

**Effective Teacher's Professional Development: the case of  
School of Rock in Italy**

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3 1 Effective Teacher's Professional Development: the case of School of Rock in Italy  
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21 9 *Key words:* Science Education; Teachers' Professional Development; Laboratory training  
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24 10  
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26 11 **Abstract**  
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28 12 School of Rock is a summer school for science teachers during which teachers become familiar  
29 13 with the International Ocean Discovery Program (IODP) and Earth Sciences through the  
30 14 interactions with IODP scientists and former Education/Outreach Officers. School of Rock 2018  
31 15 was held in Pavia at the University of Pavia and was focused on "Understanding the Climate  
32 16 System through ocean sediments". The school included scientific lectures, practical hands-on  
33 17 activities on IODP cores and databases. Sixteen Science teachers from Italian middle and secondary  
34 18 schools took part in the School.  
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40 19 Our research aimed to understand if School of Rock, based on science teachers' immersion in the  
41 20 process of doing science alongside researchers, could represent an effective way to design the  
42 21 Professional Development for science teachers in the view of fostering their confidence in Earth  
43 22 Science and in the use of an inquiry approach in their classes. We collected information from the  
44 23 participants through ex-ante and ex-post surveys. The results highlighted that School of Rock  
45 24 represented in the teachers' perception an effective professional development. In fact, the  
46 25 participants outlined the acquisition of several benefits such as a general improvement of the  
47 26 content knowledge and new ideas for their teaching practice.  
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45 28 **1 INTRODUCTION**

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8 29 In the last decades, many countries reacted to the decreasing number of students enrolling the so-  
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10 30 called Science, Technology, Engineering and Mathematics (STEM) university faculties with the  
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12 31 implementation of two approaches: 1) reforming secondary school science education and/or 2)  
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14 32 improving science teacher proficiency with a wide offer of professional development (PD). This last  
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17 33 approach arises from the assumption that the decline of interest in science highly depends from how  
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19 34 science is taught (*Osborne & Collins, 2003*).

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21 35 Several documents such as the working document of the Inter-Ministerial Committee for the  
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24 36 Development of the scientific and Technological Culture (2008) and the report of the European  
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26 37 Commission “*Science Education now: a new pedagogy for the future of Europe*” (*Rocard et al.,*  
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28 38 *2007*) highlight the role of teachers in enhancing student’s interest and achievement in science.  
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30 39 Another emerging issue, at least in Italy, is the fact that among the STEM disciplines, Earth Science  
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33 40 is the less considered in the secondary school programs. This is for two main reasons: 1) the  
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35 41 majority of science teachers have a background in biology (*Lancellotti et al., 2016; Realdon et al.,*  
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37 42 *2016*), and 2) the training of the students for the enrolment tests in some scientific faculties focuses  
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40 43 on biology and chemistry.

