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EDUCATION ON MINERAL RAW MATERIALS THROUGH RISBRIEFCASE AS A NON-CONVENTIONAL TEACHING TOOL

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Abstract

Mineral raw materials are indispensable in our daily lives, e.g., food, cosmetics, clothing, medicine, mobile phones, vehicles, electrical appliances, construction materials, fertilizers, jewelry, etc., for our well-being and for a prosperous society. Securing a responsible supply from domestic sources is a key element in achieving reliable raw material security for Europe. Mineral raw materials are crucial for clean energy technologies – from wind turbines and solar panels to electric vehicles and battery storage – they require a wide range of minerals and metals and they are essential for reaching the Green Deal goals of a climate-neutral society by 2050. In fact, the more ambitious climate targets are, the more minerals are needed for clean energy transition. Since mineral consumption in general is intensifying, there is an urgent need to educate the society, especially children, on these topics. Nowadays, in Albania, school curricula lack these topics, although recycling and circular economy are sporadically dealt with. The RISBriefcase project aims to enhance the perception of mining activities and foster awareness about the vital role minerals and mining play in our society. Engaging non-conventional teaching tools designed for students aged 6 to 14, it is applying the all-inclusive approach on this matter by teaching children about mineral properties and their uses, critical raw materials, circular economy approaches and use of secondary raw materials, sustainable mining, gender equality, and a variety of career opportunities in the mining sector.

Key words: *Mineral, raw materials, RISBRIEFCASE, mining activity, non-conventional teaching tools.*

INTRODUCTION

Albania is a country in southeastern Europe, on the western part of the Balkan Peninsula. It borders Montenegro (172 km) to the northwest, Kosovo (115 km) to the northeast, Macedonia (151 km) to the east, and Greece (282 km) to the south and southeast. It is washed by the Adriatic and Ionian Seas. The total area is 28,748 square kilometers, and its capital is TIRANA. Albania is connected by road with all the neighboring countries and with the UTEC international network, which enables the import and export of electricity. Albania is connected by rail with Montenegro. The export and import of goods by sea is done through three ports: Durrës, Shëngjin and Vlorë. Albania is known for its mineral resources. Most of them have been discovered and exploited from ancient times to date. There are also other deposits for which careful studies and evaluation of geological reserves should be conducted. The mining activity is mainly based on the extraction of minerals of chromium, copper, iron-nickel, and nickel-silicate. The processing of minerals in the country is low. Private companies and private investments enable the enrichment of chrome and copper ore and the production of ferrochrome.

The current state of the geological and exploitable reserves of different minerals, their degree of processing and the profit achieved make it necessary to conduct further geological, mining, and technological studies, as well as to carry out various research works that would enable the increase of the amount of different ore reserves, the use of low-grade minerals, and their rational processing.

Mineral raw materials are one of the most important aspects to satisfy the needs of modern civilizations. They are crucial to almost all industries. Just as important as their use is the rational administration of mineral resources. Up to now, several documents and projects have been developed

to create policies and strategies for rational and more efficient extraction of raw materials and their processing in production processes, with a particular focus on environmental protection. Mineral raw materials are essential to our daily lives.

