HOPE annual forum 2016
Physics Teaching in Europe and HOPE in Perspective

Programme and Abstracts

Constanţa, Romania, September 7 - 10, 2016,

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Scope of HOPE project

The overall aim of the HOPE (Horizons of Physics Education) is to enhance the impact of physics within the European socio-economic area. HOPE is a European project with a total budget of 1.1 million euro, of which nearly 53% is financed by the European Commission (project number 540130-LLP-1_FR-ERASMUS-ENW). Coordinated by Nadine Witkowski of Pierre et Marie Curie University in Paris, together with Ivan Ruddock of the University of Strathclyde, Glasgow, and Marisa Michelini of Università degli Studi di Udine in Udine, this three-year project (2013-2016) is based on the collaboration of 71 partners from 27 countries of the European Union along with Norway, Serbia, Switzerland and Turkey. As well as universities, they include CERN, the European Physical Society, the Italian Physical Society, the International Association of Physics Students and two private companies. The collaborating physics departments range in profile from research intensive to those focusing on physics education research and the training of physics teachers. Additional associated partners from European and non-European (USA, Brazil, India) organisations, complete the network.

HOPE is effectively the physics education thematic network for the European Higher Education Area and is the sixth in a series of large networks beginning in 1996 with EUPEN (European Physics Education Network, 1996-2003) and its successors STEPS (Stake Holders Tune European Physics Studies, 2005-2008) and STEPS TWO (2008-2011). The network will research and share good practice within four themes conducted by four Working Groups: the factors influencing young people to choose to study physics; physics graduates' competences that enable them to contribute to the new needs of the European economy and society including innovation and entrepreneurship; the effectiveness and attractiveness of physics teaching in Europe's university physics departments and their competitiveness in the global student market; strategies for increasing the supply of well-trained physics school teachers and for developing links between university physics departments and the teaching of physics in schools.

Hope is an academic network funded within the Life Long Learning Programme (2007-2013) whose overall objective is to encourage the best use of results, innovative products and processes and exchange good practice in order to improve the quality of education and training. The third annual forum organized in Constanţa, Romania, focuses on activities on the improvements of training of physics teachers (WG4) and HOPE perspectives. The forum is jointly organized by the University of Bucharest and Constanţa Maritime University.

“WG4 - Improvements in the Training and Supply of Physics School Teachers”

The working group 2 activities obectives are : to recommend strategies for increasing the supply of well-trained physics school teachers and to enhance the role of university physics departments in helping the teaching of physics in schools.
This will be met partly by objectives to :

- facilitate the training of future physics teachers,
- contribute to the professional development of existing school teachers,
- contribute more directly to physics teaching in schools, e.g. through “master classes"’ and reach-out laboratories, and
- help apply the results of physics education research.
- the application of new physics knowledge and technology transfer to the market economy
- integration of physics studies with the world of work and (c) a better appreciation of how basic physics knowledge underlies and contributes to technological developments
- re-examination of existing physics competences (e.g. those from the EU’s Tuning project and EUPEN) to take account of innovative teaching methods and new demands placed on physics graduates, and a reassessment of recently introduced unconventional physics-based degrees

Wednesday 7th September

Malibu Hotel, Constanţa (Bulevardul Mamaia 316, Constanţa, Romania)

17h00 **Registration**

18h30 **Welcome**
Cornel Panait, Rector of Constanţa Maritime University, Romania
Ştefan Antohe, Dean of the Faculty of Physics, University of Bucharest, Romania
Roxana Zus, Organizing Committee, University of Bucharest, Romania

19h00 End of day

19h30 Reception and dinner, Hotel Malibu

Thursday 8th September

Constanţa Maritime University - Nautical Base
No. 2 Cuarţului Street - Room BNP004

9h00 **Introductory remarks**
Nadine Witkowski, University Pierre and Marie Curie, France

Session 1: Physics School Teachers Education I

Chair: Nadine Witkowski, University Pierre and Marie Curie, France

9h15 **Objectives of Working Group 4 of HOPE**
Aleš Mohorič, University of Ljubljana, Slovenia

9h30 ***Guest Speaker***
Hans Fischer, University of Duisburg/Essen, Germany
Professional knowledge of science teachers and consequences for teacher education

10h30 Coffee Break - Main Hall, ground floor

Session 2: Contributed papers on themes of WG4

Chair: Aleš Mohorič, University of Ljubljana, Slovenia

11h00 **Ovidiu Florin Căltun**, Alexandru Ioan Cuza University of Iasi, Romania
Schuler Labors - Poles of Excellence in Continuous Professional Development of Science Teachers

11h20 **Víctor López**, Autonomous University of Barcelona, Spain
DIATIC: In-service physics teachers training through a community of practice about the design of teaching materials

11h40 **Joan Borg Marks**, University of Malta, Malta
Can teachers and teaching change for the better?

