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Are We Ready for a Sustainable Development? A Survey among Young Geoscientists in Italy

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Abstract: The United Nations 2030 Agenda is a plan designed to encourage prosperity that is respectful of the planet and its inhabitants. The Agenda will help introduce the concept of education for sustainability (EfS) to a wider population in order to promote inter- and trans-disciplinary knowledge about sustainability. Connecting Earth Sciences (ES) with sustainability allows us to deal with the ethical dimensions and the social implications of this field. The belief is that improving the delivery of knowledge around sustainability issues will make visible the potential of ES education as a key component of EfS. The aim of this paper is to understand whether the young Italian ES community has sufficient knowledge of and a shared interest in, sustainability. The conviction is that awareness of these topics among the younger generations is fundamental to building a new pedagogical paradigm. This study shows the results of a survey taken by participants of BeGeo 2021, the Italian national congress dedicated to young geoscientists, held in Napoli in October 2021. The majority of respondents had limited knowledge about sustainability, and only a few had attended academic activities that included these topics. Nonetheless, the importance of sustainability is well recognized and there is a great need to increase the number of activities connected to EfS.

Keywords: geoethics; education for sustainability; sustainable development goals



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1. Introduction

The 2030 Agenda [1] was launched by the United Nations during a summit in September 2015 and it was formally and unanimously adopted by the 193 member states during the 21st Conference of Parties (COP21) held in Paris in December 2015. The main purpose of this Agenda is to eradicate poverty in all its forms and dimensions, in order to shift the world onto a sustainable and resilient path [1]. The Sustainable Development Goals (SDGs) have been chosen to achieve this purpose.

The 17 SDGs are divided into 169 targets and have been designed to better address the aims of this major project, which has the year 2030 as its target date.

Achieving the 17 SDGs has become a great challenge for many sectors of society (e.g., industry, education, communication), and, from the outset, scientific knowledge has been essential to guide, measure and achieve these goals [2].

Many, if not all, of the SDGs, are related to the Earth Sciences (ES) and therefore it is necessary for the geological scientific community to recognize the role it can play and to be ready to act for this common purpose, sometimes assuming the lead role in delivering the SDGs [3]. The geological scientific community also has a key role in delivering Environmental Education (EE), which fits perfectly in the achievement of the 17 SDGs.

Is the geoscience community aware that proper education in ES can be a vector for change?

To better understand if this awareness currently exists among young Italian geoscientists, we present the results of a survey conducted between the participants of BeGeo 2021 [4], the first national congress in Italy for young geoscientists (i.e., BSc and MSc students, PhD candidates and PhD graduates who had graduated less than 3 years before).

The age of participants is meaningful for the research, in fact, most of them were under 30 years of age and at the end of their academic studies or at the beginning of their working life. This provided an insight into the current state of awareness regarding geology as a tool for achieving the SDGs within the different national university curricula.

The decision to have a national focus was supported not only by the unique opportunity to have a conference that brought together a perfect sample of people useful for the research, but also by the fact that in Italy, since the 1970s, a discussion on the ethics of geosciences has begun. In recent years, this has led to the birth of a discipline called Geoethics, whose major exponents include Italian geoscientists [5–8].

1.1. From Environmental Education (EE) to Education for Sustainability (EfS)

The beginnings of EE are grounded in the early 1960s, after the publication of the book by Rachel Carson [9], which unveiled the potential large-scale impact of human beings on the planet. The roots of the EE could also be extended further back in time to the 19th century, as far as Wilbur Jackman [10] and Anna Botsford Comstock [11] who published two books that are commonly considered two of the first examples of a pedagogical approach that encourages taking students outdoors for learning experiences [12].

The idea itself of Outdoor Education (OE), strictly connected to EE, was born in Germany in the same period and then spread mostly in Northern Europe within the half of the century [13]. Moreover, many other movements prior to 1960 have supported the development of the EE [14].

The first formal definition of EE was developed in a seminar at the University of Michigan. Environmental Education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution [15]. In the same document the main objectives of EE are underlined, the first of which is a clear understanding that humankind is an inseparable part of a system that could be altered and damaged if we are not aware of it. At the end of the document, there is a call to inform citizens of the world about how they can implement EE.

This call for change was met by the UN's Stockholm Declaration, in particular its 19th Principle about education [16], and then by the Tbilisi Report, a result of UNESCO's First Intergovernmental Conference of Environmental Education, which emphasizes the role of EE as a solution to the major problems of the contemporary world [17].

Later, the Brundtland report [18] helped to find the link between the EE and sustainable development, defined as development that meets the needs of the present without compromising the ability of future generations to meet their needs [18]. This report and the following Agenda 21 [19] have been the basis for the concept of Education for Sustainable Development (ESD) as a valuable approach to EE [12]. With its multiple definitions and wide variety of interdisciplinary approaches to support sustainability, ESD has been recognized as a key strategy for the achievement of the Millennium Development Goals (MDGs) [20] and then for the SDGs.

Moreover, the UN declared the years 2005–2014 to be the Decade of Education for Sustainable Development (DESD), to highlight the importance of education in achieving the goals of a sustainable future.

The expression “Education for Sustainability” (EfS) has appeared in academic publications since the mid-1990s [21] and has remained in use over the years [22,23] often juxtaposed with ESD, without evident differences. Here we refer to the Australian Curriculum, Assessment and Reporting Authority's definition (ACARA) developed within a National Curriculum for teacher accreditation and teacher education [24]. The Curriculum claims that sustainability is an essential element for young people and defines the EfS as follows: “Education for sustainability develops the knowledge, skills, values and world-views necessary for people to act in ways that contribute to more sustainable patterns of living. It enables individuals and communities to reflect on ways of interpreting and engaging with the world. Sustainability education is futures-oriented, focusing on protecting

environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable patterns of living require consideration of environmental, social, cultural and economic systems and their interdependence” [24].

It is actually difficult to outline borders and to clearly identify differences between the EE, the ESD and the EfS; even in presence of different definitions above mentioned, the efforts of suggesting specific terms and rhetoric for each one of the three concepts sounds fruitless; on the contrary, it seems pretty clear that collaborative action is more useful than an either-or debate over whose terminology should be adopted [25].

