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Transformation of the realizes about geoscience among schoolchildren in Ukraine in the frame of the educational projects UAG

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SUMMARY

This article describes methods of working with students in the framework of the Ukrainian educational project “Depths of the Earth, the spiritual depths” (UAG). The main aim of this project is to increase the interest of students in geoscience and the profession of a geologist. Within the frames of this educational project were prepared and created many different events for students and teachers. There held more than 100 lectures, seminars, scientific conferences, excursions, geological quizzes/quests in museums, field Olympiads, festivals.

Introduction.
The Ukrainian Association of Geologists (UAG) considers one of its main tasks to perform education with respect to the environment, dissemination of geological knowledge, and raising the prestige of professions related to the study and use of the geological environment.
Therefore, work in this direction with school and student youth is a priority in the activities of the Ukrainian Association of Geologists.
The UAG actively cooperates with young people by assisting them with industry-focused practical training and rewarding the best students with Association awards. Our events connect students and experienced professionals.
Within the frames of the educational project for students and their mentors «Depths of the Earth, the spiritual depths» many lectures, seminars, scientific conferences, and excursions were held.

Methods of investigation.
The methods of applied statistics were used in the work – statistical data obtained during personal observations and experiments.
The object of the study is a group of students born in 2001-2007.
The subject of the investigation is the increase the interest of girls to study geosciences and geo-engineering.

Results of investigation.
Since 2001, the Ukrainian Association of Geologists has begun to revive the country's children and youth geological movement. Educational activities for young people are carried out through school geological and environmental education, organization and support of clubs and schools, printing of popular science literature aimed at teenage audiences.
Since 2011, part of the program of the Ukrainian Association of Geologists is an educational project for students and their mentors – «Depths of the Earth, the spiritual depths», which is sponsored and informationally supported by the Nadra Group. The aim of the project is not only to popularize geological science, but also to increase the general knowledge base for schoolchildren, to expand their access to information through the introduction of new curricula with improved approaches to working with the younger generation. Within the framework of this project, the subject 'Fundamentals of Geology' is studied in four schools of Kyiv.
New very interesting project, ENGIE – Encouraging Girls to Study Geosciences and Engineering. The Ukrainian Association of Geologists as a Linked Third Party was involved in the ENGIE three-year project. This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation. Grant agreement ID: 19042. Starting date of the project: 01.01.2020. Finish of the project: 31.12.2022.
The overall gender pattern in geosciences, especially in the mineral exploration and extraction sectors is definitely imbalanced. It is characterised, more or less, by men and stable male stereotypes in almost all parts of the business clusters, in society and professional communities as well as in education and research. However, studies confirm that diverse teams are more creative and innovative. Participation of women in raw materials related industries is therefore necessary and may be considered as an element of business strategy.
The project 'ENGIE aims to turn the interest of 13-18 years old girls to study geosciences and related engineering disciplines. As career decisions are made generally in this period of life, the project expectedly will improve the gender balance in the fields of these disciplines. During the implementation of the three-year-long project, an awareness-raising strategy will be developed and an international stakeholder collaboration network will be established for the realisation of a set of concrete actions. These actions include family science events, outdoor programmes, school science clubs, mine visits, mentoring programmes, international student conferences, publication and awarding opportunities, summer courses to science teachers and production of educational materials. The actions will be carried out in more than twenty countries throughout Europe. ENGIE implemented by the cooperation of 26 institutions. The partnership involves 3 universities, 2 research centres and a European-level professional organisation, which has 26 national member geological associations. 20 national associations will take part in the project implementation as EFG's Linked

Third Parties. By their contribution, the project activities will be extended to more than 20 European countries.

The term "stakeholder" describes the different organisations, initiatives, groups or individuals that affect or might be affected by ENGIE and its activities. The key stakeholders of ENGIE are listed here below. The main target group: 13-18 year old secondary school girls; secondary school teachers, successful women geoscientists and engineers; decision-making bodies in charge of education and raw materials policies: regional, national, EU and international level; private sector: prospective future employers of geoscientists and geo-engineers; industry leaders; institutions involved in science communication: schools, science museums, universities; academia: earth and raw materials scientists, civil, structural and ground engineers, gender experts; general public: kids & parents.