12h00 Lunch - Main Hall, ground floor

Session 3: Physics School Teachers Education II

Chair: Marisa Michelini, University of Udine, Italy

14h00 ***Guest Speaker***
Laurence Viennot, University Denis Diderot, France
Critical Reasoning as a Component of Teacher Formation

15h00 **Round table 1 : Teacher needs in the different contexts**
Chair : Marisa Michelini, University of Udine, Italy
Participants :
Marie-Blanche Mauhourat, General Inspector, Ministry of Education, France
Yaron Lehavi, Weitzman Institute of Science, Israel
Silvano Sgrignoli, Italian Association for Physics Teaching, Bergamo, Italy
Sorin Trocaru, General Inspector, Ministry of National Education and Scientific Research, Romania
Andreea Popescu-Cruglic, **Ştefan Ghinescu**, Students - prospective teachers, University of Bucharest, Romania

Session 4: Poster Session

16h00 **Poster Session** and Coffee Break, Main Hall, ground floor

17h00 End of day's programme

18h00 Grill Dinner, Constanţa Maritime University - Nautical Base

Friday 9th September

Constanţa Maritime University - Nautical Base
No. 2 Cuarţului Street - Room BNP004

Session 5: Results of HOPE

Chair: Nadine Witkowski, University Pierre and Marie Curie, France

9h00 **Investigations into Teacher Education: report from Working Group 4 of HOPE**
Aleš Mohorič, University of Ljubljana, Slovenia

10h00 **Inspiring Young People to Study Physics: report from Working Group 1 of HOPE**
Marek Trippenbach, University of Warsaw, Poland

11h00 Coffee Break, Main Hall, ground floor

11h30 **New Competences for Physics Graduates - Fostering Innovation and Entrepreneurship: report from Working Group 2 of HOPE**
Hay Geurts, Radboud University, The Netherlands

12h00 **Improvements in Physics Teaching - Meeting Future Global Challenges in Physics Higher Education: report from Working Group 3 of HOPE Eamonn Cunningham**, Dublin City University, Ireland

12h30 Lunch - Main Hall, ground floor

Session 6: HOPE in perspective I

Chair: Ivan Ruddock, University of Strathclyde, United Kingdom

14h00 *Guest Speaker*
Pratibha Jolly, University of Delhi, India
Global Challenges in Physics Education

Contributed Papers by HOPE partners

15h00 **Olivia Levrini**, University of Bologna, Italy
What inspires young people to study physics?

15h20 **Edouard Kierlik**, University Pierre and Marie Curie, France
How to promote problem-solving on a large scale?

15h40 **Philip Möhrke**, University of Konstanz, Germany
From science to teaching - a project to increase the number of qualified physics teachers

16h00 Lunch, Main Hall, first floor

16h30 The Future: Networking and brainstorming opportunity for attendees to describe their ideas for collaboration and seek potential collaborators

17h30 End of the day's programme

19h30 Conference dinner, Le Premier Constanţa
No. 1 Aristide Karatzali Street

Saturday 10th September

Constanţa Maritime University - Nautical Base
No. 2 Cuarţului Street - Room BNP004

Session 7: Reflections and conclusions

Chair: Ivan Ruddock, University of Strathclyde, United Kingdom

9h00 **Round table 2 : SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of Higher Education in Physics within a European context in the light of the activities and results of HOPE.**
Chair: Ivan Ruddock, University of Strathclyde, United Kingdom
Participants :
Olivia Levrini, University of Bologna, Italy
Gareth Jones, Imperial College London, United Kingdom
Sune Pettersson, Umeå University, Sweden
Maria José de Almeida, University of Coimbra, Portugal
Alexis Prel, Student, University Pierre and Marie Curie, France
Pratibha Jolly, University of Delhi, India

10h30 Coffee Break, Main Hall, ground floor

11h00 **Perspectives, Conclusions, Summary and Thanks**
Nadine Witkowski, University Pierre and Marie Curie, France

11h30 **End of the Forum**

12h00 Lunch - Main Hall, ground floor

14h00 Optional excursion (details during the conference)

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List of abstracts

Poster contributions - Inspiring young people to study physics

Poster contributions - Alternative teaching methods

Poster contributions - common topics of HOPE

Professional knowledge of science teachers and consequences for teacher education

*H. Fischer**

University of Duisburg/Essen, Germany

ABSTRACT

For more than four decades, professional knowledge of teachers and its different areas have been discussed as a precondition for successful teaching (Peterson, Carpenter & Fennema, 1989; Abell, 2007; Fischer, Borowski & Tepner, 2012), whereas science education research only began to be involved in this discussion since the 1990s (Van Driel, Verloop & De Vos, 1998; Gess-Newsome & Lederman, 1999). Regarding standards of teacher education, teacher educators should know which competencies are not only validly tested with samples of student teachers at university or in-service teachers but also relevant for successful teaching and learning of students, and therefore should be taught in all phases of teacher education. From a research point of view, the demand for practical relevance of standards connects teacher education with the classroom and the quality of school instruction. But until now there are only poor connections between standards and theories; the choice of competencies listed in the standards is characterised as more or less accidental. This is not astonishing because standards in education are designed as governance tools and not directly applicable in classroom settings. However, all these standards are more or less plausible in everyday teaching practice but are not evidence-based from a research perspective (for evidence, see Fischer, Boone & Neumann, 2014). The talk will give an overview of the concept of professional knowledge and its consequences for the quality of teaching and learning physics in the classroom and at universities with a focus on pedagogical content knowledge.

