



Sınrsız Eđitim ve Arařtırma Dergisi



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Dear Readers,

We are delighted to present you the July 2023 issue of the Journal of Limitless Education and Research.

The aim of our Journal, which has been published continually by the Limitless Education and Research Association (SEAD) since 2016, is to contribute scientifically to the field of education and research. For this purpose, priority is given to publishing theoretical and applied studies and sharing scientific information at national and international level.

The Limitless Journal of Education and Research is published three times a year, scanned in various national and international indexes, and receives numerous citations. Our Journal with an impact factor of 0.5 in SOBIAD 2021 is among the first 90 journals published in our country.

SEAD Journal is published with the scientific contributions and support of academicians working in Turkey and abroad, such as articles, research and projects. Our journal has been publishing for eight years without compromising its academic and scientific quality. We would like to thank all the editors, writers, referees and translators who contributed to the preparation and publication of our journal.

In this issue of our journal, as in other issues, six scientific research and articles related to education are included. These studies are presented in two languages, Turkish and English.

We hope that our journal will make significant contributions to the field of education and research. With our best regards.

LIMITLESS EDUCATION AND RESEARCH ASSOCIATION



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Deđerli Okuyucular,

Sizlere Sınrsız Eğitim ve Araştırma Dergisinin Temmuz 2023 sayısını sunmaktan mutluluk duyuyoruz.

Sınrsız Eğitim ve Araştırma Derneđi (SEAD) tarafından 2016 yılından bu yana kesintisiz olarak yayınlanan Dergimizin amacı, eğitim ve araştırma alanına bilimsel yönden katkı sağlamaktır. Bu amaçla kuramsal ve uygulamalı çalışmalarını yayınlamaya, bilimsel bilgileri ulusal ve uluslararası düzeyde paylaşmaya öncelik verilmektedir.

Sınrsız Eğitim ve Araştırma Dergisi, yılda üç sayı olarak yayınlanmakta, çeşitli ulusal ve uluslararası indekslerde taranmakta ve çok sayıda atıf almaktadır. SOBIAD 2021 yılı etki faktörü 0,5 olan Dergimiz, ülkemizde yayınlanan ilk 90 dergi arasında yer almaktadır.

SEAD Dergisi, yurt içi ve yurt dışında görevli akademisyenlerin makale, araştırma, proje gibi bilimsel katkı ve destekleriyle yayınlanmaktadır. Akademik ve bilimsel kalitesinden ödün vermeden sekiz yıldır yayın hayatını sürdürmektedir. Dergimizin hazırlanması ve yayınlanmasında emeđi geçen bütün editör, yazar, hakem ve çevirmenlere teşekkür ediyoruz.

Dergimizin bu sayısında diđer sayılarda olduđu gibi eğitimle ilgili altı bilimsel araştırma ve makaleye yer verilmiştir. Bu çalışmalar Türkçe ve İngilizce olarak iki dilde sunulmuştur.

Dergimizin eğitim ve araştırma alanına önemli katkılar getirmesini diliyoruz. Saygılarımızla.

SINIRSIZ EĐİTİM VE ARAŞTIRMA DERNEĐİ

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The Position and Importance of Geology Education in the Schools

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Abstract: Many countries are currently focusing on obtaining financial income through the use of underground resources and promoting awareness of natural hazards. However, geology education, including these issues, is often limited to superficial coverage under geography courses in countries like Greece, China, Indonesia, and Slovenia. In contrast, some countries like Portugal struggles to engage students in their secondary school geology curriculum. While some consider that geology education is too complex for primary and secondary school students, there is evidence that new technologies, such as VR and gaming, can facilitate geology education. This review article aims to clarify the importance of geology education in schools, discussing its scope and the different approaches taken in various countries. A literature review was conducted in this study. It is obvious that geology education should be included in the school curriculum for all countries to raise awareness among primary and secondary students. Most importantly, geology education is essential for countries rich in underground resources and at risk for geological events such as earthquakes.

