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Cooperation between schools and university developing professional skills for Prospective Primary Teachers

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Summary. — Physics Education and the relative Laboratory for Physics Education course for Prospective Primary Teachers (PPTs) at the University of Udine include activities, articulated in different topics and carried out in collaboration with schools; this collaboration arises in the context of an interactive exhibition based on hands-on and minds-on experiments where PPTs implement educational paths planned on physics education. We report here the characteristics of the research-based experience carried out in Tolmezzo (Udine, Italy), involving the PPTs professional formative process, the local schools and relative teachers, with the support of Fondazione Pittini.

1. – Idea, context, and research questions

Researches evidenced a lack of scientific literacy in citizens and science is confused with technology, and it is accessible only to experts [1]. Scientific literacy is an important goal for the future generations up to now [2]. Physics is considered a difficult and demanding subject to take into account only when math competences are consolidated and it is taught in trasmissive and structured way in the different kind of schools and levels [3]: this determines a lack of motivation for young people.

Research results show how important it is that scientific education starts early, with the first experience of phenomena exploration, in kindergarten and in primary school. For this scope, it is crucial that teachers are properly prepared. In Italy, the 5-year-long program for Prospective Primary Teachers (from now on, PPTs) includes a Physics Education and relative Laboratory of 9 CTS. At University of Udine, a series of research-based

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activities are implemented in a model based on Metacultural, Experiential, Projectual and Situated strategies (MEPS model [4]). In this framework, PPTs are prepared to design a short educational path to be implement in two hours of Conceptual Laboratories of Operative Exploration [5], using the exhibit Game, Experiments and Ideas (from now on, GEI) [6], where poor materials are organized in 14 topical sections for 450 simple experiments (*e.g.*, fluids, optics, magnetism, circuits, ...) for formal and non-formal education. Each PPT designs a path on a chosen topic, discusses the proposal with a group of 10 peers and then together with the teacher of the course and 150 peers to prepare a two-hours-long individual intervention in the context of the GEI exhibit with about 10 children. Each PPT organizes the monitoring of the children learning by means of semi-structured interviews, simple tasks assigned, and in-out tests. PPTs build their professional identity during this process by means of Physics Education Research resources [4], they meet children curiosity and their teachers, who are also very interested, being the initiative a professional development opportunity for them. This way of working in PPT professional development supports children of many schools on the territory in their scientific learning and is a great opportunity for the school-university cooperation, involving different bodies of the territory as the Municipality, the Regional Theater (CSS Teatro Stabile di Innovazione del Friuli Venezia Giulia), and Fondazione Pittini.

This paper reports the research-based activities held by PPTs in the GEI exhibit that took place in Tolmezzo (Udine, Italy) in January 2020.

Research questions with respect to the goals of PPTs education and school-university cooperation are the following: How did schools participate to the initiative? Which topics are considered relevant by schools for kindergarten and primary schools? How do schools and PPTs make use of the materials available at GEI?

2. – The GEI exhibition in January 2020

The GEI exhibit, born in 1994 [6] in Udine, includes simple experiments on the following sections: measurements and physical quantities, motion, forces and equilibrium, fluids, sound, thermal phenomena, optical phenomena, spectroscopy, electrostatics, circuits, magnetism, astronomy. Each section proposes a range of 15–45 experiments that children can manipulate in order to experience inquiry-based learning in the Conceptual Operative Labs.

Teachers of the kindergarten and primary schools can reserve two hours of activity, which will be conducted by a PPT, prepared for the scope.

The GEI exhibit of 2020 lasted 9 days, from 16 to 24 January, including Saturday and Sunday. There were 1080 total visitors to the exhibit, of which 999 were students and teachers (for a total of 36 groups of activities) mainly in the morning. The exhibit was opened also in the afternoon and on Sundays to allow citizens to visit it. This was a good idea because 81 private citizens visited it, among which a community of adults with disability. Many children who visited the GEI exhibit in the morning came back with their parents or grandparents in the afternoon or during the weekend. Teachers reserved for their classes the section(s) of interests for two hours of Conceptual Operative Labs and/or 1–2 hours for the visit of the whole exhibition. The global visit was chosen by 29% of teachers, who wanted to profit from the opportunity to show many experiments to the children, to be discussed later in class. As it appears in fig. 1, the preferred sections are astronomy, measurement and physical quantities, and fluids. Astronomy is the preferred topic and has been visited by 103 children. Fluids and measurement and