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Critical Reasoning as a Component of Teacher Formation

L. Viennot[*]
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ABSTRACT

In recent years, the prevailing tendency to emphasise competencies rather than conceptual structuring in encouraging students to engage with physics may lead, de facto, to an over-simplification of taught content and a consequent lack of coherence of pedagogical resources in current use. This in turn increases the need to consolidate the critical analysis of teaching resources and texts as an aspect of teacher formation. A question then arises: Can critical thinking be fostered in students and preservice teachers without conceptual structuring and (more importantly) without foregrounding the pivotal role of coherence in science? What links can be identified between the development of conceptual understanding and critical attitude in physics students and future teachers? In operational terms: Can we help them to develop their critical thinking capability without a conceptual basis? Drawing on a series of investigations by Dcamp and Viennot with preservice teachers, some elements of an answer are presented. Mappings of prospective teachers' intellectual path during extended interaction (about ninety minutes) with an expert reveal the entanglement of conceptual and critical development in interviewees, and some threshold effects. In characterizing students' responses when confronted with various explanations of a physical phenomenon, these studies elucidate conceptual markers as well as metacognitive, affective and critical indicators. Identified profiles of co-development include "delayed critique" and "expert anaesthesia of judgment". On that basis, two possible formats are proposed for intervention in teacher formation, based on the detection of flawed explanations and on textual analysis of solved exercises, and the respective merits of these interventions are discussed.

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Global Challenges in Physics Education

*P. Jolly**

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ABSTRACT

These are exciting times for education. The world order is changing fast. With all pervasive diffusion of technology, and consolidation of information and communication networks, communities across the world aspire to partake in development and be active participants in creation of an egalitarian knowledge-based global society. Increasingly, national goals recognize that a strong foundation in science and technology is critical for socio-economic growth. The commensurate focus is on creating and nurturing a scientifically skilled human resource at all levels. In particular, there is a greater understanding of the strategic importance of physics in interdisciplinary contexts as an instrument for addressing the grand challenges facing humanity. The spread of physics research and physics-based industries/enterprises is considered a good indicator of a nation's capacity to find innovative solutions for sustainable development goals. The young are expected to provide freshness of ideas and being given early opportunities to work on community-related projects.

Despite inherent focus, there remain globally shared concerns on dwindling interest in physics among young students, lack of inclusiveness, and flight of talent to other disciplines. There is a felt need to revitalize physics education in culturally relevant ways for diverse student populations. Seminal physics education research has motivated changes in content, context, instruments, and ways of teaching-learning of physics. There is special emphasis on creating active learning environments that integrate the use of a variety of resources to create experiences that are, both, hands-on and minds-on. Effective frameworks encourage peer learning and collaborative project work. It is expected that the classrooms of the future will be technology enhanced globally networked active learning environments. Scaling educational opportunities and outreach will necessarily entail creation of effective virtual modes. Dissemination of pedagogic innovations, however, is a major challenge. Transforming educational ecosystems is a complex task that needs appropriate curricular materials and teaching resources, determined and sustained by local initiatives. Foremost, it requires adequate professional development of teachers.

Within this framework, I will relate initiatives undertaken by international bodies such as IUPAP, ICPE, UNESCO and ICTP for strengthening physics education, especially in developing countries. These have aimed at enhancing education outreach; providing access to equipment and resources; enriching teaching; and most importantly, developing sustainable collaborative models for capacity building of physics educators, through Educate the Educator series of workshops such as ALOP and Physware. The programs have led to formation of global networks of physics educators. They have also been successful in creating regional leaders equipped to trigger wide scale transformation through local action. These initiatives need to be further strengthened by providing educators sustained exposure to global examples of best praxis and greater access to eclectic resources through appropriate technology platforms.

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Schuler Labors - Poles of Excellence in Continuous Professional Development of Science Teachers

*O. F. Caltun**

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ABSTRACT

The Eurydice report 2015 results that Teachers need support in CPD realities regarding the teaching of cross-curricular themes (Teaching cross-curricular skills), in multicultural environments (Teaching in multilingual and multicultural settings) and students with special needs (Teaching students with special educational Needs TSSN) into new and individualizing learning strategies (Individualized Approaches to Learning IAL).

In European countries continuing professional development has a lot of facets to each other regional or national connotations with international resonance. Eurydice report identifies the most commonly assistance in the class, workshops and conferences. Unfortunately the lists of these opportunities are not identified informal school science labs or labs that are known in German culture with the generic name Schulerlabors (SL).

According to the author of this article besides the role of promoter of science to students and society SLs may represent poles of excellence in the initial and continuous professional development of teachers regardless of the subjects taught, regardless of the curricular areas in which they are registered.

Research carried out for two months at Saarland University started from these assumptions, justified by the current state of research and educational activities of the 11 SLs established at University of Saarbrucken:

1) SLs are a friendly environment for students and teachers involved in activities but especially to the students preparing to become teachers in various subjects. SLs is a learning environment as lively as a normal class but has a better control of disturbances that can jam the transmission of knowledge and practical values associated with them.

2) SLs is a source of inspiration and support for in service teachers that accompany group of students by giving them significant support in continuous professional development:

a. they can find and perform at SL experiments, material and time resources available that lack at their school;

b. the proposed experiments at SL may be related to the curriculum proposed in class but the way of implementation and approaches can promote a favorable image of science and technology, enabled even in place that were designed and made;

c. procedures may be dedicated to new contents that have recently been introduced into school curricula and school are not yet ready to support by their practical resources;

d. SL can introduce concepts by innovative educational methods and technologies that have entered or may enter in school laboratories;

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e. SL is a favorable environment for sharing experience and best practice in schools by student teachers worried about difficulties that they may have when are alone in front of the students.

