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Students’ Perception Related to a Responsible Research and Innovation Demarche

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Abstract

The present paper deals with the perception analysis of the importance of the non-formal education, performed as specific activities developed in museums, which promotes Responsible Research and Innovation (RRI) to the primary and secondary school students. A standard research, of theoretical and empiric type, has been achieved. The empirical research aimed both on the quantitative level - the method of structured questionnaire - but also on the qualitative research, based on the focus group method. Some analysis was drawn yielding to the following conclusion: non-formal education performed in museums is reflected like a learning process which stimulates the students’ sensitivity and intellect for RRI.

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1. Argument

Non-formal learning activities are constantly present in European projects. Usually, those activities are related to sport education, but can also include professional conferences and continuing professional development sessions (Eaton, 2011). However, actual concepts and processes can be promoted through non-formal learning activities that target to form and develop the human personality in an organized and planned frame, in school and/or extra-school

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environment, outside the formal programmes (Cristea, 2010). In fact, the paradigm “non-formal” defines “an educational reality less formalized or non-formalized, but always embraced with formative effects.” (Cozma, 1998).

In this respect, the FP7 IRRESISTIBLE Project - “*Including Responsible Research and Innovation in Cutting Edge Science and Inquiry-based Science Education to Improve Teacher's Ability of Bridging Learning Environments*” - code 612367, is trying to make young people more aware about *Responsible Research and Innovation (RRI)* issues. Practically, *RRI* represents a process where the societal actors (including researchers, scientists, teachers, students, citizens, policy makers, industry representatives) work together in order to align *RRI* outcomes to the values, needs and expectations of European society.

The actual paper illustrates the main valences of the IRRESISTIBLE project on raising the awareness of *RRI* importance for the actual society, especially for young students, in non-formal educational contexts, by: (a) attracting positive attention from students towards cutting-edge scientific subjects; (b) introducing content knowledge in a different way; (c) offering the support to discuss with stakeholders about *RRI* issues (<http://www.irresistible-project.eu/>). In addition, the paper presents the results of an investigative approach, from a sample of over 100 Romanian young students from primary and secondary education, performed with the occasion of a Workshop entitled “*Nanosciences and Responsible Research*” organized at the History Museum of Targoviste, in April 2014. Students were invited to express their opinions related to aspects that make *RRI* indispensable for the modern society activities and they were briefly asked to describe the effects on their personal development of the activities they followed. The results offer a clear answer on students’ general perception: *RRI* seems to be an important issue that can ensure a trustful and efficient relationship between science and society.

Practically, non-formal education represents a specific and guided process, accomplished outside the traditional school, in a specific environment which is necessary for the learning activities, with formative educative effects on the trainees. Non-formal education identifies in this way *para-school educational* actions (Cristea, 2010), where in a triangulate frame - the educator, the trainee and the non-formal social institution/space - all the mentioned entities become active partners of the instructive-educative process. The non-formal educative activities have concentrated a series of well-articulated practical activities, based on using the active-participative educational methods. The educative environments that may become the object of non-formal education are: museums, libraries, science centers, culture houses etc. In this context, the museum is considered a proper learning environment, a resource of information and a facilitator of knowledge, but also a horizon enlarging, an agent for stimulating the trainees’ sensitivity and intellect.

2. Hypothesis

The steps of this project concerns some hypothesis, which are predictions of the solution to the problems based on knowledge and research. This project research is done with the goal of expressing a problem, proposing an answer to it (the hypothesis), and designing a project experiment to test the hypothesis, as follows:

- Using the resources proposed by the museums as resources in non-formal education, it can be considered the approach of the knowledge from interdisciplinary and pluri-disciplinary perspective, a fact that favor an increase of the trainees’ degree of interest for discovery, by concrete research.
- The expositions organized in the museums, concentrated in objects or collections of objects, sustain the act of critical knowledge and thinking: from simple to complex.
- At the same time, the educational activities performed in non-formal environments stimulate not only the development of the imagination and the increase of the trainees’ creativity, but also the stimulation of the active-participative observation in different activities based on gained knowledge. Those aspects contribute, in our opinion, to the students’ active involvement in *RRI* activities.

3. Theoretical perspective

The explicative paradigms regarding the research in the postmodern society, place the discourse at the level of the progress dimensions and of the benefits of their results on humans, in particular, and on the society, in general. In this context, it is more and more promoted the articulation of the demarches regarding the “novelties” in the direction of considering the *Responsible Research and Innovation* dimension (Owen, Macnaghten, & Stilgoe, 2012).

In the new generation of *EU Framework Programme for Research and Innovation: “Horizon 2020”*, it is underlined the RRI concept: an “approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation”. (<http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>)

Analyzing the dimensions - innovation and research -, it is outlined the following assertion: there are complex actions developed in a responsible manner (Kulciński, 2012) and conditioned by: research ethics, benefit on the society and management of the afferent risks.

Considering the previous explicative settings and reported to education, we may appreciate that the process of RRI is projected early, like an ascendant activator and facilitator of the sustainable social development. In this sense, the education centered on RRI is to be found successfully in the educational formal and non-formal environments.