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42 44 While designing an effective PD for science teachers, different features need to be taken into  
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44 45 consideration: the student’s and teacher’s needs, the academic content, the alignment with the  
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47 46 request of the reforms in education and, last but not least, the ongoing and final evaluation of the  
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49 47 activity. This study belongs to the general topic of the PD of teachers, in particular science teachers  
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51 48 in Italy, addressing specifically the issue of PD designing and assessment. We present strengths and  
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53 49 weaknesses of a Summer School for science teachers, the “School of Rock”, held in Italy in July  
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56 50 2018 and funded by the European Consortium for Ocean Research Drilling (ECORD) and the  
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58 51 Italian Committee of the International Ocean Discovery Program (IODP - Italia).  
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3 52 The International Ocean Discovery Program (IODP) is the longest-living international co-operative  
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5 53 research program in Earth Science (Kappel, 2019). Launched in the USA in 1968 as Deep Sea  
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7 54 Drilling project, it has become a fully international program in 1985, as Ocean Drilling Program.  
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10 55 Similarly, to the international cooperation in space science, Scientific ocean drilling makes large  
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12 56 infrastructures (drilling vessels and platforms) available in every ocean of our planet to perform  
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14 57 research proposed, in a bottom-up mode, by the international researcher community. It is largely  
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17 58 thanks to this program that the plate tectonics theory of has been validated, that we know the long-  
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19 59 term climate history of the Earth, including the polar regions, and that the submarine geohazards  
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21 60 can be understood and quantified. Each scientific drilling expedition lasts on average 50 days, in  
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24 61 which a team of 25 scientists, aided by technicians and the drilling crew, explore the bottom of the  
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26 62 oceans with geological geochemical, biological and geophysical tools.  
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28 63 School of Rock is an educational workshop during which teachers become familiar with scientific  
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30 64 drilling and Earth Sciences through the interactions with IODP scientists and former  
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33 65 Education/Outreach Officers. At international level, this initiative was launched in 2005 by the  
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35 66 IODP US Implementing Organization (IODP-USIO) as an expedition designed for Earth and  
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37 67 Science teachers onboard the drilling vessel “*JOIDES Resolution*”. School of Rock is a four-day  
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40 68 long workshop with lectures given by scientists and practical hands-on activities sessions. Since  
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42 69 2014, European teachers who participated in scientific drilling expeditions onboard the “*JOIDES*  
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44 70 *Resolution*” as Education/Outreach Officers take initiatives to organize educational workshops in  
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47 71 their home country to share their experience at-sea and to teach their colleagues how to bring  
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49 72 scientific drilling science into the classroom. Our research aims to understand if School of Rock  
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51 73 could be considered an effective kind of PD for science teachers in the view of fostering their  
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54 74 confidence in Earth Science and in the use of inquiry in their classes.  
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## 58 76 2 Material and Methods

### 59 77 2.1 Ecord School of Rock 2018: main features

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3 78 The Italian School of Rock was held in July 2018 at the Department of Earth and Environmental  
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5 79 Sciences of the University of Pavia. Lectures and practical hands-on sessions on IODP sediment  
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7 80 and rock cores and database were focused on “*Understanding the Climate System through ocean*  
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10 81 *sediments*” and addressed to a group of 16 science teachers of secondary schools from all over Italy.  
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12 82 This immersive experience has provided Italian science teachers with an opportunity to work side-  
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14 83 by-side with IODP scientists, using current state-of-the-art approaches to solve scientific problems  
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16 84 of global interest, and gaining first-hand knowledge of the results of science expeditions. Invited  
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18 85 speakers were scientists who had taken part in IODP expeditions and/or have strong expertise in  
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20 86 climate change. In particular: Angelo Camerlenghi: Co-Chief Scientist on expedition ODP Leg 178  
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22 87 (Antarctic Peninsula); Technician on expedition ODP Leg 115 (Indian Ocean); Sedimentologist on  
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24 88 expedition ODP Leg 146 (Cascadia Margin). Sergio Castellari: Senior Scientist of the National  
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26 89 (Italian) Institute of Geophysics and Volcanology (INGV) currently Seconded National Expert at  
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28 90 European Environment Agency (EEA), Copenhagen (Denmark). Alessia Cicconi: Outreach and  
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30 91 Education Officer expedition IODP 367 (South China Sea). Florence Colleoni: paleoclimate & ice  
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32 92 sheet modeler at OGS. Laura De Santis: Co-Chief Scientist on expedition IODP 374 (Ross Sea  
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34 93 West Antarctica). Patrizia Ferretti: Shore-based sedimentologist on expedition IODP 359 (Maldives  
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36 94 Monsoon); Sedimentologist on expeditions IODP 344S (Baffin Bay) and IODP 306 (North  
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38 95 Atlantic). Claudia Lupi: Calcareous Nannofossil specialist on expedition IODP 367 (South China  
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40 96 Sea). Nicoletta Mancin: Planktonic and Benthic Foraminifera specialist.  
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42 97 They offered lectures and conducted practical activities about drilling operations, paleoclimate  
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44 98 archives and proxies, timing of climate change, paleoclimate modelling and climate change impacts  
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46 99 and adaptation. The hand-on activities in the laboratory included the description of sediments in  
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48 100 cores, the sampling for sedimentological and paleontological analyses, the preparation and  
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50 101 observation under the microscope of smear slides for the analysis of the calcareous nannofossil  
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52 102 content, the preparation and observation under the microscope of washed residues for the analysis  
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54 103 of the foraminiferal content, the determination of the type of sediment and the processes that