Whether it be copper for electricity cables, sand necessary for glass and concrete, clay for bricks and tiles, rare earths for the loudspeakers in our mobile phones, kaolin for paper and plates, iron for kitchenware (e.g., cutlery, plates, magnets on the refrigerator), mica and talc for cosmetics (e.g. powder, toothpaste, nail polish), halite for food (e.g. salt) etc., all the mineral resources we need to make these everyday objects are found in rocks and minerals extracted from the subsurface. According to Eurostat today, in 2021, the domestic material consumption of the EU economy stood at around 14.1 tons per person, up 4% compared with 2020 (13.6 tons per person). Non-metallic minerals accounted for more than half of the domestic material consumption (53%) in 2021, biomass for almost a quarter (23%), fossil energy materials for close to a fifth (18%), and metal ores for 6%. Additionally, due to worldwide population growth, the overall demand for raw materials is growing and their availability needs to be ensured. For a major part of society, especially for children, mining activity and mineral resources remain an unknown subject. In Albania, although children are strongly educated in aspects related to geography, biology, or other similar subjects, they are no longer taught certain topics like Earth Sciences. Earth sciences in general, geology, have less and less weight in schools. Even though society in general has knowledge on the origin of mineral raw materials, it is not entirely conscious of the relationship between mining and the materials used daily, more importantly, the possibilities of recycling and reuse of metals. In contrast to that, schools are making many efforts to teach students about paper, plastic, and glass recycling, etc. In this paper, we strongly suggest including this content also in school syllabus, since its elimination from the education system tends to general lack of knowledge in several key aspects: the presence of mines in Albania and Europe, the generation of economic resources and jobs in communities in sustainable conditions and environmental protection, the dependence on mineral raw materials but also in the impact of critical raw materials and conflict minerals. Albania is a country with a rich mineral heritage. The mining sector plays a vital role in the Albanian economy, as it has a long tradition of extracting and processing various minerals. Some of the main minerals that are mined and processed in Albania are chrome, copper, iron-nickel, coal, etc. Albania also has reserves of bauxites, phosphorites, salts, brown coal, fresh and refractory dunites, volcanic glass, kaolines and other nonmetallic minerals that have economic value. The history of the mining industry in Albania can be divided into three main stages:

The first stage covers the period until the end of World War II, which saw two important achievements. In 1922, the first Geological Map of Albania was created, which was also the first of its kind in the Balkans. In 1929, the first Mining Law of the Albanian Kingdom was passed, which allowed the exploration and/or exploitation of mineral resources in Albania;

The second stage (1944-1994) corresponds to the period when the mining activity was managed by state-owned enterprises and the concept of mining privatization did not exist.

The third stage spans from 1994 to the present. It marks the start of the mining privatization, after the approval of the Albanian Mining Law.

High school and primary school students have little or no knowledge about minerals and geosciences in general. They are not familiar with terms related to geosciences or professions such as geologist engineer, mining engineer, etc. The main reason for this information gap is the lack of curricula in pre-university education that cover earth sciences or provide suitable information on them.

A key objective is training and education, collaboration between private and public sectors, stakeholders etc. All these cross-cutting activities are of great importance for preparing the future. Thus, we will raise awareness of the raw materials for modern life and empower the next generation of innovators and changemakers in the raw materials sector.

The strategy, presented in March 2020, aims to drive Europe's competitiveness and its strategic autonomy at a time of moving geopolitical plates and increasing global competition [1]. It will provide skills for industry (a fundamental pillar for the future of mining in Europe) as the development of the Horizon 2020 project INTERMIN is proving by improving the quality and relevance of training and education, making skills more comparable, and easing the recognition of qualification, facilitate access to finance for innovative ideas via the Investment Plan, Horizon 2020 and COSME, promote entrepreneurship, support workplace innovation, empower citizens and communities with social innovation, revitalize EU regions, support digital transformation of European Industry, promote energy

and resource efficient technologies, support the development and uptake of Key Enabling Technologies such as new biomaterials, metals, polymers and advanced manufacturing, boost industry uptake of space data and promoting high level industrial dialogues (Industry 2030 High Level Industrial Round table, Strategic Forum for Important Projects of Common European Interest, Transformation of EU energy intensive industries for a climate neutral economy by 2050) [2-4]. All these plans will no doubt affect the mining industry in skills, technology, and energy consumption.

MATERIALS AND METHODS

RISBRIEFCASE project, a non-conventional teaching tools about minerals

The former BRIEFCASE project represents a project whose main goal is to bridge the gap between minerals, mining, and society bringing them closer to children, strengthening the knowledge on mineral raw materials and their uses and values in our everyday life. Imagine a world where everybody knows the origins of daily minerals and the impact of their choices on resource-rich nations. It was followed up by two other projects 3DBRIEFCASE and RISBRIEFCASE, all supported by the EIT Raw Materials Academy and co-funded by the European Union (Fig. 1, Fig. 2) [5-9].

Figure 1. Logos of each project

Figure 2. Briefcase project is an EIT Raw Materials celebrated initiatives and co-funded by European Union

The original BRIEFCASE is a novel product that has been firstly successfully used by the Spanish Geo-Mining Museum (IGME/CSIC, Spain) and by the Styrian Center of Environmental Education (Austria) during previous years. Both focus on the dissemination of knowledge of raw materials and minerals among students [10].