1.2. Geosciences, Education for Sustainability and SDGs

The role of geosciences in the field of EfS or ESD in promoting and achieving SDGs is ambiguous. From the dawn of the millennium, there has been wide recognition of the increasingly important role of the ES in the path towards a sustainable society [26], in particular in the development of a holistic system needed to understand major earth systems, such as the water and the carbon cycles [27]. Moreover, considering climate change as the major issue that our society faces nowadays, geologists could help to show the potentially dangerous effects that a rapid climate change can have on the Earth [28].

Despite this, it seems that the current discourse on sustainability has left the geosciences behind [29]. Firstly, the call for greater inclusions of the ES to help and guide the 2030 Agenda [2] has largely not been taken into consideration by the geoscience community; on the other hand, in the explosion of SDGs research after 2015, the scene has been largely dominated by the social sciences, and geosciences cover only a small fraction of the research [30] (Figure 1).

Considering the possibility that some papers about geosciences may have been counted under the label Environmental Sciences, the data in Figure 1 still highlights the minor role of geosciences in sustainability research and sustainability education today. Nonetheless, relating the key aspects of geology with the 17 SDGs, it is easy to demonstrate that geoscientists have a crucial role in achieving them. For this reason, many initiatives were created in order to engage Earth Sciences in the SDGs debate and to improve geoscientists’ awareness of their important role. One of these initiatives is Geology for Global Development (GfGD) [31], a registered charity founded in 2011 by Joel Gill, Senior International Development Scientist at the British Geological Survey and Fellow of the Geological Society of London. The not-for-profit organization is affiliated with the International Union of Geological Sciences (IUGS) [32] and they both have a shared aim that is to advance international geoscience cooperation to serve society. They support a vision of the world where every geologist is equipped with the skills and the knowledge required to make a positive contribution to sustainable development; the geology community is actively engaged in the design, implementation, monitoring, and evaluation of international development activities.

UNESCO is the only United Nations organization with a mandate to support research and capacity-building in geology and geophysics, and the International Geoscience Programme (IGCP) [33] is its flagship international engagement platform. Moreover, GfGD is a project partner on the IUGS/UNESCO International Geoscience Programme Project 685—Geoscience for Sustainable Development (GeoSD) [34], approved in February 2019 by UNESCO’s Earth Science Secretariat. This 5-year research project has the mission to champion the role of geoscience in helping UNESCO address the pressing challenges of the UN SDGs [35].

Additionally, the Geological Society of London (GSL) [36] assumed a role in the promotion of EfS related to geoscience. In particular, a poster was created in 2021 with the aim of making the connection between geology and the SDGs very easy to understand, not only for those classically related to STEM. In fact, it highlights that the geosciences, along with other STEM disciplines, are, or could be involved in all 17 SDGs and effectively help deliver the 2030 Agenda (Figure 2).