Keywords: Geology, Education, School, School curriculum, Primary school, Secondary school.

1. Introduction

Geology is a multi-layered science that studies the origin and evolution of the earth (Elias & Alderton, 2020). The science of geology is basically divided into four departments as general geology, mineralogy and petrography, mineral deposits, and applied geology. General geology examines the changes in the earth's crust caused by internal and external forces. Structural geology-tectonic in general geology discipline, in other words, earthquakes; stratigraphy, that is, the science that studies the geological units that shape the earth; paleontology, that is, the science of fossils, has sub-disciplines that examine the time factor in the formation of the earth. Mineralogy and petrography department is a science that examines the chemical structure of the minerals that make up the earth's crust and the rocks formed by the combination of minerals in the geological process. On the other hand, mineral deposits are a science that examines the formation, detection, and economic evaluation of metallic mineral deposits, industrial raw materials, and energy resources, which are indispensable in our daily life. Applied geology, on the other hand, is a branch of science that is in close relationship with renewable energy sources, such as the examination and evaluation of the grounds on which wind energy turbines and geothermal energy production facilities would be built.

According to USGS (2016) data, approximately 20,000 earthquakes occur each year, and approximately 55 earthquakes occur per day. Fifteen of these earthquakes have a magnitude of 7.0 to 8.0 or greater, meaning they have devastating effects. In the last 20 years, quite destructive earthquakes have occurred. More than 200,000 people lost their lives as a result of the Mw 9.1- 9.3 magnitude earthquake in Indonesia in 2004 and the tsunami disaster that followed (Satake, 2014). In the earthquake that took place in Mw 7.0 Haiti on January 12, 2010, approximately 300,000 people lost their lives, and almost half of the buildings in the settlements close to the epicenter were damaged (DesRoches et al., 2011). On February 6, 2023, two earthquakes occurred in Kahramanmaraş (Turkey) (Mw 7.8), and 9 hours later, the epicenter was Hatay (Turkey) (Mw 7.6), and over 50,000 people died. The earthquake also affected Syria, Turkey's border neighbor, and casualties occurred (Hussain et al., 2023). These earthquakes, which occur in quite large geographies, cause great economic losses as well as loss of life. The direct damage of 2 earthquakes that occurred in Turkey on February 6, 2023, is 34.2 billion dollars (approximately 4 percent of Turkey's 2021 GDP). Global experiences show that this cost may be two times higher when factors such as material prices and labor after the disaster are considered (World Bank, 2023). It is a known fact that earthquakes or ground shaking do not cause the death of people, but rather that buildings and objects collapsing on people cause

death (Arlıkatti et al., 2019). For this reason, an individual who is educated with earthquake awareness at a young age will increase the probability of survival by learning what to do in the event of an earthquake. In addition, individuals who grow up with this awareness will act much more consciously when they come to local administrators or decision-making positions, even if they are not experts in earthquakes. In addition to earthquakes, these students will be familiar with underground resources with geology education. The use of underground resources is as important as earthquake awareness.

Economically significant underground resources can be listed as iron and iron alloy metals (iron, cobalt, manganese, etc.), non-ferrous metals (aluminum, arsenic, bauxite, etc.), precious metals (gold, silver, platinum group elements), industrial raw materials (diamonds, graphite, salt, etc.) and mineral fuels (oil, natural gas, coal, uranium, etc.). Between 1984 and 2015, it was observed that the total production increased from approximately 9.3 billion metric tons to 17.2 billion metric tons. The largest producers are countries such as China, the United States, Russia, and Australia (Reichl et al., 2017). The approximate revenues of all mining companies in the world are 1.235 trillion dollars, and the total revenue of the best mining companies is 925 billion dollars (Garside, 2022). Considering the many metals, industrial raw materials, and energy resources, we use in our daily life, the importance of geology education at an early age emerges. In addition to underground resources, renewable energy sources are another critical element that geology education takes into account.