The partners are represented by eleven institutions from six EU countries, specifically, Spain (leader), Austria, Slovenia, Slovakia, Portugal, Italy, and six task partners and collaborators, among which is Albania. These kinds of projects inform, educate, and reach out to school children, to the public, non-governmental organizations, and decision-makers across Europe. The RISBriefcase method transforms education, enabling students to identify minerals and reflect on ethical corporate practices [11-13]. It is more than learning; it is enhancing perceptions of sustainable mining with the social license to operate (SLO).

The project is oriented specifically to primary school pupils aged 6 to 14 and training their teachers. Through innovative popular science, the RISBriefcase project seeks to explain mining activities and mineral applications to society. It takes in count important considerations like the NIMBY (Not in My Backyard) concept and “mining in equal conditions,” as well as to the problem of conflict minerals or blood minerals.

In the pre-university system, the level of knowledge related to the earth sciences in general and the mineral specifically are very vague due to the lack of curricula at this level of education. In Albanian schools, mineral knowledge finds integration within geography courses, encompassing only a singular chapter exclusively dedicated to this subject. The teaching method employed is traditional and theoretical, failing to capture interest in students. The RISBRIEFCASE project takes its name from a collection of briefcases containing mineral specimens, everyday products made from these minerals, and informational materials.

Geosciences cover a broad spectrum of topics, from finding and extracting metallic and non-metallic minerals, to processing and delivering them to the final consumers. This project faces many challenges in terms of the diversity and complexity of the subjects, as well as the need to adapt and customize the suitcases for each partner of the consortium. Based on the geology, mineral resources, and other factors of their regions, the partners agreed to design their suitcases according to their specific needs and expectations. After a round table discussion, the working group chose to focus on three main themes for the briefcases: industrial metallic and non-metallic minerals, fossils from different geological ages and daily use - mineral derived products briefcase (Figs. 1-3). In the following paragraphs, we provide detailed description of the physical and digital non-conventional tools used on the workshops and individually on-line.

1. Hands-on tools

Hands-on learning is a form of education in which children learn by doing. Instead of listening to a teacher or instructor, hands-on experience is a kind opportunity for pupils, where they can take the minerals, observe, touch, and compare with each other. It is important to educate younger generations about raw materials and their uses in our daily life in their hands for close and detailed observation, e.g., color, hardness, weight, comparison between minerals, crystal structure, etc. Hands-on experience with thematic briefcases provides additional value to learning since it has positive effects on the child's memory. An article published by PBS regarding hands-on learning noted:

"The more avenues there are to receive data through the senses, the more connections the brain can make. The more connections that are made, the better a learner can understand a new idea. This holds not only for primary age learners, but through adulthood."

Within the RISBRIEFCASE project, focusing on the most representable minerals of our country, we have developed three thematic briefcases focusing on industrial metallic and non-metallic minerals, daily use - mineral derived briefcase, and fossils from different geological ages [14, 15, 16]. Beside the two most common briefcases, we added also the third type of briefcase of fossils because fossils are like a puzzle, providing essential fossil facts for kids and adults. They tell us about the different plants, animals, and climates that existed millions, even billions, of years ago. For example, we explained to the kids that if we found a fossil of a sea creature in a desert, it indicates that the location was once underwater. Based on the pupils age the "daily use - mineral derived briefcase" can be adapted, e.g., for younger pupils in primary school only basic minerals are used, meanwhile older pupils/students (secondary school) work with the whole briefcase.