3) The SLs is a place of support and professional development of academic personnel performing instructive - educational activities in laboratory facilities for students and teachers.

Briefly research sought to answer this question: “Can be SLs poles of excellence in research innovation and sustainable development of science education in which future teachers are offered activities and employees who support teachers in continuing Professional development”

DIATIC: In-service physics teachers training through a community of practice about the design of teaching materials

V. López , M. I. Hernández*

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ABSTRACT

DIATIC (the acronym of "Design and application of digital activities"), is a community of practice that includes in-service secondary school physics teachers and science education researchers. The 30 members of this community of practice meet every month in Autonomous University of Barcelona (Spain), with the main purpose of designing teaching materials for their secondary school students. In DIATIC meetings, participants share ideas about how to design teaching materials that they will later apply in their schools, and they also provide feedback about those materials that have been previously designed and applied in schools. This process allows producing several iterative improvements in the designed materials, always based on empirical evidence. At the same time, all the designed DIATIC materials have some common features:

(1) a physics-in-context approach, which allows students to perceive physics topics as something meaningful for their life;

(2) the use of ICT for promoting inquiry and modeling with students (data-loggers, simulations, etc.);

(3) the aim to promote students scientific competences (to explain phenomena scientifically, to evaluate and design scientific inquiry, interpret data, etc.), and to provide tools for teachers for evaluating these competences.

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Can teachers and teaching change for the better ?

*J. Borg Marks**
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ABSTRACT

Education has always been high on the agenda for Maltese people. Malta always strives to bring the best practice in the classrooms for its students. Parents guide their children towards successful study paths with the aim of seeing children reap a fruitful future. Many teachers try hard to have their students achieve.

This year the Faculty of Physics at the University of Malta celebrates 100 years since its inception. The University of Malta also has a Faculty of Education founded almost 40 years ago. The majority of physics student teachers are tutored in Physics by lecturers from the Faculty of Physics while also being coached in pedagogy by lecturers from the Faculty of Education. This seems like a good student teacher preparation. Yet, somewhere along the line somebody must have posed the question: "Can teachers and teaching change for the better ?"

This presentation will look at changes which will come into effect in the coming scholastic year regarding the preparation of student teachers teaching Physics, in an effort to try and make physics teachers more effective in their job.

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From science to teaching - a project to increase the number of qualified physics teachers

Ph. Möhrke *

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ABSTRACT

As in many European countries the number of science teachers, especially Physics teachers, for secondary schools in Germany is low and the number of students choosing to become physics teachers just high enough to compensate for the retirement rate. In the past, many of Germany's federal states tried to tackle this issue by either hiring physics professionals with no teaching background at all or to assign physics lessons to other science teachers. Unfortunately, both ways do seem to neither improve teaching quality nor raise popularity of the in general unpopular subject. Therefore, the University of Konstanz started a master's programme for graduates with a purely scientific bachelor's degree in physics. In this master's programme the strong scientific background of students in physics and mathematics is supplemented by some more mathematics, but more importantly, by didactics, methodology and teaching experience at schools. In the last years we have seen the number of students in this master's programme rising constantly and the drop out rate remaining at nearly zero. Furthermore, we see a significant difference in motivation between the "traditional" students, who started with a teaching oriented programme from the beginning, and those coming from science but having reoriented towards becoming teachers. I will give a short introduction to the German system of teacher education and report on the project, our experiences during the first years and future plans.

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What inspires young people to study physics? Results from the WG1 interviews survey

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S. Hemmer, O. Pantano
INFN and University of Padova, Italy

A. Laherto
University of Helsinki, Finland

ABSTRACT

The talk will focus on the main results of an Interview based Survey of 1st Year University Physics Students, carried out within Working Group 1 (WG1) of the HOPE project.

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How to promote problem-solving on a large scale ?

*J.-M. Courty,E. Kierlik**
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ABSTRACT

'Which is the temperature change of a glass of water when one adds an ice cube?' This question, asked without more guidance but with thermodynamics data of water, is one of problem solving given since three years in tutorials to students who followed the course 'Energy and entropy' at UPMC. The aim of this activity, intermediary between table-top exercices and inquiry based learning approaches, is to bring students to mobilize knowledges, skills and competencies to address a situation with a clear (often numerical) goal but for which the resolution path is not indicated.

How this active pedagogy can manage the diversity and heterogeneity of our students without increasing the number of 'tailored' lectures in the curriculum? How can we make students more active in their training? How to teach students how to address problem solving ? How to evaluate works done when different paths can lead to the result ? These issues have been addressed through an experiment conducted for 5 years in a top-notch curriculum with Science-Po Paris (3 ECTS - 60 students) before the course be expanded on a large scale for first-year university students (9 ECTS - 450 students, 18 groups). The talk will give a REX of this expansion, including successes, limitations and challenges for the future.