Renewable energy sources (such as geothermal and wind energy) are important sources that naturally repeat themselves and provide sustainable heat and energy. Furthermore, their importance is increasing day by day (Twidell, 2021). Although energy sources that negatively affect the environment, such as oil, gas, and coal, continue to exist for the next few decades (Abas et al., 2015; Covert et al., 2016), with renewable energy resources policies and new technologies, the use of fossil fuels will decrease (Helm, 2016). Geothermal and wind energy have a significant percentage in renewable energy sources, and it is thought that they will still be the dominant energy sources in 2050 (Moriarty et al., 2019). In the transition from the dominant use of fossil fuels to renewable energy sources, the inclusion of these subjects in the curriculum is essential for adaptation to the changing world. The fact that many fields, such as renewable energy, are connected to geology education suggests the importance of geology education for students.

In the framework of the importance mentioned above, this article explains how geology education is given to primary and secondary school students in the world and how much importance is attached to it. In the literature, there is no review of geology education in schools. Thus, this research aims to explore and shed light on the position and importance of geology education in schools.

2. Geology Education in the World

Throughout the world, educational institutions have adopted diverse methodologies when it comes to teaching geology, leading to a plethora of conflicting views in academic literature. Therefore, it is crucial to delve into each country's stance on incorporating geology education into their curricula, to better understand the discrepancies that exist.

In some countries, teaching geology in schools is not a common practice. According to Ogunniyi and Rollnick (2015), African countries have experienced a shortage of science teachers, including those who can teach geology, since the 1950s. Therefore, providing geology education in schools can be a challenge in these countries. On the other hand, some countries with ample resources choose not to offer comprehensive geology education in schools. Greece is one such country where geology education is limited and overlooked in the curriculum (Mosios et al., 2023). Similarly, Brooke and Edgington (2020) report that the United Kingdom has gradually phased out geology education from the school curriculum, with few students choosing to take any remaining geology-related courses. Portugal, unlike many European countries, offers geology education as a separate curriculum and course in high schools, but students are not inclined to choose it as an option (Reis et al., 2014). As a result, geology education is limited in many countries, and even where it is included in the curriculum, students may not be motivated to pursue it.

Pražáková and Pavlasová's (2017) research indicates that non-formal geology education is becoming increasingly popular in the Czech Republic, with scientific institutions acknowledging and supporting this trend. However, formal geology education is not keeping up with this development. This creates potential problems, as relying solely on non-formal geology education may not be sufficient to support students, especially since it is not compulsory and not provided by schools. Thus, it is crucial to provide formal geology education in schools, which can complement non-formal geology education. However, it is equally important to ensure that the level of geology education provided in schools is adequate. This is a concern in several countries, including China, Slovenia, and Indonesia. For instance, in China, geology topics are

included in the geography curriculum for primary and secondary school levels (Gong et al., 2020). Similarly, in Slovenia, geology topics are found to be insufficiently covered in primary school student textbooks across various courses (Bedjanič et al., 2018). In Indonesia, geology topics are limited to only one chapter in geography textbooks for primary and secondary school levels (Maryanti et al., 2021). In these countries, geology education is often restricted to different courses, such as geography, without adequate coverage. Therefore, it is beneficial to provide geology education as a separate course, which should be comprehensive and cover all aspects of the subject. However, there is a cost associated with this. Therefore, it is important to assess the expenses and advantages of investing in geology education at this stage.

