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Development skills through responsible research and innovation educational practices

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Secondary education faced the challenge of integration Responsible, Research and Innovation (RRI). Involving students and teachers in reflecting on the role of research and innovation (R&I) fosters sustainable interactions between schools, researchers, industry and civil society organizations, both in formal and informal learning. On the other hand, following challenges of priorities set by the European Commission, school has to include innovative educational learning activities for development students' skills being in interaction with society and workplaces. This means that teaching science is not only about implementing inquiry learning activities in classroom, but it has to highlight the importance of science, research and innovation to young peoples' lives and prepare them to become responsible citizens. This paper presents the learning scenario of earthquakes as inquiry process including RRI components, as proposal to educational community for rebranding the way of teaching science in classroom.

Introduction. Why Responsible Research & Innovation?

It is the ambition of the European Union (EU) to ensure that research and innovative ideas can be turned into products and services that create jobs and prosperity, as well as help preserve the environment and meet the societal needs of Europe and the world. To achieve this, the European institutions, its Member States and private business actors invest considerable monetary and human resources into Research, Development & Innovation (RRI). The need to gear the innovation process to societal needs is reflected in many high-level policies, strategies and programming documents, such as the objective of the EU 2020 strategy to create smart growth or the Horizon 2020 programme that defines tackling societal challenges as one of the main priorities (European Commission (2010a). In the same terms, in 2007, under the seventh framework programme for research & technological development (FP7), of exploratory learning and teaching. 'Science and Society' became 'Science in society (SiS)' with the main objective to foster public engagement and a sustained two-way dialogue between science and civil society. (It) touches mainly upon civil society engagement in Research & Innovation, supported by further activities enabling easier access to scientific results, better uptake of the gender equality and ethics dimension in R&I, and formal and informal education to science.

RRI and Science education

Science education has a very critical role for the implementation of the new paradigm of RRI where a new relationship between science and society is to be established. Teachers faced the challenge of ensuring tomorrow's researchers and citizens have the necessary knowledge and skills to fully participate and take responsibility in the research and innovation process. RRI inspires all levels of science education to adopt an inquiry approach to science. Such as, formal and non-formal providers can use new tools and methods in order to integrate responsibility and responsiveness within RRI, so educational programs combine Science, Technology, Engineering, Mathematics and – moreover Arts and Computing (STEAM [6] and STEM+C [8]) with social, economic and ethical principles.

The deliberate involvement in students' scientific and technological research procedures is considered an essential requirement towards the development of scientific and technological literacy. On the other hand, RRI for students' scientific literacy is essential to foster responsible citizens. Young learners have natural-born curiosity, full of questions and wonder. Science education must help learners develop scientific thinking and challenge students to build a base of knowledge and skills for solving problems with increasingly in-depth solutions with sophisticated explanations along their lives. Teaching science is creativity preparation for the cultivation of students' scientific skills in the way of critical thinking, to acquire an important role in the development of the various sectors of human activity.

The integration of inquiry based science learning (IBSL) methods into the socio-scientific inquiry-based learning (SSIBL) approach represents an opportunity to introduce RRI into science education at schools. The SSIBL approach in STEM classes, supports both the development of scientific literacy and the acquisition of key skills for STEM such as inquiry and critical thinking skills. These practices can be easily integrated into any type of school activity. The integration of Responsible Research and Innovation (RRI) principles in educative contexts can be strongly beneficial for students, as it supports them in the development of critical thinking and collaborative learning skills while accommodating multidisciplinary and stronger student engagement. Hence, it is essential to lay out principles that will help on the implementation of RRI in teaching and learning activities in schools.

Under this framework, teachers should use high-quality vocational training opportunities and access to educational resources, feedback and re-organization of teaching practices and methods that provide RRI in Science classroom. The use of digital repositories of European projects that provide educational material, research studies and reports, good practices, free of charge, seminars on the integration of innovative teaching practices in the classroom on science (mathematics, biology, physics, chemistry, geography, astronomy, mechanics, robotics etc.) are a driving force for following RRI at primary and secondary education. The overall aim of this paper is to identify the RRI potential in the teaching-learning scenarios with the characteristic examples of earthquakes.

Earthquakes as inquiry learning process

Following the steps of an inquiry learning process for development citizen skills, at the observation phase students recall their knowledge for lithospheric plates; observe and compare maps that present the limits of them and the distribution of earthquakes; identify that the recording site of earthquakes are related to the limits of lithospheric plates; interpret data presented on maps. After the introduction, they are able to make reasonable hypotheses based on evidence of maps and their prior knowledge; they justify their assumptions, based on the morphology of the lithosphere they observe on the maps. The activities of why an earthquake occur, follow the study of what happen on an earthquakes. At the investigation, phase students study a) the types of seismic waves b) the characteristics of waves c) the propagation of seismic waves in the Earth's layers. Through access to the real data of the seismographs, students try estimate the distance between the epicenter of an earthquake and a station and not the exact location of the epicenter. Thus, you can draw a circle to represent the distance on a map. The center of the circle is the location of station and the radius of the circle corresponds to the distance between the station and the epicenter of the earthquake. The epicenter of the earthquake will be located to the point where all three circles intersect. Moreover statistical analysis through the recording data from at least 5 center-stations that record earthquakes nearby; record the areas that have experienced earthquakes of more than 5 degrees of the Richter scale; record when and where has the largest earthquake took place in the course of the last years; which areas are exhibited intense seismic activity, and so on. At the conclusion phase students make decisions of preventive measures, should we take for earthquakes and how could react to the time of the earthquake.

Earthquakes as RRI initiative

Through the specific project School Study Earthquakes (https://sse-project.eu/) engages students in employing real-problem solving skills, handling and studying situations, and participating in meaningful and motivating science inquiry activities. The RRI component of the project lies in the fact that students deal with real seismic data that they have acquired themselves while they have to communicate their findings to the local communities. In countries like Greece, Italy and Bulgaria the phenomenon is rather common. Surveys in the field demonstrate that the general public is not well informed on the necessary measures that have to be applied to minimize the impact of the natural phenomenon. A complicated geophysical phenomenon like the earthquake is possible to be studied in the classroom with the use of a simple instrument and results can be obtained with the combination of data from the collaborating schools.

Conclusion

Students take the role of researchers in employing real-problem-solving skills, handling and studying situations, and participating in meaningful and motivating science inquiry activities, understand how to manage real data and are able to know the importance of working and experimenting with this type of information, reflecting on the need to provide full mechanisms for scientific research.

References

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