. *The third group* confused the "savanna" plant associations with "tropical rainforests". As for *the fourth group project*, some information about plants were missing. The briefest virtual herbarium was that of *the fifth group*, in which a lot of information was missing, and some was incorrect: starting from the location (inadequate map), the type of climate incorrectly characterised, and the plants presented extremely briefly (only photos and some information regarding the vegetal associations).

The project of *the sixth group* was well carried out and structured, the observations referring, in particular, to editing errors. *The seventh group* structured the project well, had few omissions in the presentation of some plants. In the case of *the eighth group*, we found the lack of some clarifications regarding the climate (type of climate, average annual temperature, amount of precipitation, winds). The last group, *the ninth*, structured the project well, with few omissions (for example, the type of climate was missing).

Regarding the wording of the text, it was noticed that many times/often, typos have crept in (e.g. omissions related to diacritical marks - group 3). Regarding maps and images, most groups included distorted or blurred maps and images in the projects (except for groups 2 and 7). The natural and correct sizing of the images in favour of a certain space allocated on the page was thus neglected. During the seminar classes, the professor explained to the students the importance of not distorting maps and images. By widening or lengthening the maps, the scale of proportion changes, the distances are altered, deformations and unrealistic configurations appear thus creating a false perception of the dimensions, shape, position, etc.

Another observation is related to the fact that, although in all projects the bibliography was specified at the end, not all maps or images had specified sources (an example is that of group 2, which did not have maps or distorted images).

Table 3. Evaluating the content of virtual herbaria

Content elements		Group								
		1	2	3	4	5	6	7	8	9
Specifying the subject		yes	yes	yes	yes	yes	yes	yes	yes	yes
1. Locating the type of environment on the globe	the latitude, the distance or proximity to seas and oceans, the location within relief units	no	yes, but there are confusions of terms	yes	yes, but there are scientific mistakes	yes, but there are confusions of terms	yes	yes	yes	yes
	the map	yes	yes	yes	yes, but incorrect	yes, but incorrect	yes	yes	yes, deformed	yes
2. Climate characteristic	the type of climate	incorrect	it is not specified	yes	it is not specified	incorrect	yes	yes	no	no
	average annual temperature	correct	correct	yes	yes	yes	yes	yes	no	yes
	average annual rainfall	are correct	are not specified	yes	yes	incorrect (confusions with the Mediterranean climate)	yes	yes	no	yes
	winds	incorrect (equatorial calms, trade winds and monsoons have passed to the equato-rial climate)	are correct	yes	yes	incorrect (confusions with the Me-diterranean climate)	no	yes	no	yes

	seasons	yes	confusing the four seasons with the warm/cold, rainy/dry seasons	confusing the four seasons with the warm/cold, rainy/dry seasons	confusing the four seasons with the warm/cold, rainy/dry seasons	incorrect (confusions with the Mediterranean climate)	no	yes	yes	yes
	other important information for that environment, for example, the average temperature in January or July	yes	no	yes	yes	no	yes	yes	yes	yes
3. The characteris-tics of the environmental plant association	plant height, plant density, plant stratification, etc., their appearance in relation to each other, variety / biodiversity, biomass, etc.	yes	yes, but very brief	yes	yes	no	yes	yes	yes	yes
4. Specific plants - presentation	the correct name of the plants and their number	yes	yes	yes	yes	yes (only images, most distorted)	yes	yes	yes	yes
	treatment of all the elements mentioned in the plant file	no	yes	yes	yes	no	yes	yes	yes	yes
	appearance (stem, leaves, flowers, seeds, fruits)	yes	yes	yes	yes	no	yes	yes	yes	yes

	the age	no	yes	yes	sometimes it is not specified	no	yes	sometimes is missing	yes	yes
	the spreading area	yes	yes	yes	yes	no	yes	yes	yes	yes
	the natural environment	yes	yes	yes	yes	no	yes	yes	yes	yes
	the latitude	yes	yes	yes	sometimes it is not specified	no	yes	sometimes is missing	yes	yes
	The harvest period	yes	yes	yes	sometimes it is not specified	no	yes	yes	yes	yes
	how to use / importance	yes	yes	yes	yes	no	yes	yes	yes	yes
	other information	no	yes	yes	yes	no	yes	yes	yes	yes
	the data source	yes	yes	yes	yes	yes	yes	yes	yes	yes
The pictures		some are deformed	are correct	some are deformed	some are deformed	some are deformed	some are deformed	are correct	some are deformed	some are deformed
Other mistakes / remarks		they used the soil and the waters to characterise the climate	they added to the characterisation of the plant association, elements about fauna and population	sometimes diacritical marks are missing	they misplaced the environment	they confused the humid subtropical climate with the Mediterranean one	printing errors		sometimes sentences have no subject	

Analysing students' opinions about the virtual herbarium and the classical herbarium

The accuracy of the "Virtual herbarium" project was even better as the people involved proved that they had a wider *teaching experience*, thus there is an intrinsic connection between them. We found that 41% of students already had teaching experience (29% in the preschool system, 9% in the primary school, and 3% in the gymnasium). In terms of *age*, 79% are between 20 and 30 years old, 15% between 30 and 40 years old and 6% over 40 years old.