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3 104 generated it, the dating of a sedimentary succession and construction of an age model (Figure 1).  
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5 105 These last two practical hands-on activities were carried out thanks to the book “Reconstructing  
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8 106 Earth’s Climate History” by St. John et al. (2012). The book contains data-based activities for Lab  
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10 107 and Class made with IODP database and it was donated by ECORD to all the participants. Finally,  
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12 108 the school ended with discussion on how to build a teacher network and share IODP resources and  
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15 109 our experiences with the students.  
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## 17 110 18 19 111 2.2 Research design

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21 112 This study is qualitative and exploratory. The target consists of 16 science teachers: 9 middle school  
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24 113 teachers and 7 secondary school teachers. We collected the information from the subject of the  
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26 114 study using one of the most commonly used methods in qualitative research: *ex-ante* and *ex-post*  
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28 115 surveys (Table 1 and 2).

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31 116 Teachers were surveyed before the summer school mainly to collect information with different type  
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33 117 of questions as follows: 1) background questions; 2) questions about motivation and expectation; 3)  
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35 118 question about teaching style 4) content knowledge questions. The questions were closed-ended and  
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38 119 open-ended. In the first case the option “other” was often included in order to avoid the situation in  
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40 120 which no answer was matching the subject’s thought. The survey after the school, initiated  
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42 121 immediately after the end of the school, was aimed to evaluate the effectiveness of the School of  
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45 122 Rock as Professional Development for teachers through closed-ended and open-ended questions.  
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47 123 In accordance with the main literature on phenomenographical research, we analyzed the open-  
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49 124 ended questions of the pre and post surveys applying the discovery approach (*Ashwort & Lucas,*  
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51 125 *2000*), seeking for categories of description of the same phenomenon under investigation.

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54 126 Regarding the criteria of effectiveness, we tried to assess the School of Rock using the four level of  
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56 127 evaluation of Professional Development (*Guskey & Sparks, 2004*): 1) participant reaction to the  
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58 128 experience; 2) gain of knowledge and skills; 3) actual use of the knowledge and skills acquired in  
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60 129 the teaching practice; 4) outcomes in students’ achievement and interest in science.

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### 131 3 Results and Discussion

132 Fifteen teachers out of sixteen participants replied to the surveys. Eleven women and four men.

133 Eight are middle school teachers and seven secondary school teachers.

134 The age range of the teachers is shown in Table 1a while the master degree of the participants is

135 shown in Table 1b. Even if the sample is not randomly selected and so not representative of the

136 entire teacher population, most of the participant teachers have a master degree in Biology as it is in

137 the entire population of Italian science teachers according to the data from the Ministry of

138 Education, University and Research (MIUR).

139 According to the pre-survey results, the main motivations of teachers for the participation in the

140 school are the improvement in the content knowledge, the opportunity of collecting educational

141 material to use in their classrooms and the chance of being in contact with researchers (Table 2a). In

142 fact, only two teachers said that they experienced during the last year some collaboration with

143 scientists and researchers. The lack of contacts between science teachers and scientist has been

144 already highlighted in other studies regarding the PD of science teachers (*Cicconi A., 2017*) and

145 could be considered one of the crucial points that professional developers should address. In fact,

146 different studies carried out in the USA show the importance of the collaboration between teachers

147 and researchers in view of the enhancement of student interest for science (*NRC, 1996; Grove et al.,*

148 *2009; Enderle et al., 2014*).

149 About the previous knowledge of the topics of the summer school, the scientific drilling activity and

150 the evolution of the Antarctic ice-sheet are the less known. In fact, about 40% of the teachers were

151 not familiar before the school with the IODP program and about 50% did not know the *JOIDES*

152 *Resolution*.