Figure 3. Industrial minerals briefcase

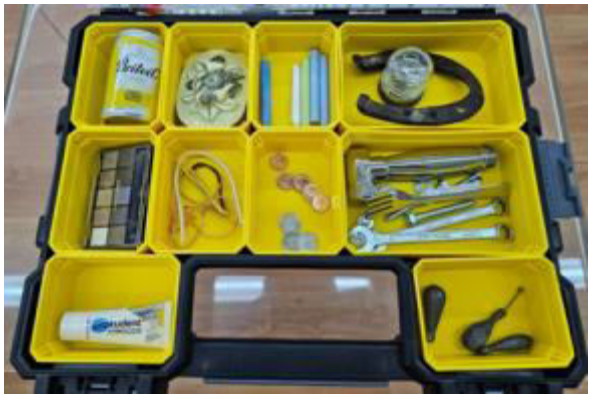

Figure 4. Daily use - mineral derived products briefcase

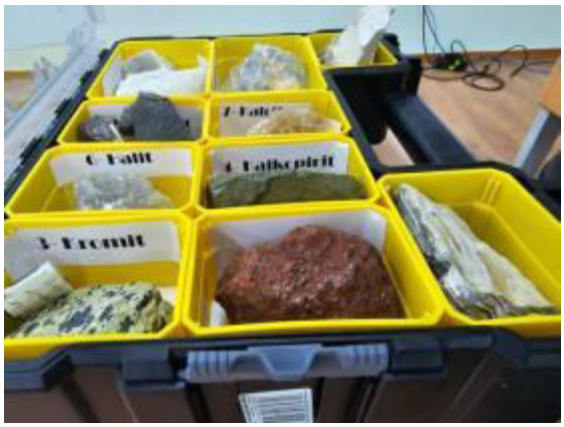

Figure 5. Metallic and non-metallic minerals briefcase

2. Workshop in Albania

The main aim of the workshop was to show and identify different minerals and the ore elements that compose them and some everyday objects made with them. In this way, students guided by teachers realize that many minerals are used in daily life. This workshop is a complementary activity to the curricula of primary and secondary students. The problem that arises is that not all schools can include these workshops and that they are designated for a period. Therefore, one of the lines of work is that this type of teaching about the uses of the general subjects and objects that they compose are compulsory incorporated into the official and regulated subjects.

The workshop aimed to teach the students about various minerals and ores, and how they are used to make common objects and to train future trainers. The students learned to appreciate the role of minerals in everyday life, with the help of the mentors and their teachers. The workshop was an extra activity for primary and secondary students in summer school. However, not all schools can offer such workshops, and they are only available for a limited time. Therefore, one of the goals was to make this kind of education more accessible and mandatory for all students. There were 70 students from primary and secondary school, aged 6 to 15. About half of them were girls. There were also four teachers who joined the workshop. The total number of participants was 74.

The workshop used two briefcases: one with metallic minerals and objects made from them, and another with fossils. Both briefcases were developed by FGM and PUT.

The workshop had five main sessions:

1. A brief introduction to geology, mining, and the RISBriefcase Project.
2. An explanation of how to play the online Briefcase game (https://www.thebriefcasegame.eu/home).
3. A demonstration of the two briefcases by the mentors of FGM.
4. Experiments to show the physical and chemical properties of the elements, activities that can be defined as hands-on activities.
5. A distribution of certificates of participation and medals for the winners of the games and most active students.

The mentors introduced themselves and their roles at the beginning of the workshop. They also presented the RISBriefcase project and its objectives. The students were divided into smaller groups, where some of them learned to play the online briefcase game and others were engaged in recognizing minerals and objects produced from these minerals. The children were given information on the names of ores, the metals they contain, the chemical symbol of the main element, the products that are produced and used in our everyday life. The other group learned about the fossils, the time they were formed, the conditions and the names of the fossils. The pupils showed a high interest and were interactive during the workshops, raising up several questions (Fig. 6).

Figure 6. Moments of the workshop, where beside explanation different experiments were performed.

3. Digital tools

We live in a digital age where technology has transformed our daily lives. The pupils or students have access to various devices such as a PC, laptop, iPad, or mobile phone that enable them to connect with the world. These devices allow us to access a vast amount of information quickly and learn new things in real time. Digital devices are essential tools for education and learning in the modern era. The original Briefcase project developed a digital game that helped pupils in elementary, secondary and media school to learn about minerals and mineral resources in an efficient way. The game of "The Briefcase of mineral applications" aims to familiarize the player with the minerals that are used in the manufacture of everyday objects. To do this, you will find in the suitcase 18 minerals on one side and 18 objects on the other. The player must match these minerals to everyday objects. This game called “the Briefcase game,” which was originally in English, was translated and revised into Albanian language. The game is translated into 35 different languages, so that students can learn and use the names of minerals and their properties in their native language. The project team also created a manual for the natural science teachers at the pre-university system to guide them on how to use the game with their students. The game is easy and individual, and it rewards the students for each right answer or gives them another chance if they answer wrong. The goal of the game is for students to identify minerals through the things they use every day. The game is online and the students can see their scores compared to other students in Europe. This makes the game more fun and competitive for students (Figs. 7-9).