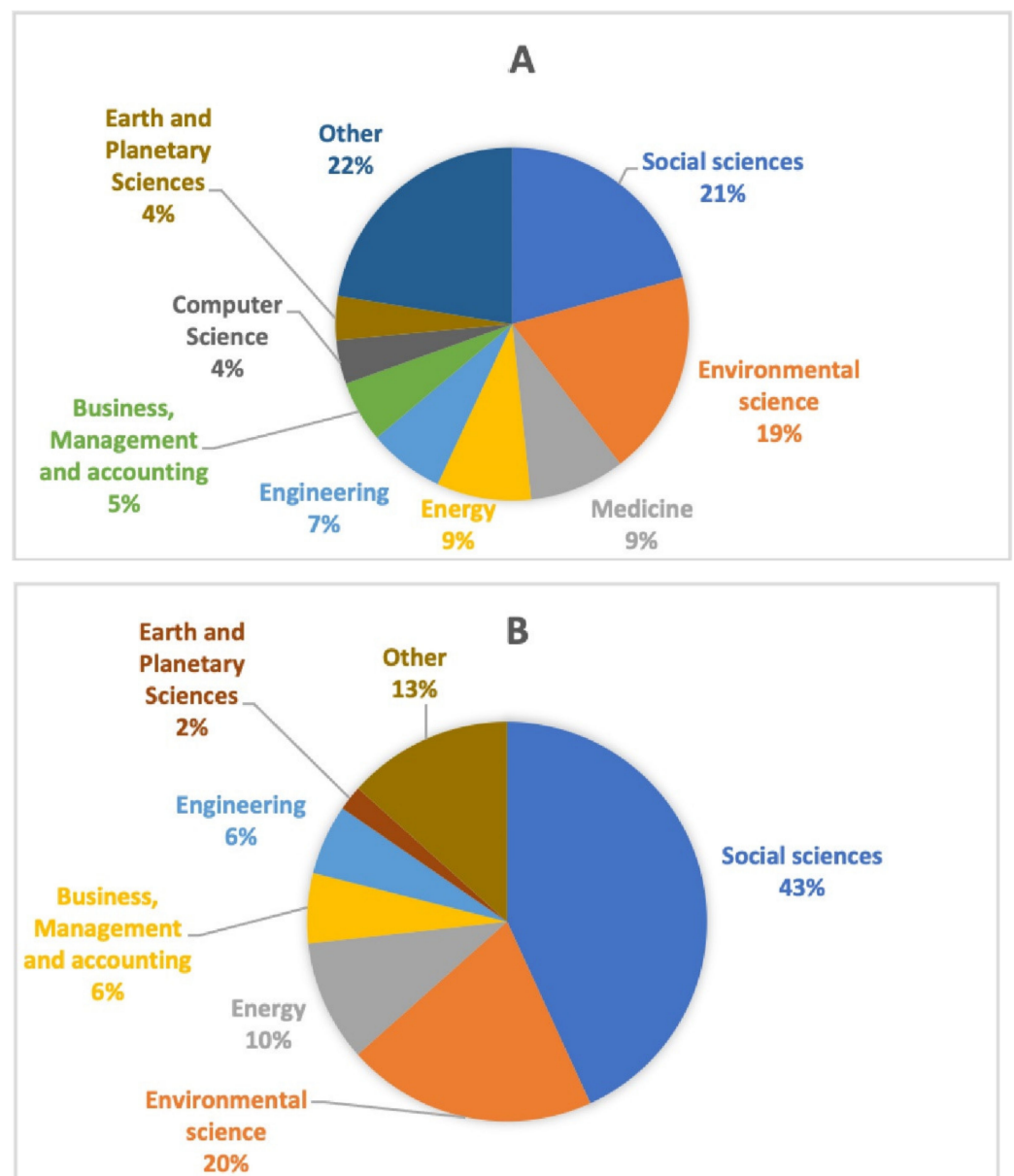


Figure 1. Results of a Scopus search on 10 December 2021. Using in “Title, abstract and keywords” the SDG-related terms “SDGs” OR “2030 Agenda” OR “Sustainable Development Goals” OR “Global Goals”. The subject area “Earth and Planetary Sciences” covers only 4% (A). Using instead “Education for Sustainability” OR “Education for Sustainable Development” the percentage of the area decreases to 2% (B).

Furthermore, with regard to the role of the geosciences in the achievement of the 17 SDGs, a table proposed in 2017 [3] demonstrates all the geological branches helpful in achieving the goals.

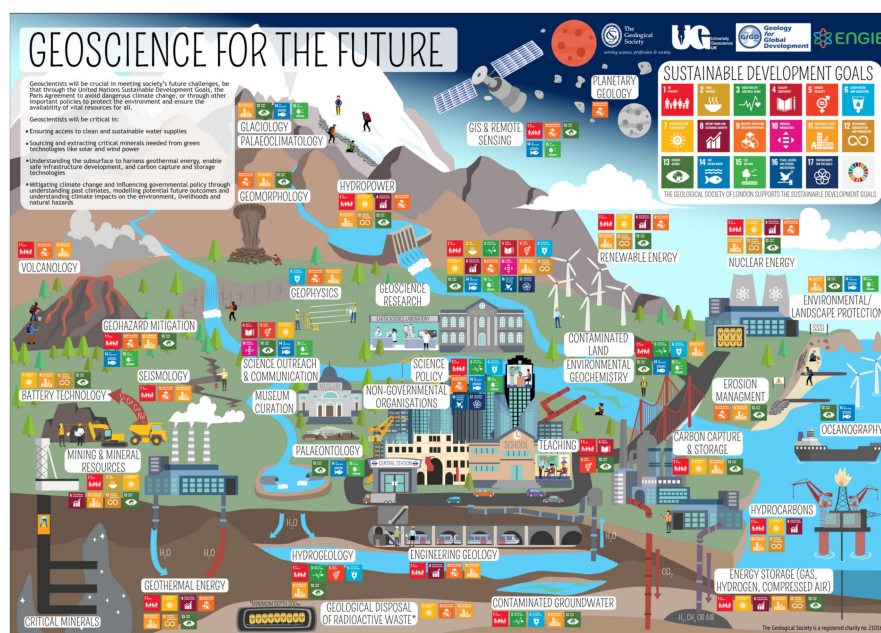


Figure 2. The poster “Geosciences for the future” made by The Geological Society of London [36] in 2021 (licensed under CC BY-NC-ND 4.0).

1.3. Geoethics and Sustainability

As mentioned above, the debate around ethics and environmentalism issues in the Italian geoscientific community has led to the emergence of a new discipline, geoethics.

Geoethics is defined as the “research and reflection on the values which underpin appropriate behaviors and practices, wherever human activities interact with the Earth system” by the International Association for Promoting Geoethics (IAPG) [37]. Dealing with the social role and responsibility of geoscientists [5], geoethics can be considered a philosophical approach, a school of thought [38] that promotes appropriate practices to shape responsible and sustainable relationships between human activities and the Earth’s systems [6].

Following the Italian tradition of reflection on the ethical aspects connected with geosciences [39–41] the first session on geoethics in a geological conference was organized for the first time in Italy, during the GeItalia congress in Rimini (2009); at the international scale, the first session on Geoethics was held during the European Geosciences Union (EGU) in Vienna in 2012. In the same year, the foundation of IAPG fostered the creation of a community to share ideas and address geoethical issues [7].

During the 35th International Geological Congress (IGC), held in 2016 in South Africa, a document that summarizes the values, concepts, and contents of geoethics was promoted, providing a perspective for the future development of geoethical thinking [8]. The result was the Cape Town Statement on Geoethics (CTSG) [8], which has been supported, since the beginning, by many geoscience organizations. The CTSG is strictly connected to the previous Geoethical Promise [42], a sort of Hippocratic Oath for geoscientists towards sustainability.

The Geoethical Promise and CTSG are important not only for the geoscience community but also for society as a whole [43]. Indeed, in recent years, geoethical thinking has spread to other techno-scientific disciplines [38].

The ambitious aim of IAPG is a pedagogical proposal based upon geoethics [6], with both formative and political purposes. In fact, both of these aspects should deal with the principles of geoethics, in order to face the big anthropogenic changes and ensure a more sustainable future.

Connecting geosciences with sustainability issues means dealing with the ethical dimension and societal implications of our research studies, as well as our professional

activities [44]. From this point of view, the increasing importance given to geoethics in the current debate reflects a demand for this new requirement in geoscientists' curricula [45].

2. Materials and Methods

First of all, a user-friendly online questionnaire (using Google Forms) was created, consisting of three main sections:

- (1) Personal information (individual and professional)
- (2) Current knowledge about sustainability, the 2030 Agenda and the 17 SDGs
- (3) Potential interests

The questions are listed in Table 1.

Table 1. Questions present in the questionnaire classified according to their purpose.