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Extra-curricular offers for student teachers at Leibniz Universtität Hannover

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ABSTRACT

We will present some examples for improvements in the education of student teachers at the Leibniz Universität Hannover. Most of them are extra-curricular, i.e. students get no credit points. Despite this fact, students are interested and chooses for examples these courses.

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The structure of physics-teacher education at Vilnius University

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ABSTRACT

Nearly two decades ago, Vilnius University (VU) abandoned its physics-teacher study programme due mostly to formal regulations for first-step study programmes. However, the collapse of physics-teacher programmes in Lithuania in the last five years forced VU to revisit physics-teacher training and provide students in all bachelor physics programmes with the possibility of acquiring a physics-teacher licence during regular studies by earning the additional required credits.

What regulations apply to these studies and what kind of pedagogical subjects can students choose?

The Physics Faculty runs six study programmes - Energy Physics, Physics, Physics and Computer Modelling, Modern Physics and Technology Management, Applied Physics, and Physics of Telecommunications and Electronics. All of these programmes include elective or free-choice subjects without restrictions. At the VU Physics Faculty, pedagogical studies are carried out according to the number of accumulated ECTS credits partially as alternative or free-choice subjects. The physics-teacher licence requires psychology, pedagogy and physics didactics, which students can take as elective and/or free-choice subjects from the 3rd to the 7th semesters of their 4 year programme. Courses in pedagogy (general pedagogy, educational philosophy and management), psychology (educational and developmental psychology, school psychology) and physics didactics are worth up to 10 ECTS credits each. Teaching Practice (Parts 1 and 2 last 2 months in the 7th and 8th semesters, and are worth 30 credits) is carried out at the Vilnius Lyceum, as well as in other gymnasiums and secondary schools under a tripartite agreement, employing schoolteachers part time at the faculty.

During their first and second years, students can choose psychology and pedagogy in the Faculty of Philosophy, and in the third year physics didactics at the Physics Faculty. A total of 60 credits are required during 5 semesters (from the 3rd to the 7th semester) in parallel with the main undergraduate programme. During the 8th semester, students have to prepare two final theses: a physics undergraduate thesis (12 ECTS) and a pedagogical thesis (3 cr.). Immediately after graduation in physics, students are formally admitted to the Department of Educology (postgraduate programme) at the Faculty of Philosophy. While VU physics bachelors have already fulfilled the requirements for pedagogy, psychology and didactics during their main programme, they need to prepare and defend the separate pedagogical studies thesis, and are then granted a physics-teacher certificate to formally take up a position as physics teacher in higher education establishments, schools, gymnasiums and other educational institutions. Number of students already picked that way.

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Case study: Physics and Chemistry teacher training program

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ABSTRACT

In our days science is becoming ever more interdisciplinary. In this situation it is important that the pupils in school would perceive connections between subjects. The contemporary teacher should be ready to know, understand and apply the interdisciplinarity of subjects which we teach at school. In addition, the new challenges are dictated also by the demographic situation in Lithuania. The number of pupils declines and, as a consequence, a number of schools and classes declines rapidly too, and the teacher must be prepared to know and teach a few subjects.

Having these circumstances in mind, the study program "Chemistry and Physics Teaching" was prepared, where teachers are trained in parallel studies. Chemistry and Physics are linked by some natural sciences logic and knowledge. Both sciences are empirical, using a variety of experimental techniques, and the laboratories play an important role in the process of teaching both subjects. In the presentation, the program objectives, learning outcomes, program structure, the interdisciplinary relations between chemistry and physics, as well as related concepts of pedagogy, will be reviewed.

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Training Physics Teachers using interdisciplinary conceptual maps

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ABSTRACT

Among alternative methods involving communication, interaction, group dynamics, creativity and surpassing students emotional blockage conceptual map both in learning teaching evaluation can be used.

The teachers are familiar with mental concept map but they are not use to draw during the classroom activities in cooperation with the students interdisciplinary conceptual map that can improve deep understanding of fundamental concept as Water, Air, Wind, Earth etc.

In order to support teachers in their professional development an activity aiming to introduce interdisciplinary concepts from both theoretical and practical point of view a training session of 4 hours was designed and implemented for middle school teachers of very different discipline of study.

Teachers will practice this method and will finally complete after the training session an observation record of how a colleague implements various types of conceptual maps during the classroom activities.

The targeted group of the training was of beginning teachers and senior teachers following training sessions in order to improve the teaching approach and want to benefit from the advantages of using alternative methods of teaching - learning and assessment. The activity gives them the opportunity to reflect on how their acting in class and to change the way that communicates and relates to students and other teachers teaching different subjects. Some of the results of activities was used for professional meeting or in class with students followed by refinement and adaptation.

The method of "Conceptual Map" is discussed on three levels of representation and operationalizing: as student, teacher and teacher trainer.

Methodological reference design aimed at reflecting on teaching, considering the questions that they propose trainers from the Training of Trainers:

3 Why:

i. I do this from a theoretical perspective?

ii. In this context?

iii. With these students?

2 HOW:

i. I will achieve my goals?

ii. I'll behave?

n BUT IF:

i. This method does not work?

ii. no concept conceptual map?

iii. They are not prepared to apply the method?

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iv. I was not explicit enough?

v. Etc.

