PROCEEDINGS OF SCIENCE

“Warning!”: an interdisciplinary project to discuss about the big planetary threats

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The project “Warning! The big planetary threats: knowing them to defend ourselves” aimed to develop interdisciplinary educational paths on the themes of environmental fragility and danger, addressing a wide audience but with a specific focus on young people. The initiative consisted of 5 debates were scientists presented an in-depth scientific analysis of so-called natural disasters, i.e. phenomena related to climate change, major pandemics, endogenous events (i.e. volcanoes and earthquakes), the fall on the earth's surface of asteroids and space debris and finally to the pollution of the seas, and their consequences. The aim was to foster a “culture of being ready” consisting in the adoption of responsible and scientifically sound behaviors, overcoming a culture dominated by the “here and now” and therefore little motivated to tackle long-term problems. All the considered phenomena have decidedly complex characteristics: the unpredictability or difficult predictability of their development, the quantification of the risks, the dangerous interconnections among them, the increasingly global nature of their effects and the diversity of their impact according to the social, economic and even cultural situations in the various geographical areas. The debates underlined the importance of internationally supportive initiatives to address these dangers. An interdisciplinary approach was used stressing the importance of the scientific method to face complex problems. Physics was the “fil rouge” accompanying the participants in this journey across many fields of science. The various events took place virtually, allowing the participation of more than 3000 high school students from about 20 schools. To encourage the conscious and direct participation of students in the debate, explanatory material provided in digital form was made available to interested teachers. Students were asked to present their questions to the speakers in advance, therefore a significant part of the seminars was devoted to answering student questions. “Warning” represented a useful educational support for students and teachers, who were able to attend the events in a “virtual classroom”, and integrate topics covered in school programs.

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1. Introduction

The SARS-CoV-2 pandemic [1] [2] is the most recent source of global risk for mankind but it is certainly not the only one. Consistent parts of the planet (also in Europe and Italy) are permanently exposed to high natural hazards. Life on earth is constantly exposed to earthquakes, volcanoes, floods and extreme climatic events due to ongoing climate change. Not only that, even external events such as asteroids can pose a great risk to our lives [3]. All these phenomena are characterized by a high degree of complexity: their prediction is highly unpredictable as is the assessment of risks. Furthermore, the interconnection between the various phenomena and of these with the socio-economic characteristics of territories and populations make their evaluation even more complex. In short, the real world is dominated by complexity and the scientific method is the only tool we have to deal with it [4].

To deepen these issues and attract the attention of the younger generations to this, the Pisa Foundation and the Italian National Institute for Nuclear Physics (INFN) have launched a cycle of seminars entitled “Warning: the great planetary threats. Knowing them to defend ourselves”, which took place between December 2020 and March 2021. The initiative conceived as an educational enrichment path for high school students it has been extended to the general public. The main purpose of the initiative was to raise awareness of the complexity of phenomena using an interdisciplinary approach based on scientific methods, thus overcoming the limits of a vision dominated by the "here and now" typical of our era.

“Warning” was therefore conceived as a knowledge dissemination project addressed to the general public but with a specific focus on the younger generations, organized in five events dedicated to specific issues addressed in an interdisciplinary way and from different and complementary perspectives. The “file rouge” that accompanied the participants in this journey was the scientific method and in particular the approach typical of physics.

2. The events organization

The project is carried out by Italian National Institute for Nuclear Physics (INFN) and Fondazione Pisa with the support of Palazzo Blu. INFN is the Italian research agency dedicated to the study of fundamental constituents and interactions of matter. Among its missions there is the transfer of acquired knowledge to the society, both as technology transfer and diffusion of the scientific culture. Fondazione Pisa is a banking foundation active in Pisa areas in the fields of philanthropy, cultural heritage and scientific research. Palazzo Blu is a center of cultural activities and exhibition managed by Fondazione Pisa.

For each events were invited two renowned speakers with complementary and interdisciplinary expertise about the events subject to give a wide view of the subject matter [5], [6], [7], [8], [9].

3. Methodology

Each seminar was the end-point of a long educational path started at least a month before with a two hours webinar to give teachers information materials about the specific topics. The recording of the webinar together with explanatory material was made available to teachers and

students to deepen, during the school hours, the topics treated in the seminar. To encourage the direct participation to the debate students were asked to prepare and send questions to the speakers in advance. On average we collected about 600 questions for each seminar so an accurate classification and selection procedure was foreseen. About 3000 students from 25 high schools all around Tuscany participated.

Due to the pandemic all the events took place virtually. Each event was broadcast online on the "Warning" site and on social media as well as being recorded. A significant part of the events was dedicated to answering student questions. Each event was followed online by 700 registered people (on average) and had from 3000 to 9000 offline visualization.

A dedicated web site (warning.palazzoblu.it) was developed for effective dissemination of the project's activities, to collect and made available all the materials about the project and collect students questions.

4. The topics

The five seminars were devoted to: alarms from the atmosphere, biological hazards, geological hazards, risk from the space and the relationships between oceans and climatic. In the following we give an overview of each events.

4.1 Alarms from atmosphere

Starting from the analysis of the physics of the atmosphere, the historical series of measured data were shown, highlighting the increase in the earth's average temperature (1 degree from 1860 until today) and the rise of the seas (10-20 cm only in 20th century) and correlating these effects to the concentration of Green House Gases (GHG) in the atmosphere [5]. Then the economic and social effects caused by extreme events such as heat waves, floods, typhoons caused by climate change were illustrated. There is almost unanimous consensus in the scientific community that it is necessary to significantly reduce GHG emissions to stop climate change.