3. Advantages of Geology Education in the Schools

Gogoi et al. (2016) highlight that geology education plays a crucial role in the identification and utilization of oil, gas, and mineral resources, as well as the comprehension of natural hazards, especially for developing countries like India. However, the significance of geology education is not limited to developing countries, as developed countries also require it to efficiently use their resources. Nonetheless, the importance of geology education varies depending on each country's specific circumstances. For instance, Referowska-Chodak (2020) points out that Poland's numerous natural places underscore the need for multidisciplinary education, including geology education. Therefore, evaluating a country's richness in resources and diversity of natural hazards is crucial in determining the scope of geology education. Moreover, emphasizing specific subjects in geology education can also benefit a country, such as focusing on natural hazards for those living in earthquake-prone areas. When countries provide a holistic geology education, students can gain a deeper understanding of their requirements. Therefore, considering geology education as a whole is highly beneficial in providing a general framework that caters to the diverse needs of students across different countries.

Geology education should be evaluated, particularly for students. According to research conducted by Buldur et al. (2020) with 60 Turkish students, students tend to develop a positive attitude towards renewable energy during the project. However, it may be more advantageous to include geology education directly in the school curriculum, rather than just as projects. This is because geology education is directly linked to crucial resources such as renewable energy and destructive hazards like earthquakes.

Furthermore, an additional study conducted by Zafeiropoulos et al. (2021) examined the most important aspects of geoeducation according to high school students who received geology education. This can be seen in Figure 1. This study, which included 612 students, revealed that students placed high importance on the geoheritage, responsible use of resources, and disaster awareness. The study also highlighted that geology education has a broad scope and can instill various essential ideas in students. Therefore, geology education that is not limited to a small part of another subject can be invaluable from primary to secondary school.

**THE MOST IMPORTANT ASPECTS OF GEOEDUCATION
ACCORDING THE OPINION OF PUPILS & STUDENTS
N=612**

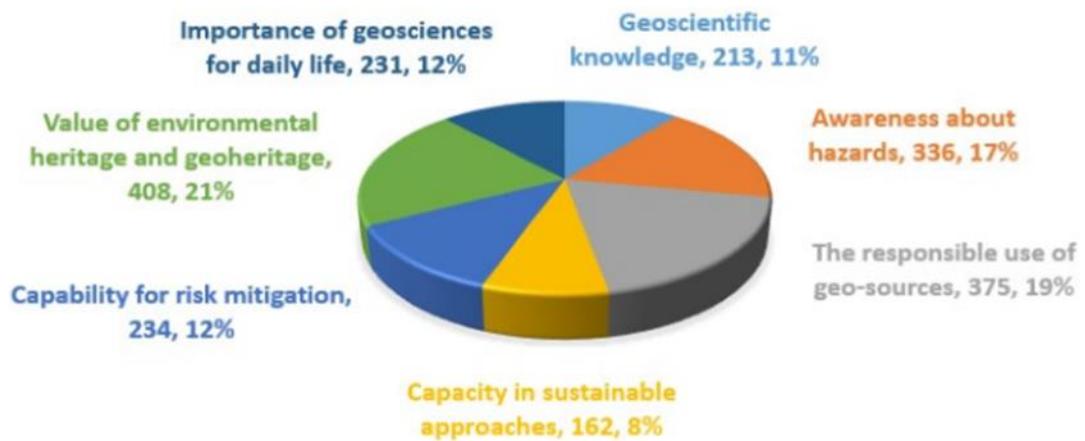


Figure 1. The most important aspects of geology education according to 612 pupils and students (Zafeiropoulos et al., 2021)

Incorporating geology education into the school curriculum can also support students in raising awareness of the relevance of geology in their daily lives. For instance, knowledge of geology can help students appreciate the importance of maintaining a balance between human activities and the environment (Vallejo et al., 2019). It can also support students understand the geological processes and how they affect human life. Additionally, geology education can also help students appreciate the significance of natural resources and the need to use them sustainably (Ruban & Ermolaev, 2020). In conclusion, geology education has some benefits, ranging from developing a positive attitude towards renewable energy to creating awareness about hazards. Therefore, it can be beneficial to include geology education as a core subject in the school curriculum, as it can help students get familiar with the relevance of geology in their daily lives and understand essential values that will be valuable in their future endeavors.