Trainee teacher assessment has several components:

The initial assessment will be done by asking teachers to draw a concept map and make the difference between map and students map. This short sequence of evaluation will be followed by a debate that should lead to the conclusion that conceptual map is an alternative method that can be applied in various classes during diverse activities at different age level and in learning at different scholar disciplines.

Continuous evaluation of the activity was done through self-assessment / evaluation during workshops, teaching by feedback of trainees and trainers.

The final evaluation will involve:

completing a final questionnaire;

compiling a portfolio that contain at least three applications of the alternative method, including commenting on them in terms of teaching;

Are interested Physics Teachers in teaching subjects threatening the nanotechnologies

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ABSTRACT

Students' interest in physics, especially those in upper secondary school, remains at a low level although they realize that they are the beneficiaries of new technologies that sometimes pushed to the limit of physical dimensions of nanometers.

The authors believe that one way that Physics teachers could use to increase the motivation of students to study physics and choose a career as a scientist is that to the extent the lessons of physics, where possible to refer to technological applications of phenomena and chemical, physical or biological effects underlying the functioning of many modern devices that students are using in every day life.

The question of the study was if whether teachers are very familiar with these applications and more if they have the necessary training, both in terms of contents knowledge but also in terms of applied didactics to transfer knowledge in nanotechnology and nano structured materials science.

Research hypothesis was that is required initial and continuous training of Physics teachers such that they can organize instructional or educational activities on this topic.

To check the hypothesis were designated several stages of pedagogical research. In the first stage it was designed a questionnaire for middle and secondary school teachers. The questionnaire was piloted on a group of Master of Education student teachers who specialized in Didactics of Science.

After that the refined questionnaire form was distributed to few hundred of Physics teachers employed in the department of Vaslui Romania.

The survey results were interpreted and then interviews were held with some of the teachers who responded to the questionnaire. Their choice was made in order to represent different social and cultural environments or schools, distributed evenly across age and gender with various options in relation to the study of nanotechnologies in secondary school.

The questionnaire opened with a question in which teachers were asked to assess their own knowledge of applications that Physics has in materials science and nanotechnology.

The second item which ask respondents to specify the source of the information they hold about nanotechnologies: university courses, training actions for teachers in service, specialized publications, information from audiovisual media, internet or other sources.

The third item require a definition of nanotechnologies, while the fourth item request examples of how nanotechnology has revolutionized knowledge and life.

To check if the correct understanding of the term of nanotechnologies is requested in item 5 was demanded teachers response on several physical and biological structures that have nanoscale dimensions that can be handled within nanotechnology.

Item 6 changed the register of questions and ask their views on age level at which the teachers should bring into question the Physics applications in nanotechnologies: elementary school, middle and upper secondary schools, high school or university.

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The rest of the, in more than 6 items questionnaire tried to diagnose the level of knowledge of a particular case, namely that of nanotechnology applications that nanoparticles have in various fields of science and medicine.

Questionnaire responses were encouraging for authors only from the interest of teachers about nanotechnology and their desire to introduce in school speech the subject as soon as possible at low level of students age. In fact the teachers are not familiar with nanotechnology and are aware to introduce to the students gently the topics.

Interviews confirmed the desire of teachers to participate in training sessions in which both in terms of knowledge contents but also in terms of psycho-pedagogical and didactic approach to be demonstrate good practice.

Using mobile technology to improve policy Reform for Inclusion of Disadvantaged Groups in Education / mRIDGE Project

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ABSTRACT

Social inclusion is a core value of the European Union and a key priority of the Europe 2020 strategy. The three main reinforcing priorities “to become a smart, sustainable and inclusive economy” should help the EU and the Member States deliver high levels of employment, productivity and social cohesion. Analysing these trends the mRIDGE project concept showcases how the individual learning approaches, the mobile technologies and the digital educational resources build by means of mobile technologies can concretely contribute to tackling social exclusion by increasing motivation and participation of the vulnerable students in the educational process. The project emphasises on geographical inclusion and the feasibility of mobile-based distance education. It is directed towards a wide range of disadvantaged groups including learners groups at risk, whose ethno-cultural peculiarities, special needs and social-economic situation considerably limit the opportunities for adequate education for them. mRIDGE project specifically addresses the problem of Roma children retention to school, enhances the acquisition of the educational material by them, by bringing personalised learning paths, enhancing accessibility, and adapting education to specific needs.

The mRIDGE project concept is built upon a wide range of preliminary research studies which outline that digital resources, developed by means of mobile technologies, as well as the use of these technologies in the implementation of these resources in the process of learning, lead to retention of Roma children in schools, to better acquisition of the school material by students with special educational needs, and could be a better option for educational integration of disadvantaged people into the educational system, as well as a better opportunity for inclusion in this system for isolated, due to social-economic reasons, people. One of the project objective is the full intensive and comprehensive practical training for the academic staff is scheduled during the trial, aiming to build up and strengthen institutional capacities of the universities and to prepare motivated junior and senior staff that will be able to efficiently introduce and teach the developed approach.

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Interactive Science Museum and Experimentarium incubators for Science Teachers Training Programs

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ABSTRACT

Interactive Science Museums or Experimentaria open with the support of the Universities - mainly the Departments of Physics. There, a number of educational programs can be offered to students, science teachers and school administrators in order to enhance teaching and learning procedures and support their continuous professional development.