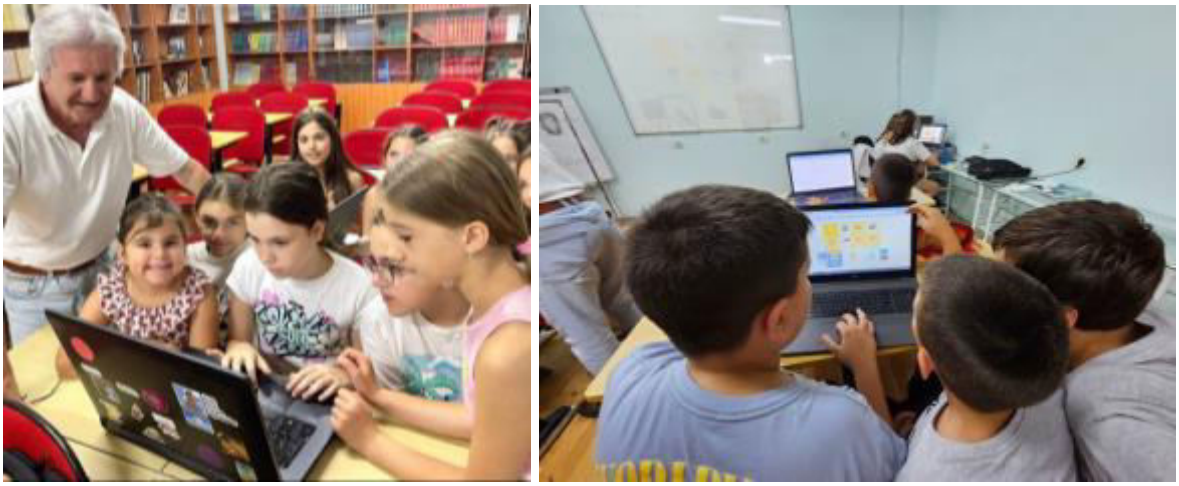

Figure 7. Virtual Briefcase game of minerals played by pupils during the workshop

They need to discover what minerals are used for in the manufacture of everyday objects and match an element/mineral with an object that is made from this element. In the game for younger pupils, the objects (i.e., toothpaste, wire, soda can, mobile battery, fertilizer, rings, and fridge magnet) need to be properly matched with the elements/minerals (i.e., copper/malachite, potassium/potash, lithium /lepidolite, aluminum/cyanide, gold/native gold, iron/magnetite, and fluorine/fluorite). In the version for older pupils, the objects (i.e. fireworks, solar panels, galvanized steel, X-ray protection vest, cup, automobile catalyst, paint, battery, rings, dental tools, thermometer, wind turbines, wire, horseshoe, can toothpaste, wrapping foil and fertilizer) also need to be properly matched to the elements/minerals (i.e. magnesium/magnesite, iron/magnetite, lead/galena, magnesium/talc, platinum/sperrylite, gold/ native gold, silicon/quartz, fluorine/fluorite, lithium/lepidolite, zinc/ sphalerite/ tin blende, tin/cassiterite, copper/malachite, aluminum/kyanite, aluminum and silicon/feldspar, mercury/cinnabar, tungsten/wolframite, potassium/potash and cobalt/skutterudite) [13].