4. Methodology

As we have previously mentioned, in the present study, it is proposed to reveal the modalities through which the demarches of Responsible Research and Innovation demarches may be promoted and valorized in the context of non-formal activities in which students from primary and secondary students took part.

The activities which are the base of the study have been developed in the IRRESISTIBLE project, as workshops oriented on promoting science and RRI. The first workshop - entitled “*Nanosciences and Responsible Research*” was held at History Museum Dâmbovița, in the frame of the program “*A Different School: To Know More, To Be Better*”, on the 9th of April 2014. During the workshop, presentations, projections and experiments were done, which had the role to introduce to the participant students the concept and components of RRI.

From the methodological perspective, the students’ feedback have been collected using a questionnaire with four items - three pre-established answers and one with an open answer -, in order to identify their perceptions regarding RRI in a non-formal environment. The sample submitted to investigation was formed of 100 students, out of which: 25 students from primary school (IIIrd grade), 38 students from lower secondary school (VIth and VIIth grades) and 37 students from upper secondary school (IXth grade).

In the same context, created by the workshop, in the qualitative research it was used the focus group method, by which was intended the identification of the students’ attitudes and behaviors in situations that claim RRI (considered variables are: ethics, risks and benefits management). The processing of the results was made by statistical method: quantitative, percentage analysis, correlated with qualitative interpretation of the information gathered using the focus group method.

5. Results

The respondents were asked to appreciate the degree in which the specific demarches of Responsible Research and Innovation must be found in the context of the Sciences classes (Chemistry, Physics, Biology). The answers were measured at the level of the respondent groups, namely: primary, lower secondary and upper secondary students (Fig. 1). In this sense, the students from the primary school appreciated in a percentage of 84% that this aspect must be accomplished in a very high measure, and 16% in a great measure. On the contrary, 28.94% of the students from the lower secondary school consider that the specific demarches of RRI must be found in the context of the Sciences classes (Chemistry, Physics, Biology) in a very great measure, 47.36% in a great measure and 23.70% in a moderate measure. At the level of upper secondary school students, the answers are structured as: 24.32% of the students consider that the specific demarches of RRI must be found in the context of the Sciences classes (Chemistry, Physics, Biology) in a very high measure, 32.43% in a great measure and 29.72% in a moderate measure, and 13.53% in a small measure.

The second item aimed the measurement of the perception of the interest generated by the experimental activity in which the students participated (Fig. 2). Thus, 64% of the primary school students appreciated the activity as being interesting in a very great measure, 24 % in a great measure, and 12% in a moderate measure. Students from lower secondary schools considered that the activity was interesting in a very great measure (89.47%) and in a great

measure (10.53%). Students from upper secondary schools appreciated that the activity was interesting in a very great measure only for 16.21% of them, in a great measure for 62.16% of them, and in a moderate measure for 21.63% of the respondents.

Reporting strictly to the performed experiments during the workshop (regarding the formation of nano-fluids), the students from the primary school appreciated that it was interesting for them in very great measure (88%), in a great measure (4%), and in a small measure (8%). Referring again to this experiment, the students from the lower secondary schools appreciated that it was interesting in a very great measure for a percentage of 73.68%, in great measure for 18.42% and in a moderate measure for 7.90% of the respondents. At the level of upper secondary school students, the answers at this item are distributed in percentages as: 27.02% consider that the experiment was interesting for them in a very great measure, 56.75% in a great measure and 16.23% in a moderate measure.

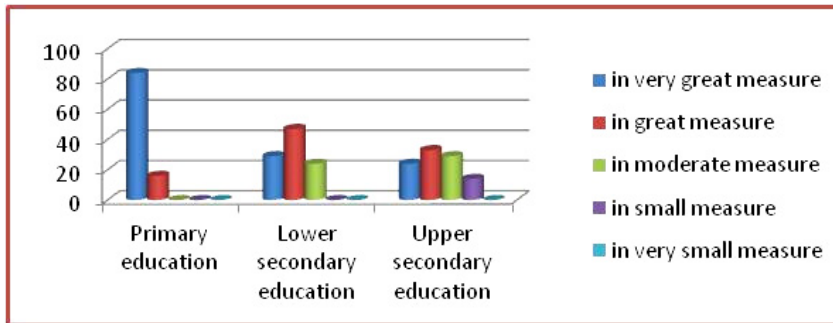


Fig. 1. The measure in which students consider that specific demarches of RRI should be found in Sciences classes.