4.2 Major biological hazards

Obviously this encounter was dominated by the current SARS-CoV-2 pandemic and related disease covid-19 [6]. The usefulness and necessity of behavioral rules such as social distancing, hand hygiene and the use of masks was highlighted. The functioning of vaccines and their importance in fighting the epidemic was also discussed in detail. Ample space has also been given to the historical discussion of pandemics and how they have influenced the fate of entire populations and human habits, highlighting how some methods of contrast have substantially unchanged over the centuries.

4.3 Restless soil

The purpose of this seminar was to present the study of volcanic and seismic risk by reflecting on the various aspects of this topic [7]. This theme is very broad: while a scientific approach allows focusing on the assessment of hazards and their origin, studies that tend to focus on vulnerability reduction and risk communication, as well as popular understanding of risks in hazardous areas, are of great relevance. Many recent studies examine the perception and

communication of seismic and volcanic risk and suggest that these risks are not at the top of the social agenda until an event occurs. An integrated analysis of physical geography, social sciences and economics offers a new point of view for understanding the risk associated with these phenomena. During the seminar it was also highlighted how the studies on the seismicity of a place are very interdisciplinary, involving both the geophysical aspects and the historical analysis of the places and customs. The interaction between man and volcanic-seismic environments is multifaceted and complex.

4.4 Astonishments and hidden dangers from Space

Since ancient times, celestial bodies have inspired interest and fear, especially unusual ones such as comets, but their real danger has only been appreciated in recent times [8]. Only in the eighties of the last century it was assumed that the disappearance of the dinosaurs was due to the impact of an asteroid. Craters on earth have always been considered as the result of volcanic or seismic activity. We have gotten very efficient at identifying and tracking Near Earth Object (NEO) but we still have no solution for comets or asteroids on a collision path with earth. It is clear that a NEO represents a global risk and the only way to mitigate its effects is to identify it long before the possible impact and requires strong collaboration on a global level.

4.5 Climate and Oceans: sinister changes

The oceans cover more than 70% of the earth's surface, they are a source of food for humans, they absorb the carbon dioxide we produce and the microorganisms that populate them are responsible for producing half of the earth's oxygen [9]. It is therefore easy to understand that changes in their chemical and physical characteristics can lead to serious problems for human been and the planet in general. In this seminar, the close links between human activities and the physical and chemical variations of the oceans were analyzed in detail and how these variations in turn cause the climate changes we experience.

5. The survey

At the end of the cycle of seminars a questionnaire was proposed to teachers to assess the degree of satisfaction with the initiative. The evaluation was generally very positive with only some doubts about the degree of direct involvement of the students. The result of this survey constitutes an objective basis for reflection in the planning of the second edition.

6. Conclusions

This project represented a valid tool to support the activity of teachers and students who were able to participate in seminars thanks to a virtual classroom despite the pandemic period. The preparatory material and the seminars themselves made it possible to integrate the normal teaching activity. The success achieved, both in terms of participation and response to the questionnaire, exceeded our expectations. In the light of these results we have created a second edition of "Warning" in which investigate the man-made risks with which we may have to confront in the near future.

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References

[1] https://en.wikipedia.org/wiki/Severe_acute_respiratory_syndrome_coronavirus_2#cite_note-CoronavirusStudyGroup-2

[2] Jennifer Prah Ruger, The Lancet Volume 4, Issue 7, E264-E265 July 01, 2020 DOI: 10.1016/S2542-5196(20)30147-9

[3] Romana Kofler, Gerhard Drolshagen, Line Drube, Alissa Haddaji, Lindley Johnson, Detlef Koschny, Rob Landis (2019) International coordination on planetary defence: The work of the IAWN and the SMPAG, Acta Astronautica Volume 156 2019, Pages 409-415 DOI: 10.1016/j.actaastro.2018.07.023

[4] Alan Reid, Justin Dillon, Nicole Ardoin & Jo-Anne Ferreira (2021) Scientists' warnings and the need to reimagine, recreate, and restore environmental education, Environmental Education Research, 27:6, 783-795, DOI: 10.1080/13504622.2021.1937577

[5] Roberto Buizza and Francesco Lamperti (Scuola Universitaria Superiore Sant'Anna, Pisa) Alarms from atmosphere (https://warning.palazzoblu.it/2020/seminari/le-minacce-dell-atmosfera/).

[6] Francesco Menichetti (Azienda Ospedaliera Universitaria di Pisa) and Paolo Malanima (Università di Catanzaro) Major biologcal hazards (https://warning.palazzoblu.it/2020/seminari/pandemie/).

[7] Carlo Meletti (Istituto Nazionale di Geofisica e Vulcanologia (INGV), Pisa) and Viviana Castelli (INGV, Bologna) Resteless soil (https://warning.palazzoblu.it/2020/seminari/la-terra-inquieta/).

[8] Alessandra Celletti (Università di Roma Tor Verata), Laura Faggioli and Ramona Cennamo (NEO Coordination Centre, Frascati – Roma) Dangers from space (https://warning.palazzoblu.it/2020/seminari/meraviglie-ed-insidie-dallo-spazio/).

[9] Elisabetta Erba (Università di Milano) and Carlo Barbante (Università di Venezia and CNR) Climate and Oceans (https://warning.palazzoblu.it/2020/seminari/gli-eventi-oceanici/).