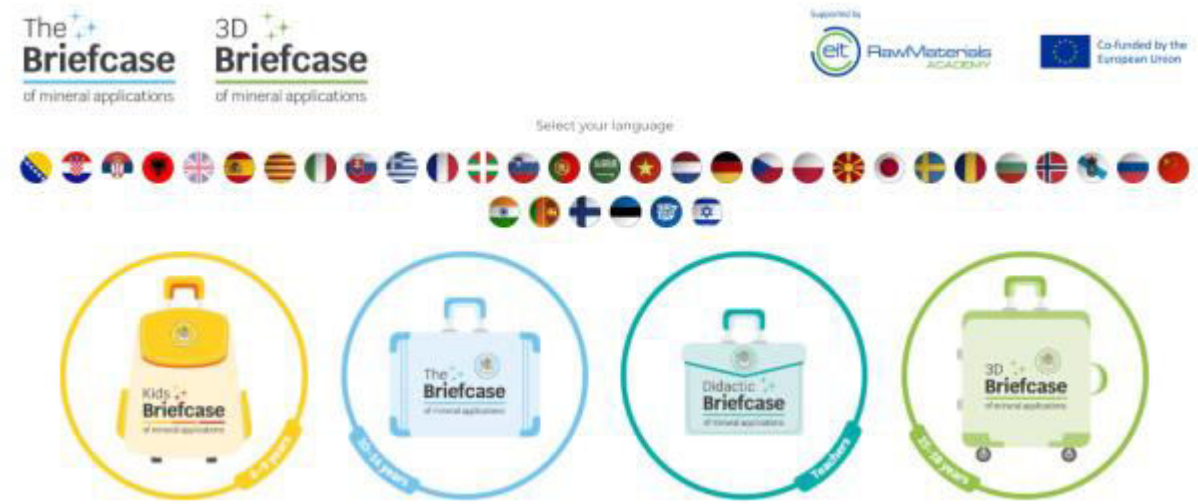

Figure 8. Kids, 10-14 and 15-18-years old pupil, teacher briefcase of the online game https://www.thebriefcasegame.eu/

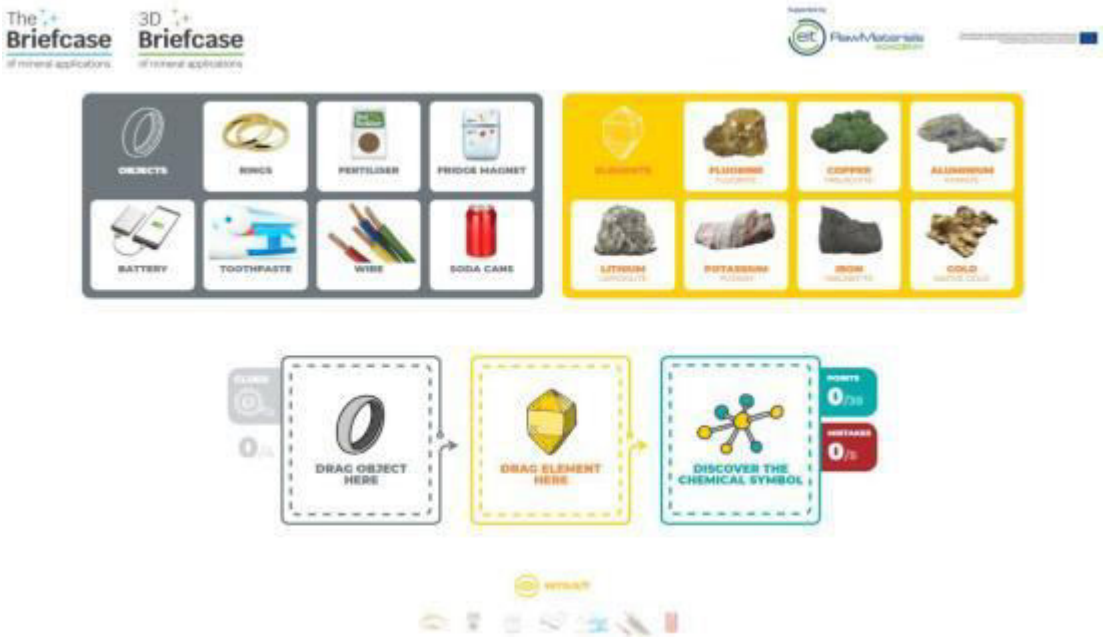

Figure 9. One of graphic user interfaces in the online game https://www.thebriefcasegame.eu/

CONCLUSIONS

The National Program for Extracurricular Activities (JOM) is a program approved by the Albanian government to promote and develop extracurricular activities in educational institutions of pre-university education, schools of basic education and higher secondary education. This program aims to provide additional opportunities for students to develop their skills in various fields such as sports, arts, sciences, technology, engineering, and mathematics. In addition, the program aims to help improve the quality of education and increase students interest in learning.

