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HIGHER EDUCATION STUDENTS' KNOWLEDGE AND OPINION ABOUT GEOETHICS AND SUSTAINABLE DEVELOPMENT

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Abstract

Geoethics is a scientific area that has as its main concern the investigation of ethical conduct of humans with the Earth. Given that, geoethics has the potential to contribute to the achievement of the sustainable development. Geoscientists are professionals that investigate the Earth and have various professional responsibilities when performing their work. As such, geoethics started its emergency in the last decade and initially was focused on the geoscientists' conduct. Afterwards, geoethics evolved to be concerned about every interaction of mankind with the Earth system, like mining, geoheritage conservation, and climate change. The present study aimed to understand students' perceptions concerning geoethics and its relationship with Sustainable Development Goals of the 2030 Agenda of United Nations. The present study was developed under the scope of a Ph.D. thesis project with the aim to investigate and implement an innovative syllabus for teaching geoethics in higher education. Before the implementation of classes aligned with the mentioned syllabus, we conducted a survey that gathered data from 90 students studying geosciences higher education courses. Ages ranged between 18 and 58 years (mean=22.7) including 48 females and 42 males. The survey questionnaire comprised of 11 closed questions related to the importance of learning geoethics in higher education. The analysis of the closed questions' answers allowed us to understand that students consider important to have and follow an ethical conduct (n=87, 96.7%) and think that geoscientists have responsibilities towards the planet (n=83, 92.2%). The majority of the participants assumed to have already heard the term geoethics (n=53, 58.9%). When confronted with the meaning of geoethics most of the respondents stated that its knowledge is essential to the future professional work (n=87, 96.7%), and gave importance to the teaching of geoethics in higher education (n=82, 91.1%). Concerning the 2030 Agenda for Sustainable Development, the majority of the students showed having some knowledge about the goals and considered them relevant due to the current state of the world and the need for citizen intervention on society (n=83, 92.2%; n=68, 75.6%; n=77, 85.5%). Most of the participants assumed that geoethics can contribute to sustainable development (n=89, 98.9%) and were able to point out three Sustainable Development Goals that they considered as related with geoethics. As our main conclusion, we can say that the participants of the study appraised geoethics as a relevant matter to be learned in higher education and grant it as a path for planetary sustainable development.

Keywords: *Ethics, geosciences education, survey, sustainability, syllabus.*

1. Introduction

The Earth-related challenges society currently faces are serious problems and need urgent solutions to guarantee the future of the planet, including the human species. To find the way to govern the planet is necessary to establish a better relationship between humans and the Earth system. The developing field of geoethics investigates and reflects on how to change the referred relationship to resolve environmental, social, and economic problems (Peppoloni & Di Capua, 2020; Vasconcelos & Orion, 2021). For this, geoethics seeks ethical conduct to be followed by everyone whenever they interact with the planet. Initially, it was aimed at ethical conduct only for geoscientists, but later it expanded and should be followed by every citizen. It is important to understand that not only geoscientists are accountable for the damage inflicted on the planet in the past and present. This responsibility is great for geoscientists mainly because they work directly with the Earth system, but every citizen contributes to its state (Bohle, 2021; Peppoloni & Di Capua, 2020; Peppoloni & Di Capua, 2021).

Hereupon is fundamental to recognize that geoethics must be taught (Mogk, 2018; Peppoloni & Di Capua, 2021; Vasconcelos & Orion, 2021) and it would start to educate future geoscientists first. However, geoethics is not integrated into higher education curricula. Additionally, some assume that

geoethics should even be taught at young ages (Cardoso, Ribeiro & Vasconcelos, 2021). Thanks to the international Erasmus+ project Geoethics Outcomes and Awareness Learning (GOAL — ref. 2017-1-PTO1-KA203-035790) there is now a syllabus for teaching geoethics in higher education "Teaching Geoethics Resources for Higher Education" (Vasconcelos, Schneider-Voβ, Peppoloni, 2020). The survey presented in this study was done before the first implementation of a syllabus about geoethics for future geoscientists. Also, the educational resources provided by the referred book for the syllabus implementation were about diverse subjects of geoethics related to thematic that require a sustainable approach to the resolution of the problems posed.

On the subject of geoethics education, it is important to refer to the "Geoethical Promise". It intends to make future geoscientists, before their professional careers, declare their duties with society and the planet, and assume its commitment with the content of the promise (Di Capua & Peppoloni, 2017).

If geoethics cares about the relationship of humans with the planet, it is natural that it can contribute to various aspects of sustainable development. Geoethics can play a key role if applied to decisions of different natures, like environmental, social, economics, politics (Bohle & Marone, 2021; Peppoloni & Di Capua, 2020; Peppoloni & Di Capua, 2021). If we can teach future geoscientists about applying geoethics in their work it will be a great step for future generations to influence the way the world develops, increasing the chances of reaching sustainability. Also, every citizen plays a role so geosciences and geoethics need to be disseminated more broadly. The "Agenda 2030 for the Sustainable Development" is currently the guide for seeking sustainability until 2030, having the aim to solve severe problems from environmental, social, and economic natures (United Nations, 2015). If we consider the 17 Sustainable Development Goals, we can see that every one of them has connections to geosciences (Gill & Smith, 2021) meaning geoethics can help to reach these vital goals promoting the sustainability of the Earth system.