Questions	Types of Question
(1) Personal Data	
Who are you (gender)?	Closed (Single answer)
What's your age?	Closed (Single answer)
In which university do you study /work?	Open
In which department do you study /work?	Open
Which level of graduation do you have?	Closed (Single answer)
Which is your specific field of interest?	Closed (Multiple choice)
(2) Knowledge	
Have you ever heard about the 2030 Agenda and 17 SDGs?	Closed (Single answer)
How would you define your knowledge about sustainability?	Closed (Single answer)
Where does your knowledge about sustainability comes from?	Closed (Multiple choice)
Does your knowledge about sustainability has changed some of your behaviours?	Closed (Single answer)
If yes, which ones? (connected to the previous)	Closed (Multiple choice)
(3) Interest	
Do you think EfS is important?	Closed (Single answer)
Have you ever heard any initiatives about EfS in your department?	Closed (Single answer)
If yes, which ones? (connected to the previous)	Closed (Multiple choice)
If no, would you join activities about EfS?	Closed (Single answer)
Which aspects of sustainable development do you think are suitable for Earth Sciences educational curriculum?	Closed (Multiple choice)
For which ones of the 17 SDGs do you think Earth Sciences can be helpful?	Closed (Multiple choice)
If you want, you can write here your idea or a personal comment about the relationship between geosciences and 2030 Agenda	Open

None of the answers were compulsory, so there is little difference in the number of the answers received question by question (generally speaking, ± 2).

The answers to the last question have been analyzed with a content analysis; the other data, instead, are quantitative.

The questionnaire was submitted to every participant (more than 400) using the mailing list of the organization staff 10 days before the congress. A recall was sent one week later to everyone. Finally, we produced a QR code with a direct link to the form and we exposed it during our presentations at the congress.

The Case Studies: Torino and Napoli

One of the specific objectives of the research was to understand the role of ES departments in promoting EfS. Two of the questions were related to this aspect, one in the second section (“Where does your knowledge about sustainability come from?”) and one in the third (“Have you ever heard of any initiatives about EfS in your department?”). Nonetheless, it was immediately clear that the answers to this last question may not be completely truthful: the fact that respondents have/have not heard about activities on EfS in their department does not mean at all that departments have or have not activated them. Thus, we decided to check the real situation by looking at the educational opportunities on offer in their respective departments. Since the departments represented in our answers numbered more than twenty, we focused on the two most representative departments, DST (Dipartimento di Scienze della Terra) of Università di Torino, Piedmont Region (17 answers) and DISTAR (Dipartimento di Scienze della Terra, dell’Ambiente e delle Risorse) of Università di Napoli, Campania Region (10 answers).

The survey on the educational offerings was made via the websites of the two departments [46,47] in which the activities programs were easy to find and download. After the individuation of some sustainability-related terms, the title and the description of every single course (BSc, MSc, PhD) were analyzed. The terms searched were: sustainability, sustainable development, 2030 Agenda, sustainable development goals.

3. Results

The answers received are 110 in total, approximately 25% of the participants in the BeGeo 2021 conference.

The results are illustrated in this chapter, section by section.

3.1. Personal Information

The first question is about the gender of the participants. The majority of the respondents answered “male” (56.4%), the other part “female” (42.7%). Only one person (0.9%) answered other. The age range of respondents is mostly 26/30 (63.6%), followed by 20/25 (23.6%) and some over 30 (12.8%).

Thanks to the third question (“In which university do you study/work?”), it was possible to understand the academic background of the questionnaire participants. The answers showed that the participants came from 26 different Italian universities (Figure 3). In addition, three of the answers referred to three foreign universities (Royal Holloway—UK, Universidad de Salamanca—Spain, Tongji University—China).



Figure 3. Geographical distributions of the participants to BeGeo 2021 conference. The red dots represent all the Italian universities offering a geological degree.

With regard to the educational level of the participants, 11.8% of the respondents had a bachelor's degree (BSc); 67.3% answered that they had a master's degree (MSc); 19.1% hold a PhD. In total, 1.8% of participants had only a high school diploma.

With regard to the participants' fields of study/research, it was possible to identify 18 areas (Figure 4). Among these, the prevailing one was structural geology (20.6%).

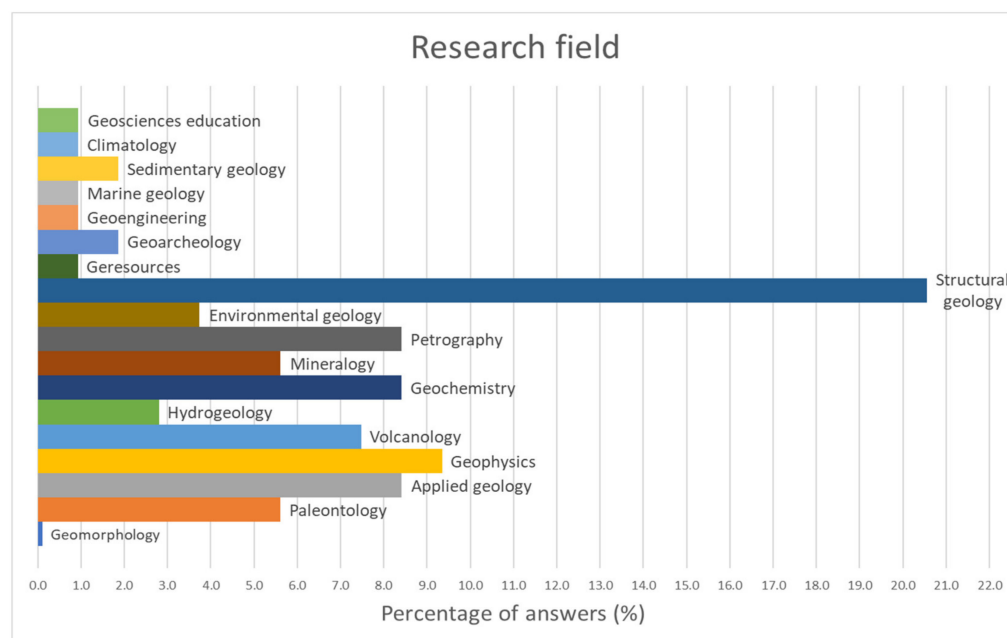


Figure 4. The research fields covered by the participants.