The project RISBriefcase aims to integrate students from all age groups, into the field of geosciences by offering short-term courses provided by academic staff of the Faculty of Mining Geology. The courses will include experimental demonstrations in an open area, visits to geoheritage sites, short videos explaining the properties of minerals and their applications, etc.

The project also involves training of teachers on how to use the Briefcase of minerals as a non-conventional teaching tool, aiming to continue the education process after the project ends.

The project is part of a European initiative to promote the interest of children in geosciences, as Europe recognizes the importance of raw materials for its economic development and sustainability.

The Briefcase contains samples of metal minerals and the objects produced by those commodities, selected based on their significance, relevance, and demonstrability in classroom settings and with simple instruments, but especially those exploited within the Albanian territory.

The Briefcase is a model for an innovative and interactive way of teaching students about minerals, fossils, and rocks, and their role in society and the environment.

The project encourages the collaboration among academia, business, and industry in the field of geology and mining, and highlights the main areas where education should be focused: 1) mining activities and their benefits; 2) mining impacts and their mitigation, efficient use of mineral resources, circular economy, social license to operate, etc.

The **EIT RawMaterials** is a Knowledge and Innovation Community (KIC) that aims to enhance innovation in the raw materials sector by sharing knowledge, facilitating matchmaking activities, developing innovative technologies, and supporting business creation. It is part of the European Institute of Innovation and Technology (EIT), which is an integral part of the new Horizon Europe program 2021-2027. The EIT RawMaterials community brings together leading companies, universities, and research centers across Europe to address existing and future societal challenges.

The EIT RawMaterials has a new strategy for 2021-2027 that puts increased emphasis on its regional dimension. The strengthened Regional Innovation Scheme provides targeted support to countries that lag in innovation performance. Additionally, a new pilot initiative will increase the entrepreneurial and innovation capacity of higher education institutions. The EIT RawMaterials will also manage the stakeholder consultation process across the entire raw materials value chain, working with an innovation project-driven community. This community brings together more than 150 industrial and non-industrial actors with the common objective of securing the supply of sustainable raw and advanced materials for industrial ecosystems to build Europe's resilience and competitiveness.

For more information about EIT RawMaterials, you can visit their official website.

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Disclaimer

The content of this paper does not reflect the official opinion of the European Union. Responsibility for the information and views expressed therein lies entirely with the authors.

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ЕДУКАЦИЈА ЗА МИНЕРАЛНИ СУРОВИНИ ПРЕКУ RISBRIEFCASE КАКО НЕКОНВЕНЦИОНАЛНА НАСТАВНА АЛАТКА

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Резиме

Минералните суровини се незаменливи во нашиот секојдневен живот, на пример, храна, козметика, облека, лекови, мобилни телефони, возила, електрични апарати, градежни материјали, ѓубрива, накит итн., за нашата благосостојба и за просперитетно општество. Обезбедувањето одговорно снабдување од домашни извори е клучен елемент за постигнување сигурност за минерални суровини за Европа. Минералните суровини се клучни за технологиите за чиста енергија - од турбини на ветер и соларни панели до електрични возила и акумулатори - тие бараат широк спектар на минерали и метали и тие се од суштинско значење за постигнување на целите на зелениот договор за климатско неутрално општество до 2050 година. Всушност, колку се поамбициозни климатските цели, толку повеќе минерали се потребни за транзиција на чиста енергија. Со оглед на тоа што потрошувачката на минерали, воопшто, се интензивира, постои итна потреба да се едуцира општеството, особено децата, на овие теми. Во денешно време, во Албанија, на училишните програми им недостасуваат овие теми, иако рециклирањето и циркуларната економија повремено се занимаваат со нив. Проектот RISBriefcase има за цел да ја подобри перцепцијата за рударските активности и да ја поттикне свеста за виталната улога на минералите и рударството во нашето општество. Вклучувајќи ги неконвенционалните наставни алатки наменети за ученици на возраст од 6 до 14 години, се применува пристапот кој е сеопфатен по ова прашање со тоа што ги учи децата за својствата на минералите и нивната употреба, критичните суровини, пристапите на циркуларната економија и употребата на секундарни суровини, одржливо рударство, родовата еднаквост и различни можности за кариера во рударскиот сектор.

Клучни зборови: *Минерали, суровини, RISBRIEFCASE, рудничка активност, неконвенционални наставни алатки.*