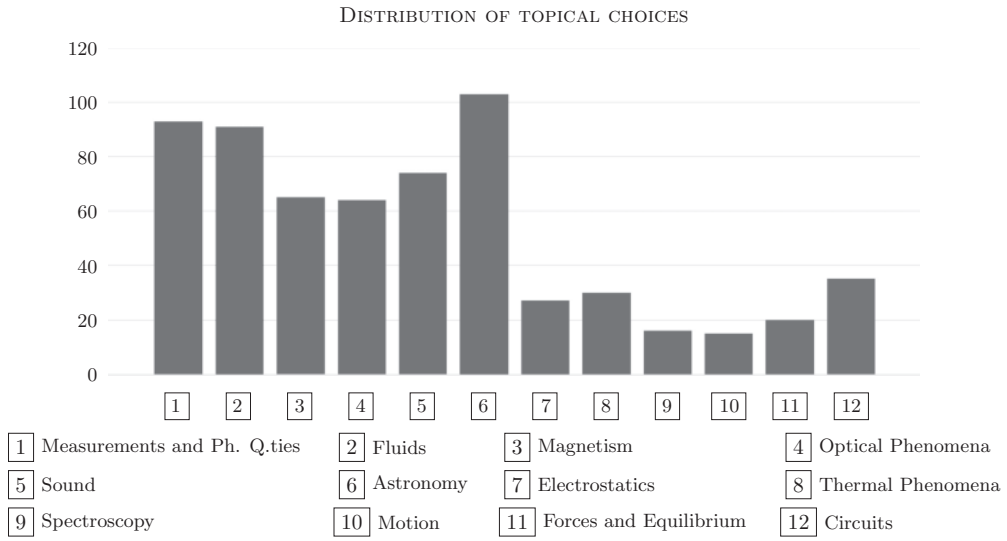

Fig. 1. – Distribution of the chosen topics by schools.

physical quantities have been visited by 91 and 93 children, respectively. All the other sections had less than 80 visitors.

The total number of available experiments in the GEI exhibit was 263. PPTs could choose the kind and number of experiments they wanted to focus on and the path for the Conceptual Operative Labs; they were also allowed to invent new experiments. Figure 2 shows, for each section, the number of experiments available, the number of PPTs involved, and the number of different experiments chosen by at least 40% of the PPTs for each topic. The experiments of the global visit are distributed according to their sections.

The sections with the highest number of experiments are magnetism, spectroscopy, fluids, and thermal phenomena. Among all the available materials, the most chosen experiments by PPTs belong to the topics of circuits, optics, fluids. This is understandable for magnetism and fluids, being the richest of experiments; it is less clear for circuits or measurements, where the experiments available were in a limited number. PPTs tended to homologate their paths, neglecting some possibilities. In most of the cases, the number of chosen experiments among the ones offered by GEI is less than 10. PPTs chose the experiments in theirs paths with a distinguished preference.

3. – Conclusions

The described initiative in GEI exhibit has proven to be important for the territory by the great presence of the schools and of the private citizens in the first two editions and it can become an important support for schools. The collaboration between schools and University made it possible for children of a disadvantaged mountain area to have access to scientific materials and to help and support the teachers in promoting the scientific literacy and their scientific education. PPTs find the long research-based process for their intervention in Conceptual Operative Labs of GEI (and for the outcomes evaluation) long and demanding, but relevant for their professional development. They

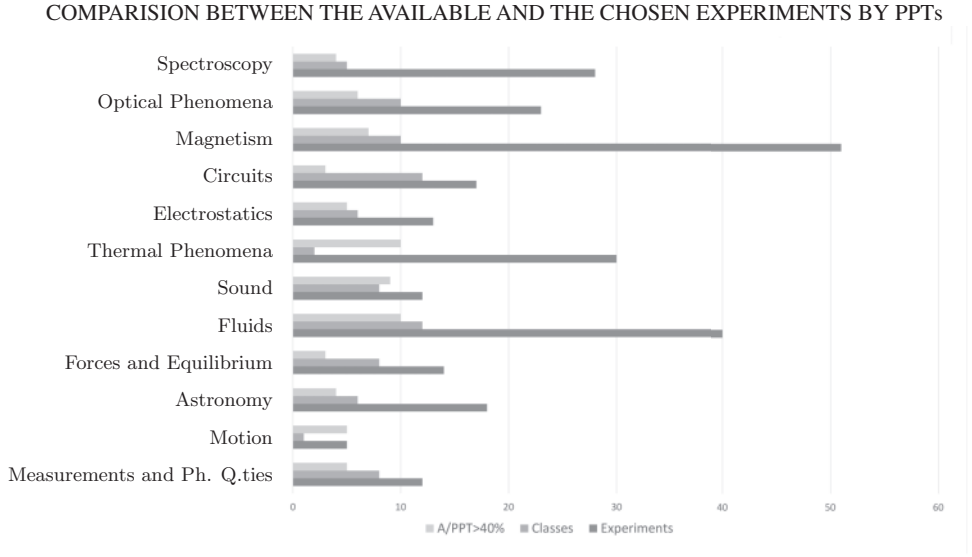

Fig. 2. – In light grey the number of experiment per topic is shown. In grey, the PPTs involved for each topic and so represented by the choices of the schools. The dark grey represents how many different experiments are chosen by at least 40% of the PPTs for each topic.

experience during the process the integration between pedagogical and physics education knowledge, in particular they learn how to create a learning environment, how to reflect on action, applying Inquiry-Based Learning methods to stimulate interpretative engagement in children natural curiosity. The way in choosing experiments gives us the opportunity to understand their competence needs.

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