3.2. Knowledge about SDGs

Relating to the first question of this section ("Have you ever heard about the 2030 Agenda and 17 SDGs?") the majority of respondents declared they had limited knowledge (Figure 5a).

When asked about sustainability (Figure 5b), on the other hand, the majority claimed to have an average level of knowledge of the topic (63.6%) and 14.5% in-depth knowledge. Only 1 in 5 respondents said that his/her competence on the subject is poor (21.8%).

To better investigate the variety of the sources of their knowledge, the following question ("Where does your knowledge about sustainability come from?") allowed a multiple choice. Innovative sources (social networks, blogs, websites, 73.6%) and traditional ones (TV, radio, newspapers 52.7%; books and documentaries 55.5%) seem to be the principal information channels. Schools clearly have had a secondary role in their education for sustainability (Figure 6).

In general, the respondents answered almost unanimously (91.8%) that knowledge about sustainability changed some of their behaviors. Figure 7 reports the answers of those that answered positively to the previous question, emphasizing that the most widespread behavioral changes involve waste sorting, purchasing choices and transport.

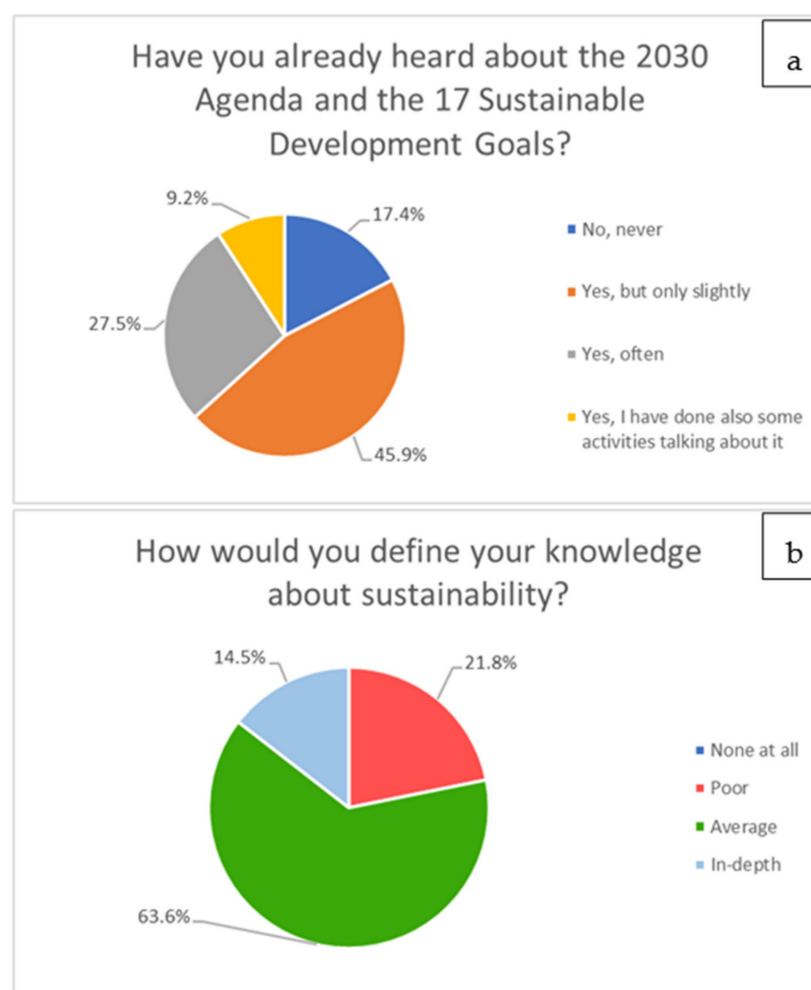


Figure 5. Self-evaluation of personal knowledge about the 2030 Agenda and SDGs (a) and sustainability in general (b).

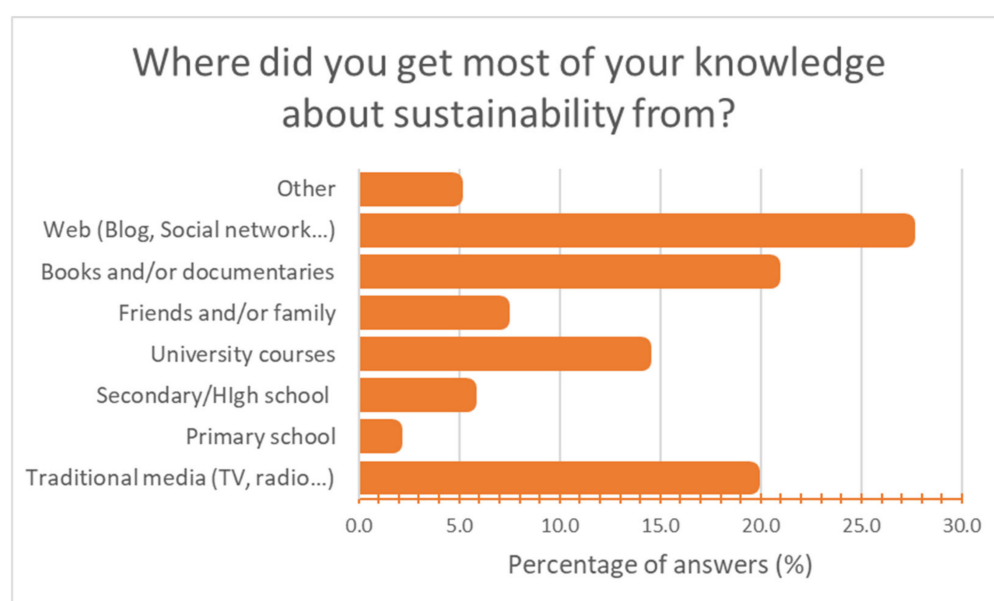


Figure 6. More common sources of information about sustainability issues.