2. Methodology

The present study followed a quantitative approach through the descriptive statistics analysis of the results obtained in a survey, using the IBM SPSS Statistics version 27. The data collection instrument was composed of 11 closed questions. The administration of the survey occurred before a Ph.D. intervention program, which consisted of the application of a geoethics syllabus in higher education developed as part of an international Erasmus+ project GOAL.

The administration of the survey occurred before the classes about geoethics and sustainable development. The aim was i) to diagnosticate students' perceptions about the thematic mentioned and ii) evaluate the potential of teaching geoethics and its connections with the SDGs of the 2030 Agenda for Sustainable Development for the professional development of the future geoscientists. This task fulfillment took an average of 20 to 30 minutes. The respondents participated voluntarily and with the information of the confidential nature of the data collected, both of these facts were explicitly written in the introduction of the survey.

The sample of this study comprised of 90 higher education students (n=90) from the northern region of Portugal, enrolled in geosciences-related courses. Most of the students (n=57; 66.3%) were attending the first degree in geology. Their ages ranged between 18 and 58 years (mean=22.7 years old), including 48 females (53.3%) and 42 males (46.7%).

3. Results

We grouped the questions into three domains for better reading and analysis: i) geoethics (Q1 to Q6), ii) sustainable development (Q7 to Q9), and iii) connections between both (Q10 and Q11) (table 1).

Table 1. Domains and questions/statements of the survey applied.

Domains	Questions/statements	
D1. Geoethics	**Q1.**	I consider important the existence of an ethical conduct for the professional practice of geosciences.
	Q2.	Geoscientists have an increased responsibility towards planet Earth due to the nature of their professional activity.
	Q3.	Have you ever heard of the term geoethics?
	Q4.	Geoethics "consists of research and reflection on the values which underpin appropriate behaviors and practices, wherever human activities interact with the Earth system", do you consider it to be an important scientific area for the future of society?
	Q5.	Considering the definition of geoethics explained above, I think that the incorporation of geoethics in the higher education curriculum of courses in the geosciences area is important.

	Q6.	According to your previous answer, would you be in favor of the existence of a "Geoethical Promise" (analogous to the "Hippocratic Oath" of the medicine) to be assumed by future geoscientists?
D2. Sustainable development	**Q7.**	Are you familiar with the sustainable development?
	Q8.	Have you ever heard about the United Nations' "2030 Agenda for Sustainable Development" and its goals?
	Q9.	Do you consider the "2030 Agenda for Sustainable Development" and its goals relevant to the current panorama of our society?
D3. Connections between geoethics and sustainable development	**Q10.**	Bearing in mind the formal definition of geoethics, do you consider that this is a scientific area with the potential to contribute to sustainable development?
	Q11.	If you have answered affirmatively to the previous question, what are the three goals of the "2030 Agenda for Sustainable Development" that most integrates, in your perspective, the role of geoethics?

3.1. Questions about the geoethical domain

The following table allows to demonstrate that the students, in a five-point scale, mostly totally agree that ethical conduct is important in geosciences (Q1 – n=71, 78.9%), also believe that geoscientists have a higher responsibility concerning the Earth system (Q2 – n= 52, 57.8%) and consider the integration of geoethics on higher education in geosciences important (Q5 – n=56, 62.2%), followed by the option partially agree about the same topics (Q1 – n=16; 17.8%; Q2 – n= 31, 34.4%; Q5 – n= 26, 28.9%). It must be noted that the mean in all questions is closer to 5 revealing concordance with the statements presented to students.

Table 2. Five-point scale questions and answers about the geoethics domain (n=90).

Question/ statement	**Answers**										**Mean and Standard deviation**
	Totally agree		**Partially agree**		**Neither agree nor disagree**		**Partially disagree**		**Strongly disagree**		
	n	%	n	%	n	%	n	%	n	%	
Q1	71	78.9	16	17.8	3	3.3	–	–	–	–	M = 4.76 SD = 0.504
Q2	52	57.8	31	34.4	5	5.6	2	2.2	–	–	M = 4.48 SD = 0.707
Q5	56	62.2	26	28.9	6	6.7	1	1.1	1	1.1	M = 4.50 SD = 0.768

Table 3 shows most of the students never have ever heard about geoethics (n=37, 41.1%), being the mean naturally low (M= 1.91) This can reflect that geoethics is poorly taught in the higher institution participating in this study.

Table 3. Three-point scale questions and answers about the geoethics domain (n=90).