Regarding the achievement of the "Virtual herbarium" project, we followed the elements related to: the duration of solving the task, the advantages and disadvantages of this type of activity, the targeted competences, the abilities and attitudes that can be formed, the evaluation criteria, its usefulness in the didactic activity, the difficulties encountered. Students have allocated more or less *time* to solve this task, of compiling a virtual herbarium. Over 53% of students worked more than 120 minutes, 24%, between 90 and 120 minutes, 12%, between 60 and 90 minutes, 9% between 30 and 60 minutes and only 3% under 30 minutes. From the discussions at the seminar, the allocation of time was influenced by many factors: experience of using the media, computer, internet, psychological factors (some of the people being parents), the need to allocate time to complete the Bachelor's degree, the ability to synthesize differently, etc.

There were several advantages of making virtual herbaria: the possibility to choose from various sources of information (56.9% of the answers) requires a short time to be achieved (15.7%), and it does not require field trips (11.8%), and it is easy to be achieved (15.7%). The students also mentioned other advantages: "possibility to select the most relevant information"; "cooperation between teammates, team spirit, organisation and discussion of the development of the virtual herbarium project, analysis of specific information, content"; "I think, for students, the digital herbarium is an easier way to learn about certain plants"; "the realisation of a virtual herbarium requires a relatively short time, which is a quite big advantage; also the fact that it is done online, using virtual libraries or the internet, is an advantage during this pandemic"; "accumulation of information about species belonging to the tundra environment (subpolar environment)"; "the internet gives us a multitude of images (very beautiful)"; "it helps to recognise many plants in the future"; "with the creation of a herbarium, we have to look for sources and information in several books or bibliographic sources and we will discover many more things that we do not yet know."

Regarding *the disadvantages* of this type of activity, the answers were as follows: 52.4% mentioned that there is no interaction with the natural environment, 19% wrote that the interaction among group members is low, 12.7% stated that there is too much information difficult to manage and verify, 4.8% mentioned that, in the case of children, adult

supervision is required, and 11.1% wrote that the sources of information cannot be verified. The students also mentioned other disadvantages: "Not all information on the Internet is correct or sometimes does not exist for different plants"; "Direct contact with the plant does not exist"; "Other disadvantages in creating a virtual herbarium could be the fact that team members could work together more effectively if they had face-to-face meetings …"; "In many cases, we take false information!"; "It is necessary to have digital competence, otherwise it is very difficult"; "Some information about certain plants was hard to find and takes a long time to be gathered"; "The most useful information we retain is the one we interact with; in the case of the digital herbarium, we were not able to get out of our own comfort zone to see what an oak, a sessile oak, a blackberry looks like [...], to touch them, to take a breath of fresh air, to observe their development environment".

The main purpose of some questions was to highlight the role of the professor in implementing such an activity, in the formation and development of skills and attitudes in children. Regarding *the competences* to be trained, the following answers were specified: "to document" (31.4% of responses), "to cooperate" (22.9%), "to investigate" (21%), "to experiment" (13.3%), "to make a herbarium" (11.4%). Other skills that are intended to be trained in making a virtual herbarium are: "finding information specific to the topic given by the teacher, individual organisation, as well as the group in order to accomplish the task received"; "to analyse, synthesize, process the information found"; "digital competence (using the computer and the Internet)"; "cultivating a taste for the new".

The skills that can be achieved by creating a virtual herbarium are the following: "scientific documentation and scientific reasoning" (31.9%), "to work in a team" (29.7%), "to take care of the environment" (14.3%), "to observe" (13.2%) and "to use the equipment" (11%). Other skills that can be acquired by making a virtual herbarium are: "knowledge of data, information, documentation regarding the task given from specific auxiliaries, as well as from the online environment", "digital and synthesis skills".