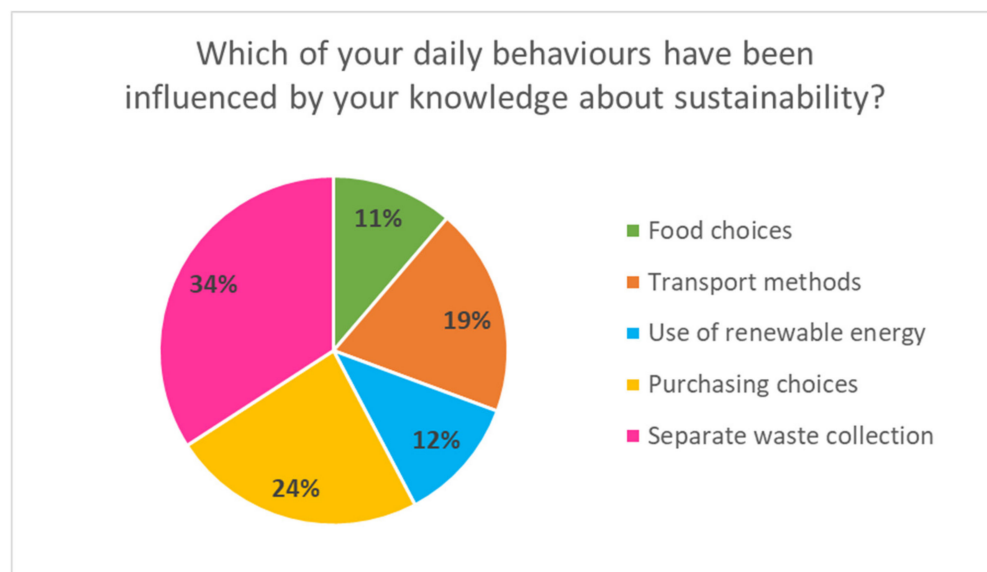


Figure 7. Impact of knowledge on daily behaviors.

3.3. Interest about SDGs

Almost all the respondents (99.1%) answered that they consider EfS important at every educational level.

After this basic question, to better understand the real interest in sustainability, it has been asked if the respondents have ever heard of any initiatives about sustainability in their department: 56.4% said yes, 43.6% no.

Then we proceeded to ask the ones who answered yes (62 persons, 56.4%) to indicate which kind of activities their departments had initiated about sustainability, providing them with a multiple choice of four answers (courses, seminars or workshops, specific PhD or degree programs, special projects). In accordance with the answers, the initiatives about sustainability are often seminars and workshops (35.4%), rather than disciplinary courses (18.3%). Some of the respondents had heard about specific PhD or degree programs (29.3%) and 17.1% about special projects in their department (Figure 8).

Concerning respondents who had not heard about any initiatives about sustainability in their department, 89% of them declared that they would like to participate in such activities; only 11% did not show any interest.

The last two questions of this section focused more on the connection between sustainability issues, the 2030 Agenda, education and the practice of geosciences.

For the first one (“Which aspects of sustainable development do you think are suitable for Earth Sciences educational curriculum?”), a list of possible answers has been set, with the possibility of selecting “other” or of providing a better specification of various aspects. Figure 9 shows that the major interests of the respondents focus on sustainable use of geological resources (14.9%), renewable sources of energy (14.7%), and management of the territory (14.5%). These three main aspects are followed by studies on climate change (12.5%), waste management (10.6%), geohazards (11.0%) and water management (10.6%). Only a few people chose the answers education to sustainability (6.3%) and agrogeology (3.7%).

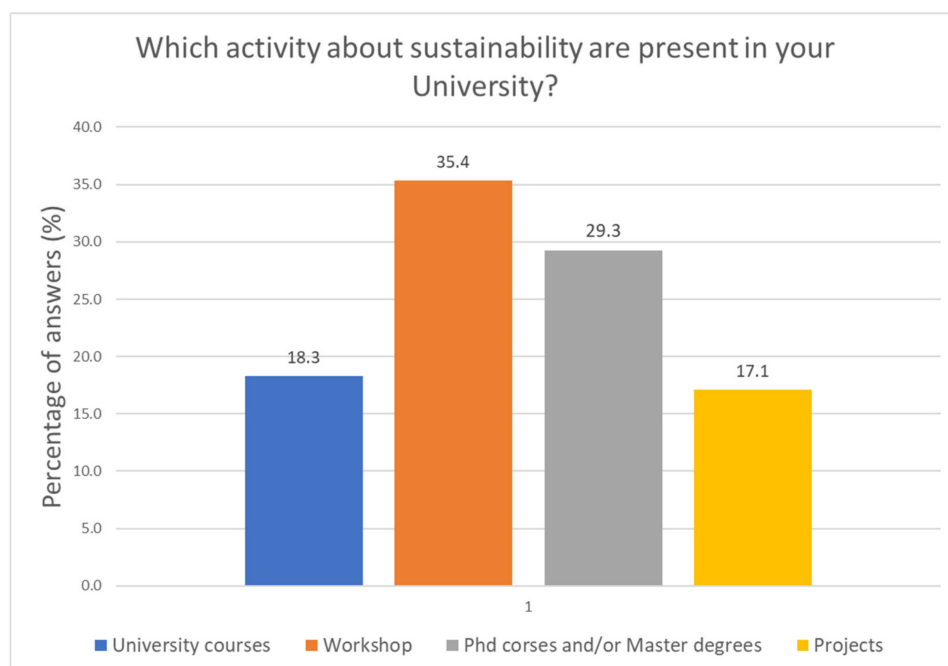


Figure 8. Different typologies of activities about sustainability in geosciences departments.