Question/ statement	**Answers**						**Mean and Standard deviation**
	Yes, and I know what it means		**Yes, and I do not know what it means**		**No**		
	n	%	n	%	n	%	
Q3	29	32.2	24	26.7	37	41.1	M = 1.91 SD = 0.856

Table 4 shows that: i) most of the respondents, after being confronted with the definition of geoethics, considered it essential for the society's future (n=87, 96.7%) and ii) most of the opinions of students are in favor of the existence of a "Geoethical Promise", yet the opinions are both expressing concerns if the promise is essential (n=56, 62.2%) or not (n=30, 33.3%). Also, four respondents placed themselves against the implementation of the promise.

Table 4. Three-point scale questions and answers about the geoethics domain (n=90).

Question/ statement	**Answers**						**Mean and Standard deviation**
	Yes, it is essential		**Yes, but it is not essential**		**No**		
	n	%	n	%	n	%	
Q4	87	96.7	3	3.3	–	–	M = 2.97 SD = 0.181
Q6	56	62.2	30	33.3	4	4.4	M = 2.58 SD = 0.580

3.2. Questions about the sustainable development

Concerning two questions about sustainable development revealed that most of the students know what sustainable development is (n=83, 92.2%) and what is the "2030 Agenda for Sustainable Development" (n= 50, 55.6%). However, it is also important to denote that a considerable number of students don't know what the "2030 Agenda" is or don't know at all about its existence.

Table 5. Two and Three-point scale questions and answers about the sustainable development domain (n=90).

Question/ statement	Answers						Mean and Standard deviation
	Yes		Yes, but I do not know what it is		No		
	n	%	n	%	n	%	
Q7	83	92.2	n.a	n.a	7	7.8	M = 1.92 SD = 0.269
Q8	50	55.6	18	20.0	22	24.4	M = 4.43 SD = 0.937

n.a. – not applicable

On the five-point scale question of this domain, table 6 demonstrates that most of the students recognize the importance of the "2030 Agenda" implementation giving the panorama of society. Also, the mean was high (M=4.43) for a five-point scale demonstrating the positioning of the students.

Table 6. Five-point scale question and answer about the sustainable development domain (n=90).

Question/ statement	Answers										Mean and Standard deviation
	Very relevant		Partially relevant		Neither relevant nor not irrelevant		Partially irrelevant		Very irrelevant		
	n	%	n	%	n	%	n	%	n	%	
Q9	58	64.4	19	21.1	10	11.1	–	–	3	3.3	M = 4.43 SD = 0.937

3.3. Questions about the connections between geoethics and sustainable development domain

On the last domain, the results of a four-point scale question demonstrate that most of respondents consider geoethics essential to the sustainable development. However, a considerable number of students (n=27, 30.0%) also respond affirmatively, but assumed they had poor knowledge on the subject.

Table 7. Four-point scale question and answers about the connections between geoethics and sustainable development domain (n=90).

Question/ statement	Answers								Mean and Standard deviation
	Yes, it is essential		Yes, but it is not essential		Yes, but I lack more knowledge on the subject		No		
	n	%	n	%	n	%	n	%	
Q10	55	61.1	7	7.8	27	30.0	1	1.1	M = 3.29 SD = 0.939

In table 8 we can see that some students gave an invalid answer for the Q11 (n=22, 24.4%), that is because those students selected more or less than three or none Sustainable Development Goals as asked in the questionnaire. The three selected goals mostly selected by the respondents were the 13 (Climate change) (38.9%), 7 (Affordable and clean energy) (n=30; 33.3%) and 15 (Life on land) (n=29; 32.2%). We can consider that these goals are very relevant for geoethics, and geosciences and the students recognize that.

Table 8. Frequencies of stated Sustainable Development Goals (n=90).

f	Sustainable Development Goals																	Invalid answer
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
n	5	6	4	6	1	21	30	1	9	2	15	22	35	15	29	2	1	22
%	5.6	6.7	4.4	6.7	1.1	23.3	33.3	1.1	10.0	2.2	15.7	24.4	38.9	16.7	32.2	2.2	1.1	24.4

Although students positioned themselves in favor and value geoethical subjects, most of the students revealed they did not know what geoethics is. In the sustainable development domain, we can assume that it is known by students but the recognition of the "2030 Agenda for Sustainable Development" was poor. Finally, students recognize the potential of geoethics to help in future sustainable development and the "2030 Agenda for Sustainable Development".

4. Conclusion

With the current global panorama it is essential to have the best tools for thinking of solutions for the problems we face and will face in the future. It is more important than ever to finally find the sustainable development of the planet. Geoethics can contribute to pursuing a pathway to improve the relationship between human beings and the Earth system. For that, it needs to be disseminated and one way it can be done is through education. This study shows favorable opinions about geoethics of higher education students from geosciences-related courses. However, as most of the students do not know what geoethics is, it is a possible indicator of poor investment in geoethics education. Furthermore, sustainable development and the "2030 Agenda for Sustainable Development" were the subjects more known by the respondents. After knowing what geoethics is, most of the students recognize the important role geoethics can play in sustainable development. Students chose Sustainable Development Goals very relevant concerning what great benefits geosciences and geoethics can bring. The education on geoethics for future geoscientists can help them to improve their knowledge and practice of geoethics, allowing this latter to be present in every decision made.

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