153 In the pre-survey, we also tried to explore the teaching style of the participants. About 50%

154 confirmed that they don't use the laboratory in their teaching practice for different reasons: lack of

155 space, material, time and technical help. Even if the sample is not representative of the population

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3 156 of the science teachers this data are aligned with the findings published in the 2008 by the  
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5 157 Committee of Development of Scientific and Technological Culture in its report about school  
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8 158 laboratories in Italy.  
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10 159 On the other hand, the results of the post-survey show that all the teachers gain an improvement in  
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12 160 the contents' knowledge and in their confidence in addressing them (Table 2). The best appreciation  
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15 161 is for the opportunity to relate with scientists. One of the strengths in designing the school was that  
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17 162 the theoretical classes and laboratories were conducted by researchers with a personal, direct  
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19 163 research experience in the topic. Most of the teachers consider the involvement of science teachers  
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21 164 in research activities as a great opportunity of Professional Development.  
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24 165 The School of Rock, due to its brevity (4 days), even if immersive for teachers, cannot be  
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26 166 considered an actual Research Experience for Teacher (RET), a kind of professional development  
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28 167 for science teachers that the literature in education and teachers training shows as one of the most  
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31 168 effective (*Lupi et al., 2018*). Nevertheless, the design of the School of Rock aimed to mirror the  
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33 169 main feature of a RET: the immersion into the entire process of doing science working alongside  
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35 170 scientists.  
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38 171 Regarding the single activity, the highest teachers appreciation is for the practical activities in the  
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40 172 labs such as the preparation of the smear slides, nevertheless these laboratory activities are  
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42 173 evaluated by the teachers as the less usable in their teaching practice for different reasons such as  
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44 174 the lack of time and the need for a technician helping the teachers during the practical activities.  
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49 176 **5 CONCLUSION AND FURTHER DEVELOPMENT**  
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51 177 Although the majority of data we have investigated are self-reported, and the sample is not  
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53 178 representative of the science teacher population, this research represents an introductory exploration  
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56 179 about the design and evaluation of professional development of science teachers in Italy. This topic  
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58 180 is not studied in depth in the Italian educational setting despite the science teacher proficiency is  
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60 181 considered a key point of any reform of the education system.



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3 182 School of Rock is a well-structured activity that seems to be an effective professional development  
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5 183 for Italian science teachers. In fact, the participants outlined the acquisition of several benefits such  
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8 184 as a general improvement of the content knowledge and new ideas for their teaching practice.

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10 185 Overall, the Italian edition of School of Rock seems to have been effective in terms of:

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12 186 1) enhancement of teachers' knowledge in Paleoclimatology and seafloor exploration;
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15 187 2) enhancement of interest in solving scientific problems of global interest through first-hand results  
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17 188 of science expeditions;
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19 189 3) enhancement of interactions with scientists and increase of enthusiasm for Earth Sciences.

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21 190 Finally, some further developments of this study could be an experimental research for the  
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24 191 assessment of the impact of a teacher PD in students' achievement in science and in their future  
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26 192 careers. In particular, in some months the authors will interview the participants in order to know if  
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28 193 they used the activity and the knowledge they acquire in the summer school, in their practice during  
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31 194 this school year.

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35 196 Table and Plate Captures

36  
37 197 Table 1.a) Range of age of the teachers; b) Master degree of the teachers.

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39 198  
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42 199 Table 2.a) Selection of answers of the pre-survey; b) Selection of answers of the post-survey.

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44 200  
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47 201 Figure 1. Photographic summary of the practical activities carried out during School of Rock in  
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49 202 Pavia. A) group work on IODP databases; B) description and sampling of core sediments; C) work  
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51 203 on washed residue; D) preparation of smear slides; E) work on washed residue; F) work at the  
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54 204 polarized microscope; G) practical lab on age model; H) participants and instructors of Italian  
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56 205 School of Rock 2018.

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60 207 Acknowledgements

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Photographic summary of the practical activities carried out during School of Rock in Pavia. A) group work on IODP databases; B) description and sampling of core sediments; C) work on washed residue; D) preparation of smear slides; E) work on washed residue; F) work at the polarized microscope; G) practical lab on age model; H) participants and instructors of Italian School of Rock 2018.