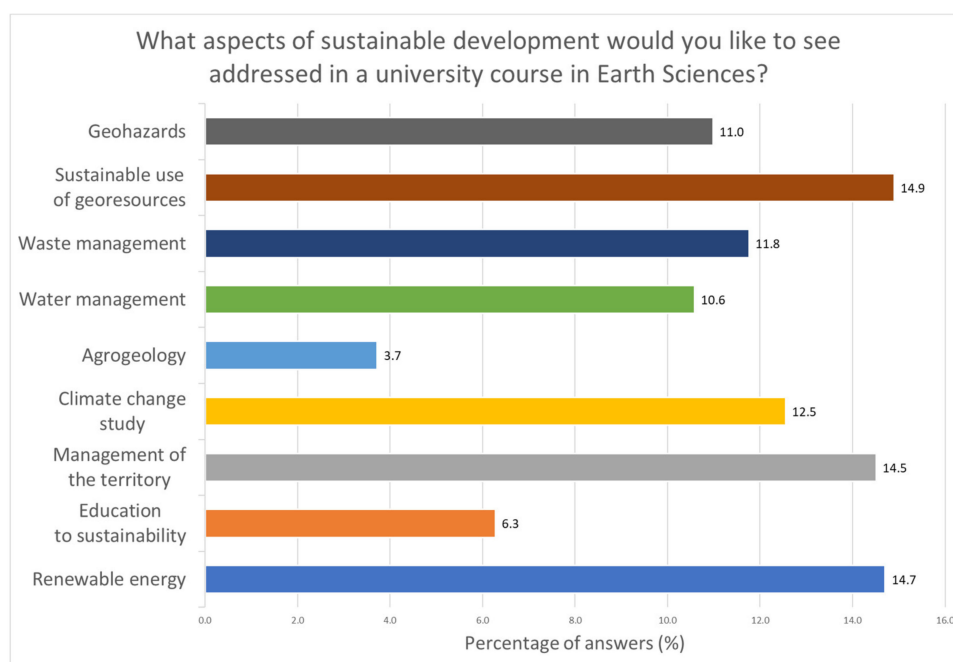


Figure 9. Major interests of the respondents for future courses about sustainability issues.

Finally, the 17 SDGs have been listed, with respondents being asked to select those SDGs in which the geosciences can play an important role (multiple choice was allowed). As shown in Figure 10, four of the SDGs were the most selected ones; these were goal 7 (affordable and clean energy, 73.8%); goal 13 (climate action, 72%); goal 15 (life on land, 72%) and goal 6 (clean water and sanitation, 61.7%). Among those less chosen, we have goals 5 (gender equality, 7.5%), 10 (reduce inequalities, 6.5%), 16 (peace, justice and strong institutions) and 1 (no poverty, 5.6%).

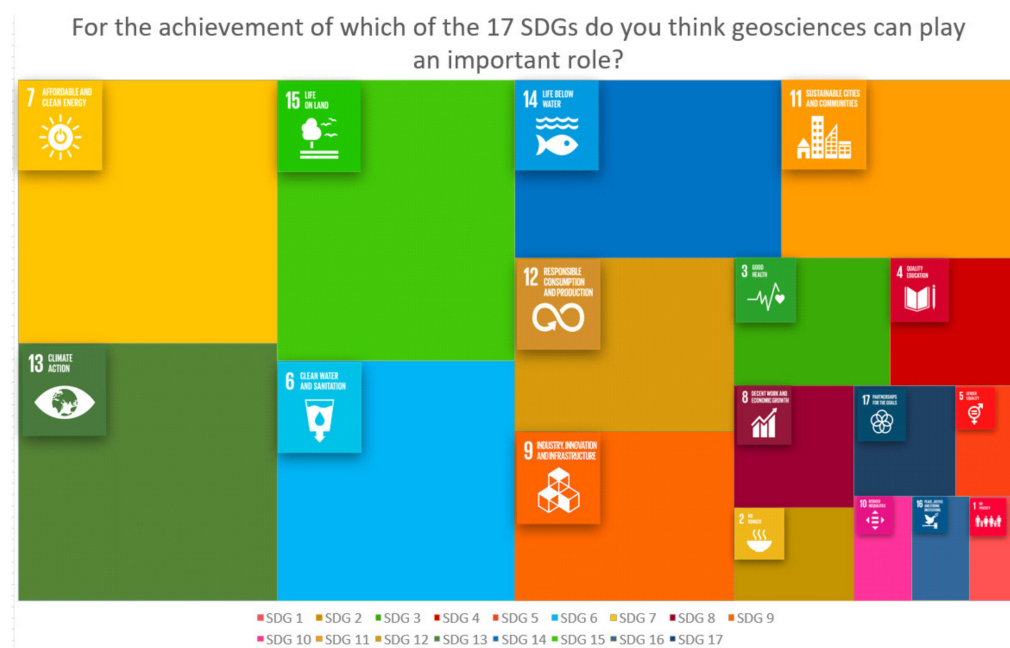


Figure 10. Most selected goals in which the geosciences can play an important role, according to the opinion of the respondents.

3.4. Content Analysis

At the conclusion of the questionnaire, we gave the possibility to leave a comment about the relationship between geosciences and the 2030 Agenda, with an open question. Only 11 respondents left a comment (10% of the total). Obviously, this is a very small sample to analyze (2.5% approximately of the conference participants); however, it has been decided to proceed with a content analysis in order to determine the frequency of certain topics or ideas. Apart from one openly skeptical response (*Don't you think it's possible that the term sustainability is added to many themes just for fashion and convenience?*), no one else had doubts about the importance of introducing the sustainability point of view in the geoscience education. Nonetheless, some responses underlined that there are some obstacles, mainly in the field of ethics and politics. The following two answers are focused on the political aspects:

The 2030 Agenda is a strong initiative, but it does not seem to be accompanied by drastic changes in the development and use of green materials at the political level...in this sense our hands are a bit tied.

All these initiatives seem to me very short-sighted, I would like to see important political positions taken at European level on geo-resources.

A crucial ethical issue, instead, is underlined in this answer, that was given by a foreign PhD student and deals with public behavior in Italy:

If you are not able to clean your streets or to remove the trash that is lying around everywhere, you won't be able to educate the people in sustainability, because they see every day that no one cares.

One respondent is openly critical of the role of departments:

I think the Departments are just pretending to adapt to what is a real revolution in Energy Transition (. . .) We geoscientists come out of university and have no idea what a real job is like in, for example, companies in these new emerging industries.