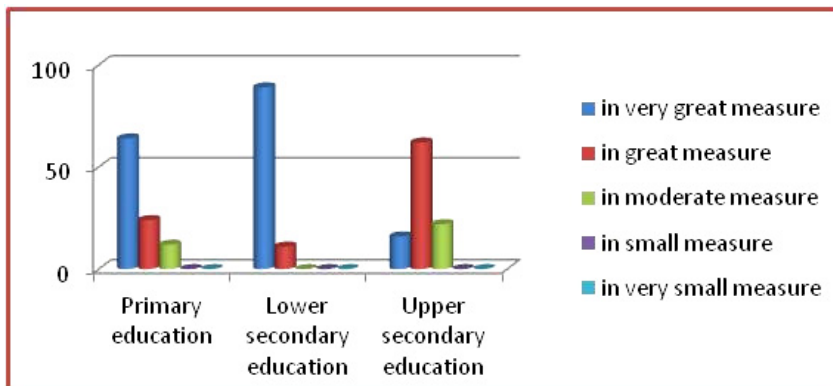


Fig. 2. The perception of the students' interest towards the experimental activities.

The last item of the questionnaire allowed the analysis of opened answers which surprised the students' opinions regarding the idea according to which RRI represent indispensable activities for a modern society. At the same time, we asked the students to make a succinct description of the effects, in a personal plan, produced by the activities in which they participated. In this context, the students mentioned a series of learned ideas/notions, attitudes or feelings etc. The students acknowledged the need for education considering also the non-formal environments. More, nanotechnology is perceived as a field in which the research is attractive, interesting, which stimulates progress. Following the information gathered from the activities developed at the museum, it is admitted the fact that, many of the benefits of the research in the nanoscience field and concretized in several products are known, without knowing (until then) that they belong to the nanotechnology. Reported to the attitude towards the orientation of the educational process in the sciences field, the students appreciate that the education that involves RRI concepts in

non-formal environments eliminates the constrictions and increases the degree of interest and responsibility.

In this respect, it is obvious that the evolution of peak-technologies, typical for the knowledge-based post-modern society, determined the projecting and perfecting of specific forms of non-formal education, through specific channels, including mass-media and Internet (Cristea, 2010).

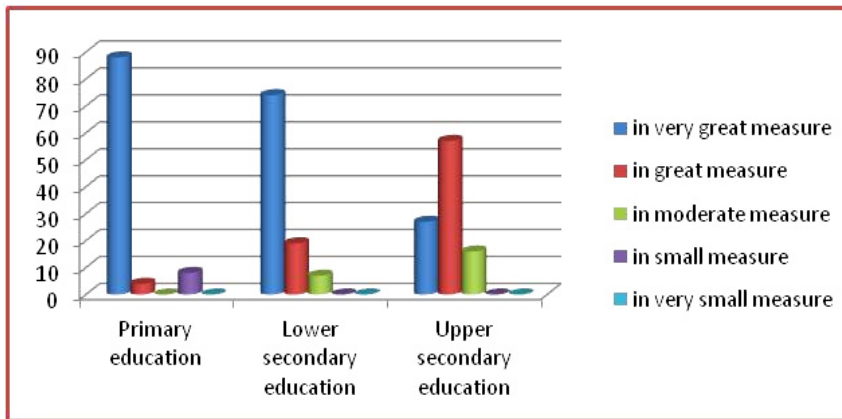


Fig. 3. The students' interest level reported to the experiment concerning the formation of nano-fluids.

6. Discussions

Considering all the factual data previously presented and correlating them with information obtained after the focus group discussions, with the students who took part at the workshop, we may observe a high interest and a very high implication manifested by the students, reported to this problematic.

We must remark the fact that a very high percentage of the students from primary schools consider the specific demarches of RRI must be retrieved in the context of sciences classes (Chemistry, Physics, Biology). This may be explained based on the integrated approach of sciences in primary school, context in which the teachers are interested by the students' awareness regarding the ethical aspects that any research demarche involves.

At the same time, the answers of the students from lower and upper secondary school may be take into consideration the fact that sciences are no longer approached in an integrated manner and the teacher is mainly preoccupied to transmit and assimilate specific knowledge, and less, if not at all, by the ethical aspects of scientific research. In contradiction with this reality determined by the structure of the curricula and the valuable school programmes, we must observe the fact that students from secondary school understand the necessity of integrating information related to RRI in the curricula afferent to sciences classes.

It is important to remark that the experiment regarding the formation of nano-fluids has been appreciated as interesting by most of the students who participated, because it offered the opportunity to directly visualize the manner in which nano-fluids appear. We are referring at learning by action, by experiencing, by students' active implication in the act of knowledge, which produces, in an indubitable manner, superior qualitative effects, reported to the classical approach of sciences, based of pre-established transmission and assimilation of knowledge.

7. Conclusions

The workshop *Nanosciences and Responsible Research*, performed in the frame of the *IRRESISTIBLE* project, recorded a great success, with an important impact on students' level.

The results obtained from the analysis of the feed-back offered by students related to the interest that the workshop *Nanosciences and Responsible Research* aroused among them, emphasize not just a very high interest, but also other relevant aspects - following the discussions made with the students, they were able and happy to share their opinions regarding the activity, demonstrating at the same time, the enthusiasm and the desire that such

experiences to be multiplied. Given the fact that the activity is developed in a non-formal environment, the students expressed themselves freely, spontaneously, independent, not being censured by the rigors of the formal educational environment.

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