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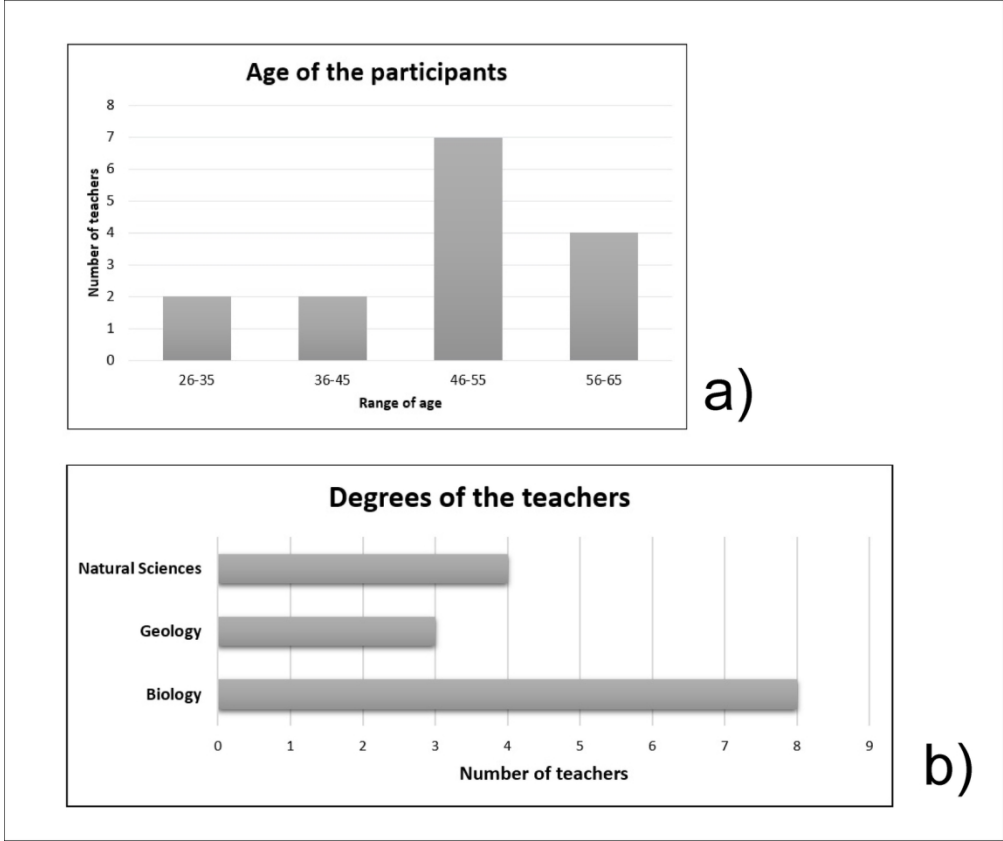


Table 1. a) Range of age of the teachers; b) Master degree of the teachers.

147x124mm (300 x 300 DPI)

I would like to participate in the School of Rock in order ...	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
...to improve my Earth science knowledge	75%	25%	0%	0%	0%
...to link to other teachers	60%	33%	7%	0%	0%
...to connect with researchers	60%	40%	0%	0%	0%
...to change my teaching activity	65%	35%	0%	0%	0%
...to collect new teaching ideas for my classes	86%	14%	0%	0%	0%
...to gain professional development (in general)	55%	45%	0%	0%	0%

a)

Participating in the School of Rock gave me these benefits...	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
...improvement in Earth science knowledge	65%	35%	0%	0%	0%
... link to other teachers	45%	55%	0%	0%	0%
...connection with researchers	65%	35%	0%	0%	0%
...to change my teaching activity	20%	70%	0%	10%	0%
... new teaching ideas for my classes	60%	40%	0%	0%	0%
...to gain professional development (in general)	55%	35%	20%	0%	0%

b)

Table 2. a) Selection of answers of the pre-survey; b) Selection of answers of the post-survey.

149x178mm (300 x 300 DPI)