Indicative was the performance of the task of interviewing two key groups of stakeholders: students 13-18 years old and teachers of secondary schools. The task was carried out within the WP1. 205 Ukrainian students (girls filled in 115 online and 90 paper questionnaires) and 54 teachers (online survey) took part in the survey. Questions for students can be divided thematically into three blocks: 1. Part A: Introductory questions; 2. Part B: Knowledge of geoscience; 3. Part C: Interest in geoscience

Table 1. ENGIE survey of secondary school students' interest in geoscience

1. Part A: Introductory questions

1.1Year of birth – 2001-2007; the main part of students were born 2004-2003 (near 70 %)

		Online survey %	**Paper survey %**
1.4 Do any of your parents/caregivers have a university/college degree?	Yes, my mother	78,3	53,3
	Yes, my father	58,3	31,2
	Yes, other caregiver of mine	13,0	6,6
	No, none of them	2,6	8,9
1.5 Are you planning to continue on to college/university education?	Most likely yes	97,4	95,5
	Most likely no	2,6	4,5
1.6 In what area are your planning to study at college/university?	Most likely social science, Humanities	35,4	36,7
	Most likely natural science, Technology	19,5	24,4
	Other	45,1	38,9
1.7 Please, motivate your answer to question 1.6. Select the alternative that best reflects your motivation	It's an area of study that I believe I can succeed in	70,4	53,4
	It's a field that I believe can give me great career utilities	55,7	43,3
	It's a field that teachers and/or my parents/caregivers encourage me to pursuit	2,6	2,2
	It's the area that friends of mine are interested in	0,9	1,1

1.4. Do any of your parents/caregivers have a university/college degree?

It is noteworthy that the number of women (mothers) with higher education in this category significantly exceeds the number of men (fathers) with higher education: 78.3% vs. 58.3% in the online survey and 53.3% vs. 31.2% in paper questionnaires. So, in Ukraine, women with higher education are about 20% more than men in the category of parents of children aged 13-18.

This is all the more interesting because men clearly predominate in leading positions in Ukrainian organizations of various levels.

1.5 Are you planning to continue on to college/university education?

The next interesting fact is that more than 95% of girls in this age category plan to continue their studies at university, college.

In our opinion, there was a devaluation of higher education, its quality fell and the selection criteria for higher education institutions decreased.

1.6 In what area are your planning to study at college/university?

The category other (art, music, languages, sports, medicine, medical care) is gaining the largest number of fans – 45.1% in the online survey; 38.9% – on paper.

The category "social sciences, humanities (such as history, literature, economics) is gaining a little more than 35%.

Category "natural, technological sciences (such as physics, chemistry, biology, Earth sciences) 19.5% and 24.4% respectively.

Note/remark: this discrepancy can be explained by the fact that paper questionnaires were filled out by students of schools where the group "Geological local lore" works and as a variable component, the course "Basics of Geology" (Liventseva and Krochak, 2019) was taught. It demonstrated that systematic work with students to promote geosciences has positive results.

On the other hand, the smaller percentage of those wishing to study natural sciences, which are a priori more difficult to master, does not indicate the reluctance of most students to make significant efforts, but the lower demand for such specialists in our country today.

1.7. Rationale for answering question 1.6. gives interesting results.

Students rely on their own vision of the future and are almost not influenced by parents, teachers, and friends:

This is an industry that interests my friends – 0.9-1.1%

is an area in which teachers and/or my parents/guardians encourage me to study in the range of 2.2-2.6%;

This is an area of knowledge in which I can succeed – 70.4% and 53.4%;

This is an area where I can build a great career – 55.7% and 43.3%.

Thus, children think independently and make a choice of the future profession based on their own knowledge and experience.