The literature demonstrates the positive impact of outdoor school environments on students' development (Buldur et al., 2020). The United Nations and the European Union recommend incorporating outdoor activities into structured school curriculums (Fonseca, 2023). In particular, geology education can play a significant role in enhancing students' growth by involving them in fieldwork that allows them to connect with nature. Fieldwork has been proven to affect student development positively (Jolley et al., 2018). Fieldwork is commonly used in undergraduate-level geology education, but it can also be highly beneficial for students at the primary and secondary levels.

Van der Hoeven (2017) indicates that educational psychologists have long emphasized the importance of engaging students' affective and cognitive components to enhance their motivation and interest in learning environments like school. Field experiences are a valuable resource in this regard. By immersing themselves in nature and actively participating in the learning process, students can develop a deeper understanding of geology concepts and foster a greater awareness of the natural world. Thus, it is crucial to explore how fieldwork, a significant aspect of geology education, can benefit students and contribute to their overall development.

Chiarella and Vurro (2020) have proposed a model for fieldwork evaluation, which is beneficial for assessing student outcomes. The model is presented in Figure 2. This model highlights that fieldwork can increase motivation, knowledge acquisition and enhance academic and social skills. According to this model, fieldwork also promotes a change in student attitudes toward their environment. However, this model highlights that it is important to consider the field environments, such as available resources, cultural context, location, and physical nature, as they can affect the learning experience. Each country's field environments and cultural contexts differ, and this affects the practical application of theoretical knowledge in geology education. Students can realize the difference in geological conditions of their countries compared to other countries when they experience fieldwork. Additionally, this model indicates that students' prior experience of fieldwork, learning styles, social and interpersonal skills, disability, and motivations can affect their learning activity. Fieldwork can be arranged for all students. Hence, geology education, including fieldwork, is crucial not only for students with normal development but also for students with disabilities in primary and secondary schools.

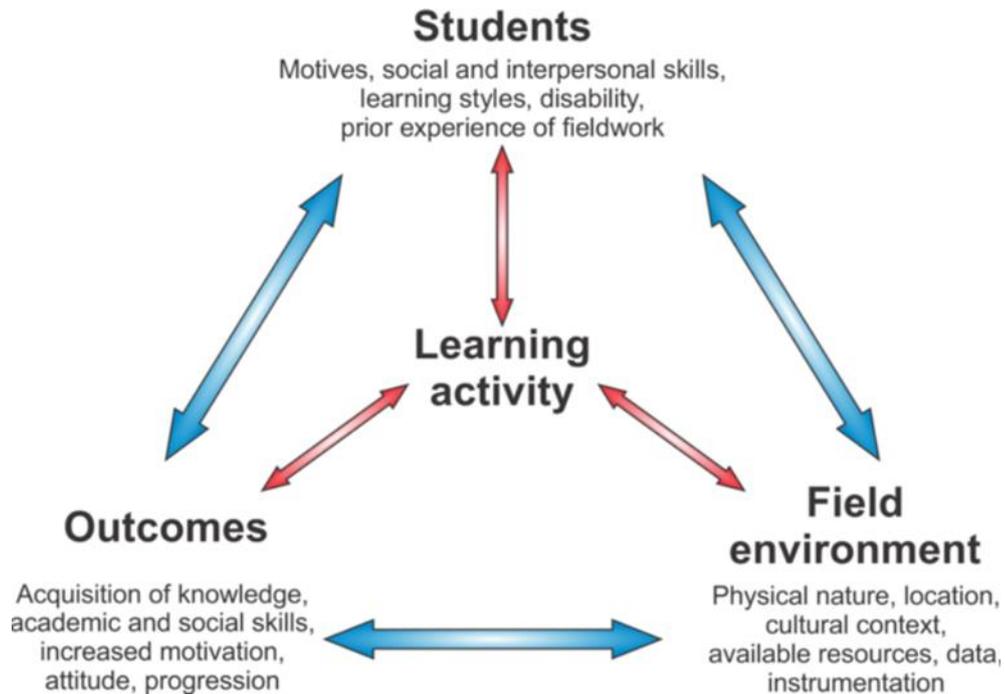


Figure 2. Model of learning activities for fieldwork (Chiarella & Vurro, 2020)