The attitudes developed as a result of this activity are: "meeting the requirements" (31.1%), "positive attitudes towards the environment" (26.7%), "working in an orderly manner" (22.2%), "assuming errors, gaps or failures" (15.6 %), and "precision" (8.9%). The students also added attitudes that can be formed by creating a virtual herbarium: "discipline, as well as self-analysis, in the sense that each student in this case self-analyses through what he/she has achieved as a result of the activity proposed by the professor", "proactive attitude", "attitude to order things".

Two questions concerned the *grading criteria* of this activity, their purpose being to make future / current teachers aware that the pupils / students expect their work to be acknowledged, in this case, as grades (evaluation having a special role in the didactic activity). The answers were lined up like this: "correctness of scientific information" and "compliance with requirements" (each representing 23.4% of the total answers), "the aspect of the project (page design, positioning of the images, etc.)" (18%),

"importance of information" and "originality" (each, 13.3%), "specification of title, sources of information / bibliography" (12.5%), "grammatical and lexical correctness, etc." (10.9%) and "image distortion / non-distortion" (5.4%). It should be noted that the deformation / non-deformation of the images received the lowest score, which explains that most of the analysed projects had such photographs, proving a sufficient misunderstanding that the images are part of the project and that their alteration by enlargement / elongation leads to distortion of reality and wrong learning (it is known that the learning process is much faster through photographs than through written text).

Other assessment criteria that teachers would use to be able to evaluate this activity if they carried it out with students are: "observation, analysis based on content criteria", "effort, because I have never done it", "the creativity they showed in carrying out the project, the work of each team member", "the information retained after the project", "the importance of the volume of information".

To the question "*What difficulties did you meet in creating this virtual herbarium?",* the answers were very varied: "I did not find enough information for all plants and criteria, or I found wrong information"; "Communication with group members was more difficult"; "I found useful information, but I would have liked if I had at least other books in this field at hand, so I could be sure of the answers given, as well as other teaching materials that would have helped me in making the virtual herbarium through the exposure of new knowledge"; "Putting all the information together, equal involvement in the project, lack of interest"; "Some information was different from one source of information to another, and this took more time to establish the correct information"; "It was quite difficult to frame the pictures"; "Identifying some interesting information, with novelty elements"; "We didn't cooperate well enough with the other colleagues, we didn't synchronise at all, and this was seen at the end of the project ...". There were also five people who replied that they did not meet any problems. It is noted that the difficulties faced by students relate to the identification and processing of information with scientific content, as well as the difficulty of communicating with team members.

The following question was about the usefulness of this project in teaching: 36% of students consider it "very useful", 55% of respondents consider it "useful", 3% answered "so and so", 3% "a little" and 3% "not at all". Regarding the subjects in which they would make and use this virtual herbarium, they said: "Sciences" (37.2%), "Geography" (35.1%), "Romanian language" (2.1%), "Technological education" (8.5%), "Mathematics and environmental exploration" (17%). Other subjects mentioned were: "Biology" (3 answers), "English" (2 answers) and "Civic education - in order to protect the natural environment around us" (1 answer).

The last part of the questionnaire tackled the creation of a classic herbarium. To the question: "*What are the advantages of making a classic herbarium?",* the answers were: "explore the natural environment" (34%), "easier cooperation among team members" (27%), "stimulate creativity"

(22%), and "create memories" (17%). Students also added other benefits: "direct contact with the plant (a more detailed analysis)", "team spirit, discipline, organisation, knowing the other team members in a sense of collegiality, making friends" and "recreation".

To the question "*What are the disadvantages of making a classic herbarium?", 33% of students considered that "some regions are dangerous",* 26% mentioned that there are "space limits", 13% said that "the sources of information cannot be verified" and 28% wrote that if "the plants are not pressed properly, they can be altered". In addition, one student added that a weak point in this activity is the long time needed to make the classic herbarium. They added other disadvantages: the much smaller variety of species that can be known, some plants can be dangerous, being poisonous, etc.

As for the time required to make a classic herbarium, this is much longer: "one week" (17%), "one month" (31%), "one semester" (40%) or even "one school year" (11%). We consider that the choice of time is quite subjective and takes into account both the goal pursued and the teaching experience that the respondent has.

At the end of the questionnaire, some students wanted to add a few more comments: "I liked this activity that I did with my groupmates in Science and science didactics, after which I remembered so many things, information that can be laid at the foundation of general culture, also, I had the opportunity under other circumstances to learn and know in depth aspects related to what I had to prepare, as well as from this thematic area"; "By creating this virtual herbarium, we have acquired new and interesting information about different plants and their environment."