Nonetheless, the importance of geosciences for sustainable development seems to be well recognized:

Among the disciplines involved to foster a set of skills in sustainable development, there are also the Earth Sciences; in the academic year 2021/2022, students attended a course in paleontology and paleoecology (GEO/01) [48].

Finally, UniTo is one of the university partners of the national PhD program in Sustainable development and climate change, a project of the School for Advanced Studies IUSS of Pavia and the Center for Climate Change Studies and Sustainable Actions (3CSA) of the Federation of the Italian Schools of Advanced Studies, co-funded by the Italian Ministry of the University and the Research (MUR) [49]. The first curriculum (CU1) of the program is in Earth systems processes and new perspectives in environmental development, in which the candidates study the key processes and interactions that determine the Earth's climate, comparing the changes of the last decades with the ones that occurred in the distant past (paleo-climate) and investigating the impact of climate change also on the land surface and sub-surface. However, DST is not directly involved in the teaching courses of this curriculum.

The Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse in Napoli (DISTAR) has a bachelor's degree in Geological Sciences and a master's degree in Geology and Applied Geology. As in DST, in these two programs (in which the majority of the students are supposed to graduate) there are no occurrences of our keywords. Nonetheless, DISTAR in collaboration with the Department of Biology offers also a degree in Sciences and Technologies for Environment and Nature (STENA), that aims to train graduates with an interdisciplinary and systemic preparation in the field of Natural Sciences and Environmental Technologies, based on biological, geological and ecological knowledge [50].

At the moment of our investigation (1 April 2022), the website showed only teaching courses up to the academic year 2019/2020. The lists of teaching courses do not show which ones are directly involved with geological knowledge.

4. Discussion

BeGeo 2021 was a unique chance to gather a great part of young Italian geoscientists. Most of them (87.2%) were under 30; this means that most likely they will be part of the future geoscience departments for at least the next 20 to 30 years. This period (up to 2050) is crucial for the future of our society and the relationship between the environment and humankind [51], so is the conviction that their knowledge and interests are fundamental to connecting the Earth Sciences with sustainability issues and to building a pedagogical proposal for the new generations that moves toward geoethical principles [6].

The answers received for questions 1 and 2 of the knowledge section are easily interpretable: since sustainability is at the center of public and scientific debate, 78.1% declared to have average or deep knowledge on this topic; but only 36.75% thought they had a sufficient background on the 2030 Agenda. These data show that the sustainability education of a geoscientist nowadays in Italy still lacks a connection with the general framework of EfS. Students of the Earth Sciences deal every day with problems of natural resources, sources of energy, environmental protection, but rarely do they have the competencies to frame their studies "in the bigger picture", even with something very famous such as the 17 SDGs.

Are the Italian departments of Earth Sciences trying to improve their students' knowledge of sustainability issues? From the case studies of Torino and Napoli the emerging evidence is that in these two departments the word sustainability is not considered valuable enough to appear in the title of the most disciplinary courses (i.e., Geological Sciences and Applied geological sciences), but we find it (and the related terms) in interdisciplinary courses and collaborations with other universities. Yet, that means that it is possible for the majority of the students in Earth Sciences to graduate without attending a course explicitly focused on how geosciences can address SDGs and contribute to their achievement. So, as far as the topic of sustainability is concerned, it can be seen that this is often included in various courses but is not made explicit. Therefore, it would be suitable to formalize the presence of this theme within the various curricula in the Earth Sciences.

This aspect appears paradoxical if we relate it to the other two records: almost unanimously the respondents declared that EfS is important and that they would join activities about SDGs if present. There is therefore a great deal of interest and a deep consciousness of the relevance of EfS for geoscientists' professional and cultural development, and many of the respondents would be particularly interested in studying the sustainable use of geological resources (71.7%), renewable sources of energy (70.8%), and management of the territory (69.8%).

Moreover, only 5 out of 17 SDGs were selected by at least half of the respondents as the ones for which geoscience research and practice can be helpful. These goals are affordable and clean energy, climate action, life on land, clean water and sanitation and life below water. Just a small fraction of the answers address some fundamental issues such as defeating hunger, reducing poverty or gender inequalities and promoting peace or social justice. This suggests that in the common opinion of young geoscientists their contribution to achieving sustainable development goals would likely be technical, rather than ethical.

5. Conclusions and Future Insights

The ecological transition requires society not only to find new technological solutions or new resources for energy supply but also to rethink philosophical and ethical frameworks, guarantee a future for humankind on this planet and reduce the likelihood of crossing local or global tipping points [52]. In this realm, the competencies of future scientists (including geoscientists) will be decidedly different from those of today: their real impact on society will depend on how much they will be able to share an inter- and trans-disciplinary point of view with other stakeholders [53], in order to understand the growing complexity of global challenges [54].

More than thirty years ago, a debate started about what would constitute the geoscience departments of the future [55]. Today the answers may be different, but the question remains the same. Not only has geoethics arrived at a turning point [34] but the geosciences are looking for their place in future scenarios. It is our conviction that to rebuild the knowledge and competencies of future geoscientists, we have to analyze what departments offer now, in order to understand if their programs are suitable to educate and train the professionals that will face the future challenges [56].

Our conviction is that education curricula of geoscientists have to be more focused on sustainability and geoethical issues, in order to discover the potential of ES education as a key component of education for sustainability [57]. We suggest that courses related to the ecological and social footprint of georesource extraction, and the ethical problems associated with resource exploitation be included in curricular pathways; it might also be useful to provide doctoral courses with inter- and trans-disciplinary teachings involving ethical, environmental and social aspects.

Recently, the Società Geologica Italiana (SGI) announced that its 91st Congress will be held in September 2022 in Turin, and it will be titled "Geosciences for a sustainable future". This title clearly shows that in the Italian geoscience community awareness about the paramount importance of sustainability issues in Earth Sciences' studies and practices is increasing. Events such as this congress, or the European Geosciences Union (EGU)'s General Assembly held annually, would be good occasions to propose a similar questionnaire to a larger number of participants, thus extending the research not only nationally but also internationally.

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