In recent years, geology education has been arranged to be inclusive for students with disabilities in undergraduate programs (Lang & Persico, 2019). This positive trend can be expected to have a trickle-down effect on primary and secondary school students with disabilities as well. However, teaching geology to younger students can be quite challenging, which may explain why it is not yet a widespread part of the curriculum in primary and secondary schools (El-Deghaidy & Mansour, 2015). To address this issue, educational institutions need to recognize the importance of geology education and explore innovative solutions to make it more accessible. Virtual reality is one such solution that has already proven to be highly effective for undergraduate geology students (Cho & Clary, 2020). By providing an immersive learning experience, virtual reality can help younger students engage with geology in a way that is both entertaining and informative.

Another promising solution is the use of video games, such as Minecraft, to teach geology. Through these games, students can create geological features and gain hands-on learning experiences that are both enjoyable and highly educational (Papanastasiou et al., 2017).

Despite the challenges associated with teaching geology to younger students, there is a growing consensus on the importance of this subject. As technology becomes increasingly available in schools, it may become a separate curriculum for primary and secondary students in the near future. By embracing innovative approaches to teaching geology, schools can help

all students develop a deeper awareness and understanding of the natural world around them, regardless of their abilities.

4. Conclusion

Geology is a crucial branch that encompasses various essential issues, ranging from exploring underground resources to understanding natural disasters. While many countries recognize the significance of geology education, it is only a small part of the geography curriculum in some nations like Greece, China, Indonesia, and Slovenia (Bedjanič et al., 2018; Gong et al., 2020; Maryanti et al., 2021; Mosios et al., 2023). This limited scope of geology education results in a shallow understanding of the subject. However, geology education has financial benefits in countries like India that rely on underground resources (Gogoi et al., 2016). More importantly, it is crucial for countries situated in earthquake zones and with active volcanoes. Since almost every country is vulnerable to natural hazards, geology education is vital and should be broadened beyond a small part of another course. A greater benefit can be achieved if geology education is included in the school curriculum for primary and secondary education. In this way, it can be ensured that geology education, which is of vital importance in today's conditions, supports and raises awareness of students.

The inclusion of geology education in primary and secondary school curricula is a topic that requires careful consideration and evaluation of its potential benefits and drawbacks. While some may express concerns about the complexity of the subject matter and its suitability for younger students (El-Deghaidy & Mansour, 2015), there are now a variety of innovative and effective teaching methods available, such as virtual reality (VR) technology and gaming, that can be utilized to teach geology at the different educational levels (Cho & Clary, 2020). New developments in this field may make geology education, which can be difficult for primary and secondary school students, easier. It can also make the learned knowledge for these students more understandable.

In fact, even preschoolers can begin to learn the basics of geology through engaging and interactive video games like Minecraft (Papanastasiou et al., 2017). With these new technologies now accessible in schools, considering the possibility of adding geology education as a separate subject in the school curriculum is worthwhile. By doing so, students can gain a deeper understanding of the Earth's structure and processes and develop an awareness of the natural world.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest in this study.

RESEARCH AND PUBLICATION ETHICS STATEMENT

The authors declare that research and publication ethics are followed in this study.

AUTHOR LIABILITY STATEMENT

The authors declare that the "Conceptual Framework, Method Design, Research, Data Analysis and Software, Gathering Sources" part of this work was done by Burak Can KORKMAZ, "Post Draft, Review and Editing, Visualization, Project management, Financing" part of this work was done by Mustafa Gökhan ALTINSOY.

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