The Department of Physics can organize in such an environment certified programs lasting six hours or more. The teacher educators can use the rich resources and experience of a Science Museum as well as its facilities, library collection, access to ITC (Information and Communication Technology) to support the needs of teachers as professionals and adult learners. Programs for initial teacher training can be offered too. University professors are encouraged to bring their student-teacher classes to the Museum for an introduction to a learning process in an informal education environment of high prestige as well as for them to benefit of interactive experiments.

Following a short lesson on inquiry based science education or engineering design, student-teachers have time to interact with the exhibition and media resources. They take profit of the temporary exhibitions organized for special purposes. The course-professors involved in the program planning, supervise the whole structure of actions in order to ensure their quality. Also, lessons should support the overall goals of the program. One example of implementation in Iasi Experimentarium is the program: Influence of the Progress of Magnetic Recording on the Information Evolution while in Patras University Museum of Science & Technology (MET) a permanent ongoing exhibition treats the History and Evolution of Telecommunications.

An important program is designed to start in Patras, in which the Museum of Science of University of Patras is going to play an important role. This program is targeting mainly to teachers of primary and secondary education. They will beneficiate of high-quality professional development (PD) in STEM (science, technology, engineering, and math) receiving knowledge, a complete set of teaching tools and methodology to use in their classrooms, as well as sufficient competences for successful and fruitful experimental (laboratory) activities. All units in the curriculum integrate scientific topics in different engineering fields through inquiry-based learning.

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Professional developmment of physics teachers in the frame of Chain Reaction project

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ABSTRACT

Chain Reaction is the European Communitys FP7-supported project* that has aimed to develop Inquiry Based Science Education (IBSE) within twelve partner countries coordinated by Sheffield Hallam University (SHU, Sheffield, UK). A key element of the project was a training of science teachers to enable delivery of IBSE in the classrooms. Each of the partners has developed his own model of teacher training in the inquiry based teaching methods. In Slovakia the training of physics, chemistry, biology and geography teachers consisted of three face-to-face sessions complemented with ongoing support and consultancy provided by teacher educators of the Physics Department, Matej Bel University Bansk Bystrica. The first one-day briefing was focused on the introduction to IBSE approaches in general and on an interactive practical training of inquiry-based activities. The teachers worked with a set of resources that had been originally developed, trialed and tested by SHU and adopted by each of the Chain Reaction partners. The teaching materials focused on the Earth and the Universe themes present realistic scenarios to reflect real science and have proved a potential to encourage and motivate students in science subjects. Teachers could decide which of the introduced topic areas they would use with their students. Cosmic Web Site (creating a website to explain the Big Bang theory) and Green Light (advising on the use of a low energy light bulb) belonged to the most popular topics among the Slovak physics teachers and their students. Equipped with the knowledge and skills to use IBSE effectively in the classroom the teachers delivered the inquiry-based activities to their 14 16-year students. They were continuously supported by University staff as well as by young scientists, who served as role models to young learners at schools as well. Second face-to-face meeting aimed to provide the teachers an area for sharing ideas and experience, discussing difficulties that could occur during the in-school delivery period. Further they could share their ideas at an online forum within both national and Europe wide teacher networks, whose development belonged to one of the Chain Reaction projects objectives. The teachers met finally at the third session which was dedicated to the reflection of their professional development within the school year and evaluation of all the activities. Over the three-year project each partner directly briefed 30 science teachers from fifteen schools. In addition, by involving the teacher education providers, Chain Reaction has supported the development of IBSE literate teachers in future cohorts of newly qualified teachers as well.

The developed support materials are available to other teachers interested in IBSE via website www.chreact.umb.sk or www.chreact.eu. (*FP7/2007-2013, grant agreement No 321278)

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Workshop for Science and Math Teachers as Lab for a Teacher Leaders

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ABSTRACT

The new curriculum introduced in Latvia (2016) is focused on transition to a competency based learning. The process of changing the paradigm highlights the question: how can innovative experience of teaching and learning be developed and disseminated further? Implementation of innovative practice calls for professional, practitioners teachers who are qualified and willing to develop and share with their colleagues.

Center for Science and Mathematics Education organized workshops for group of 35 science (13 of those - physics teachers) and math teacher leaders during the school year. The workshops (6 x 6 hours over one study year) included input sessions on a particular issue (knowledge construction, meaningful use of ICT, feedback etc.), joint lesson planning, adapting to own classes and reflection sessions.

The aim of workshops were: to create learning situations that allow the teachers to acquire different kinds of experience, take part in discussions, exchange opinions etc.; to develop lessons focused on competence based learning and carry out these lessons in school. In order to make changes happen teachers analysed in their own and colleagues practice during lessons and reflecting on it. The teachers share their experience of planning and leading lessons by demonstrating the new approach. In this way teachers became as leaders, because one of the important role for teacher leaders is learner. They demonstrate lifelong learning and use what they learn to help students achieve new level - deeper learning.

The impact of the workshops for teacher leaders was analyzed through teacher questionnaires, written feedback from teachers after workshops and developed lessons during one school year. The feedback was coded for the purposes of analyses. According to the feedback teachers indicated that joint planning and analyzing lessons has helped them to became a more competent as a professional, as well as a teacher leaders (ownership, CPD, analyzing and reflecting own performance, openness, teamwork, self-awareness etc.).

