Contribution ID: **52**   Type: **Parallel**

The impact of Particle Physics Masterclasses on higher school students'Understanding of Science and Attitudes towards Science

Friday 6 July 2018 11:45 (15 minutes)

This paper presents early results from a research into the impact of Particle Physics Masterclasses on the Understanding of Science and the Attitudes towards science of higher school students. The author has found that science communication efforts in plain science are criticized for being "deficit –style"approaches or ones that seek to educate rather than engage. The literature is lacking when it comes to fields such as Particle Physics Communication whereas much research into public engagement has involved studying fields of research with an immediate impact on human life and society (e.g. climate change, genetically modified organisms, nuclear power). Despite this deficit- style approach into the science communication research field, there is a large Particle Physics researchers community really involved in communication. An example of this engagement are the International Masterclasses, an outreach programme run by IPPOG, International Particle Physics Outreach Group. Each year (in February-March) more than 13.000 high school students in 52 countries were involved; each country has usually several sites and experiments. The global Public Engagement in the field has long been coordinated by IPPOG whereas in Italy the international Masterclasses are coordinated by INFN, National Nuclear Physics Institute, involving in every edition around 3.000 students (aged 15-18). This science engagement format was imported into Italy in 2005 and it involves around 2.500- 3000 higher school students every year.

The sample was extracted from the population of the students that attended the Italian Particle Physics Masterclasses during the 2017, edition that involved 2.700 students (source: Data INFN).
The paper focuses on the quantitative analysis of data which were collected at twice (1) via a paper-based survey distributed to the students before attending the Masterclasses and (2) via an online-based survey distributed to the students after attending the Masterclasses.
In order to measure the Understanding of Science were used variables - consisting of different items - which through a factorial analysis were sum up to create 8 scales: Objectivity, Direct and Indirect Observations, Interpretations, Culture and Society, Communication Findings, Accepting a New theory, Disagree with a Theory, Governments and Politics; with a view to measure the "Attitudes towards science", the reference scale - consisting of several variables - is unique and was defined properly as "attitudes towards science" scale. Futher, the questionnaire provided some open –ended questions to provide more meaningful data as well. To verify any differences in Understanding of Science and in the Attitudes towards Science because of attending the INFN Masterclass, was used a paired samples t-test. The results shown here refer to two topics among all those covered in the survey and relate to a paired comparison between respondents ex ante and ex post:

(1) gender diversity - Concerning Understanding of Science, males appear to have higher scores in "Direct and Indirect Observations"and in "Objectivity"categories; concerning Attitudes towards Science, males in general turn out to have higher scores compared to females.

(2) interest in Physics - Concerning Understanding of Science, students interested in Physics turn out to have higher scores in "Direct and Indirect Observations"; concerning Attitudes towards Science,students interested in Physics appear to have in general higher scores in "Attitudes towards Science"category.

The survey was part of the author's research towards a PhD in Science Communication. This research project for the first time collected data about this outreach format in Italy.

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Session Classification: Education and Outreach

Track Classification: Education and Outreach