CONCLUSIONS

The research project and the practical application represented an essential and obligatory component of the instructive-educational process, bringing an extra freshness to the scientific knowledge. Creativity, the capacity for inter and transdisciplinary approaches, the responsibility for learning and its results have been developed, especially since, as current or future teachers, they will be able to develop, implement and evaluate such projects in the classroom. In addition to the fact that these students were put in a situation of authentic research, the research project was also an effective method of interactive learning, but also of assessment.

The involvement of students in carrying out the virtual herbarium as a research project stimulated their initiative, the development of relationships and communication skills, self-confidence, and promoted self-assessment and inter-assessment.

Through the feedback provided by the students at the seminar, as well as in the free answers given to the questionnaire, we found that they solved the tasks with attention, seriousness, perseverance, love for

scientific research, using various sources of online documentation and from their own library.

Even if some did not fit in the time in terms of presentation, all were within the time allocated to make up the virtual herbarium. Although some students had a more difficult expression, with scientific mistakes, with gaps, it is important that they were available to learn, progress, and, moreover, in most situations, they self-corrected (both regarding the language, as well as certain aspects related to writing, respectively the use of irrelevant maps and images).

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Appendix 1

QUESTIONNAIRE

I. Data about participants
1.   The age:
       20-30 year old
       30-40 year old
       40-50 year old
       Over 50 year old
2.   Teaching experience (choose only one answer)
    -    I teach/I taught in kindergarten
    -    I teach/I taught in primary education
    -    I teach/I taught in middle school, high school
    -    I never taught

II. Informații despre ierbarul virtual
3.   What are the advantages of making a virtual herbarium?
    -    easy to build
    -    requires a short time
    -    the possibility to choose from several sources of information
    -    does not require travel in the field
4.   What other advantages have you noticed in making a virtual herbarium? Please write them in the box below.
5.   What are the disadvantages of making a virtual herbarium?

- there is no interaction with the natural environment
- interaction with group members is very low
- the sources of the information cannot be verified
- too much information is difficult to manage
- in the case of children, adult supervision is required

6.   What other disadvantages have you noticed in making a virtual herbarium? Please write them in the box below.

7.   What skills do you think are aimed at being formed by creating a virtual herbarium?
- to investigate
- to experiment
- to be documented
- to cooperate
- to make a herbarium

8.   What other skills do you think can be formed by creating a virtual herbarium? Please write them in the box below.

9.   What skills do you think can be formed by creating a virtual herbarium?
- to observe
- to use equipment
- scientific documentation and scientific reasoning
- to work in a team
- to take care of the environment

10.   What other skills can be formed by creating a virtual herbarium? Please write them in the box below.

11.   What attitudes can be formed by creating a virtual herbarium?
- compliance with the requirements
- assuming errors, gaps or failure
- to work methodically
- positive attitudes towards the environment
- punctuality

12.   What other attitudes can be formed by creating a virtual herbarium? Please write them in the box below.

13.   What criteria would you use to be able to evaluate this activity if you were doing it with students?
- project layout (page framing, image positioning, etc.)
- the correctness of scientific information
- the importance of information
- grammatical and lexical correctness etc.
- specifying the title, sources of information/ bibliography
- image distortion/ non-distortion
- originality
- compliance with the requirements

14.   What other criteria would you use to evaluate this activity if you were doing it with students? Please write them in the box below.

15.   How much time did you spend creating the virtual herbarium? (choose only one answer)
- less than 30 minutes
- 30-60 minutes
- 60-90 minutes
- 90-120 minutes
- over 120 minutes

16.   What difficulties did you meet in creating the virtual herbarium?

17.   How useful do you think this virtual herbarium is for teaching?

(choose only one answer)
- not at all
- a little
- so and so
- useful
- very useful

18. In which subjects can you create and use this virtual herbarium?
- Science
- Geography
- Romanian language
- Technological education
- Mathematics and environmental exploration

19. In what other subjects can this virtual herbarium be made and used? Please write them in the box below.

III. Information about the classic herbarium

20. What are the advantages of making a classic herbarium?
- the natural environment is explored
- easier collaboration between team members
- memories are created
- creativity is stimulated

21. What other advantages do you think there are in making a classic herbarium? Please write them in the box below.

22. What are the disadvantages of making a classic herbarium?
- some regions are dangerous
- the limits imposed by space
- the sources of the information cannot be verified
- if not properly pressed, the plants can deteriorate

23. What other disadvantages are there in making a classic herbarium? Please write them in the box below.

24. How long do you think it takes to make a classic herb?
- one week
- one month
- a semester
- a school year

25. If you would like to add something else, please write in the box below.