This generation is less dependent on the opinion of teachers, parents, guardians, in general, the older generation. They haven't a lot of authority persons among their peers.

The next block of questions concerns knowledge of geology (Table 2).

Table 2. ENGIE survey of secondary school students' interest in geoscience

2. Part B: Knowledge of geoscience

2.1 Would you say that you are familiar with geoscience?	**Yes**	**100,0**	**78,9**
	No	0	21,1
2.2 What is geoscience to you? Please choose the alternative that first comes to your mind	The study of matter and its motion through space-time, along with related concepts such as energy and force	3,6	7,8
	The study of the earth – its oceans, atmosphere, rivers and lakes, ice sheets and glaciers, soils, its complex surface, rocky interior, and metallic core	95,5	87,8
	The study of the relationships that living organisms have with each other and with their abiotic environment	0,9	4,4
2.3 Do you know someone who is working as a geoscience professional?	Yes	45,1	51,1
	No	54,9	48,9

2.1 Would you say that you are familiar with geoscience?

Interestingly, 100% of the answers were given by students from schools, where geology was not taught.

The answers (78.9% – yes and 21.1% – no) were given by students who studied geology as a subject of variative part of the education or the participants of the group "Geological local lore".
This interesting result confirms the opinion of Socrates. “The more I know, the more I realize I know nothing.” Students who have just touched the study of Earth sciences have understood the power of this unlimited layer of knowledge and have not rightly given an unequivocally positive answer to this question.

2.2 What is geoscience to you? Please choose the alternative that first comes to your mind

87.8 – 95.5% of students gave the correct answer to the definition of geology.

2.3 Do you know someone who is working as a geoscience professional?

Yes - in the online survey 45.1%
Yes - in paper questionnaires 51.1%.
That is, almost half of the girls know who the geologist is and what professional tasks he performs.
The last block of questions concerns the interest in geology (Table 3.)

Table 3. ENGIE survey of secondary school students' interest in geoscience

3. Part C: Interest in geoscience

3.1 Would you consider working as a geoscience professional?	**Yes, I absolutely could consider that**	**25,4**	**28,9**
	No, I don´t think that´s something for me	74,6	71,1
3.6 Would you be interested to learn more about geoscience in general or as a profession?	Yes	65,5	66,7
	No	34,5	33,3

3.1 Would you consider working as a geoscience professional?

The answer is 25.4% and 28.9%.

3.6 Would you be interested to learn more about geoscience in general or as a profession?

Yes – 65.5% - 66.5%
No – 34.5% -33.5%
This result inspires and gives an incentive to work further, popularizing geological knowledge, forming a natural worldview.The results of the polls (Table 4) showed a significant increase in interest in earth sciences among children participating in the project “Depths of the Earth, the spiritual depths”. After nine years, almost half of the children participating in the survey were informed about the profession of a geologist, and we were able to interest children in geology as a field of activity (Liventseva and Krochak, 2020).

Table 4. Changes in knowledge and ideas of schoolchildren about geology

Year	**Do you know someone who is working as a geoscience professional?**				
	Number of children taking part in the survey	Number of children who answered ‘Yes’	Percentage of children who answered ‘Yes’	Number of children who answered ‘No’	Percentage of children who answered ‘No’
2011	225	3	1.3%	222	98.7%
2020	205	96	46.9%	109	53.1%
	Would you consider working as a geological professional?				
2020	205	56	27.1%	149	72.9%

The second group of stakeholders who took part in the survey were teachers (54 secondary school teachers in Ukraine took part in the online survey).
ENGIE survey on secondary school students’ interest in geoscience. Questionnaire for teachers.

Part 1: Introductory questions

Only 9.8% of them are geography teachers. Mostly women 92.2%. Age 45-54 – 27.5%; 25-34 – 23.5%; 55-64 – 21.6%; 35-44 – 13.7%; > 64 – 9.8%; <25 – 3.9%.

Part 2: Background for teaching geology

Does geology form part of the compulsory curriculum at your school?
Yes – 20,8%; No – 79,2%
How is geology involved in the curriculum at your school? (multiply choices possible)
As a separate subject 24.1%; As a part of natural sciences 44.4%; As a part of geography 46.3%; As a part of chemistry 5.6%; As a part of physics 7.4%; Other (please specify) 3.7%
Is geology (either as a separate subject or involved in other subjects) at your school taught by (multiply choices possible)
General science teachers 9.3%; Geology teachers 35.2%; Geography teachers 66.7%; Chemistry teachers 13%; Physics teachers 11.1%
These answers demonstrate that at the level of public policy, the subject of geology is not considered as a separate branch of natural sciences, as in many European countries, but only as a small part of other, often descriptive (as geography) disciplines.. This is largely reflected in the low interest of girls in geosciences and geoengineering.
What is the age of students who learn geology (either as a separate subject or involved in other subjects)?
14-16 years olds 83.3%; 16-18 years olds 16.7%
Part 3: Gender perspectives on learning geology
From your perspective, which students show greater interest in geology?
Girls more often than boys 14.9%; Boys more often than girls 12.8%; Girls' and boys' interests are generally equivalent 72.3%
From your perspective, which students participate more actively in learning geology? (e.g. asking and/or answering questions, taking notes and extra tasks, etc.)
Girls more often than boys 23.9%; Boys more often than girls 8.7%; Girls' and boys' participation are generally equivalent 67.4%
From your perspective, which students' scores are better on tests related to geology?
Girls' scores more often than boys 29.8%; Boys' scores more often than girls 8.5%; Girls' and boys' scores are generally equivalent 61.7%
From your perspective, which students at your school are involved in compulsory or optional activities (fieldtrips, site visits, mentoring, etc.) which can raise their interest for the geoscience profession?
Girls more often than boys 21.3%; Boys more often than girls 12.8%; Girls and boys are equally involved 66%.
The equal interest of girls and boys confirms the idea that there are no gender differences in the interest in studying and the desire to master the science of the Earth. The answers to the questions of Part 3: Gender perspectives on learning geologyshow that girls of this age are a little more active than boys in the study of geology, attend optional events, receive, accordingly, better grades.
But, in our opinion, this is not due to the subject of study, but to the natural greater activity of girls at this age.

Part 4 Promoting gender equality in geoscience profession
What do you see as barriers to increase the representation of women in the field of geoscience and related engineering? (multiply choices possible)
Girls might be discouraged by the lack of women role models in geoscience and related engineering profession 14.8%; Girls might be discouraged by the masculine symbols and images that dominate geoscience and related engineering profession 16.7%; A career in geoscience might be difficult to combine with the responsibilities associated with women's gender role 50%; Girls might not be encouraged by friends and/or family to pursuit a career in geoscience 38.9%; Not enough girls have the grades/educational merits to continue studying geoscience at university level 0%; Girls tend not to be interested in geoscience 33.3%
The main conclusion of Part 4 Promoting gender equality in geoscience profession that the teachers themselves are influenced by the stereotype that a career in geoscience can be difficult to combine with responsibilities associated with the gender role of women. 50% of respondents give such an answer!
Thus, gender stereotypes need to be overcome not only by working with young people, but also with the older generation of stakeholders.

Summary.

1. The survey showed that the main reasons for the low interest of girls in geosciences and geoengineering are gender stereotypes that exist in society regarding the profession of geologist.. The lack of state policy on the study of geology by young students harms the dissemination of geological knowledge.
2. Modern girls think about their future consciously, focusing on their own preferences and the opportunity to succeed. The girls sure they can build s great career in the different areas.
3. And although they are, to a certain extent, hostages of the information space in which they live and study, their opinions do not depend on the older generations, on the society, and these girls have their own view.
4. Career guidance, specialized training and examples of successful women can positively influence the interest of girls of this age in geosciences and geoengineering and help them choose this career path for their future.

References

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