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Labs for secondary teacher education on DC circuits

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ABSTRACT

A wide literature underlines the important role of conceptual and explorative labs for teacher education in educational reconstruction of subject topics and in offering the opportunity for a reflection on conceptual knots.

The topic of the electrical DC circuits in low secondary school (12-16 years old) is relevant because it allows bringing the role of a functional model in physics, just when students learn models in other scientific disciplines such as in Biology, for the model of circulation blood or the digestive system. It gives the opportunity to the students to understand that science promotes the construction of models for phenomena interpretation even in different contexts. We designed a formative intervention module (FIM) based on exploratory and conceptual activities for secondary pre-service teacher education. The aims of the FIM are to improve the teachers expertise in the interpretation of the topology of DC circuits and highlighting the importance of the interpretive model, in a way that allow them to provide to pupils the understanding on the topic of dc circuits. We implemented the FIM in the University of Udine (46 pre-service low secondary teachers). It is interesting to discuss the characteristics of the FIM and learning outcomes of teachers on six dimensions: 1. Discuss what a circuit is; 2. Produce operative ownership of the idea of equivalent circuit; 3. Gain familiarity with simple DC circuits, distinguishing series and parallel conditions; 4. Overcome the main conceptual knots as those on the functioning of the circuit and topological one; 5. Attribute the proper role and meaning to the battery, to the current and to a resistance; 6. Perform current and tension measurements, learning Ohm law.

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Full immersion national summer schools on modern physics for secondary teachers

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ABSTRACT

In the context of the project IDIFO (Innovation in Physics Education) submitted in the framework of the Italian Plan PLS, the research unit in physics education of the University of Udine organized two national full immersion summer schools for secondary teachers on modern physics in 2007 and 2013. The first one in 2007 was an experiment integrating two innovative activities: a biannual Master for in-service secondary school teachers and a summer school for gifted students on modern physics. The focus was on four dimensions: 1) advanced experiments in modern physics for educational goals; 2) discussion of educational plans prepared by teachers for schoolwork activities; 3) in depth discussion on conceptual aspects on relativity and quantum physics; 4) apprenticeship of Master teachers in supporting talent students on the innovative activities offered on modern physics. Those held in 2013 was on the base of a call for 30-guested positions. The applicants were 480 and the school accepted 60 teachers, supporting only the first 30 of them for local living expenses. The school offered in 48 hours a wide overview of the different ways of looking at modern physics. Teachers discussed with physics education researchers the basic concepts and educational proposals on quantum mechanics, as foundation of theoretical physics, on superconductivity, by means of a phenomenological approach, on condensed matter analysis techniques as RBS proposed as problem solving. In the perspective of an experimentation with their students, teachers discussed the lab work done on crucial experiments as concern interpretation in classical physics framework. Teachers produced a series of modern physics educational paths re-elaborating discussed proposals from research and many of them decided to continue the formative activity in an annual teacher formation course (15 cts).

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Master IDIFO for teacher professional development in teaching learning modern physics

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ABSTRACT

From 2005 the Italian Ministry of Education (MIUR) financed a national project (now Plan) to promote scientific degrees (Piano Lauree Scientifiche-PLS). The PLS project support more than 60 biannual local university projects with initiatives for school-university cooperation in mathematics, physics, chemistry, material science. In the PLS physics section, the collaboration of Universities with school teachers is an important goal realized in different ways. In this framework, the Research Unit in Physics Education of the University of Udine promoted a research based coordinated project among the Italian University Physics Education Research Groups (IPERG) on Innovation in Physics Education and Guidance (IDIFO) including at time 6 universities and now 20. The main cooperative action was an articulated research-based proposal for teacher professional development on innovations in teaching/learning (T/L) modern physics, didactic innovation and problem solving for formative guidance (Master IDIFO). The proposal consists in 168 cts offered in presence and in e-learning, organized in 5 profiles to leave attending teachers to be able to select a personal path for: 1) a single 2 cts formative activity (Corso di formazione), 2) an annual formative activity of 15 cts (Corso di Perfezionamento), 3) a biannual Master of 60 cts, which 6th edition is now closed.

The design structure of the Master IDIFO is in the theoretical framework of the Model of Educational Reconstruction on the light of research results on the pedagogical content knowledge (PCK), integrating different teacher education models and activities (educational, experimental and design labs, discussion and reflection activities conducted individually, in small groups and large groups, carried out with tutorials). The basic materials for the activities are those developed by means of physics education researches (PER) on T/L quantum mechanics, relativity, material science, in context physics, using new instruments and methods, multimedia to overcome conceptual knots to promote active learning and problem solving for guidance.

PER is present in the Master IDIFO in various dimensions: the materials used for teacher development are research products, the educational activities include research-based proposals, teaching experiments, didactic tools and lab experiments, selected PER papers. The professional development processes and the appropriation process of the educational innovation in modern physics are monitored to identified elements for a model of in-service teacher professional development.

In this contribution, we discuss the main characteristics of the six editions of the Master IDIFO in term of a community where a fruitful interaction between teachers and researchers produces a research-based model for teacher professional development. Case studies on T/L quantum mechanics exemplify the ways in which teachers acquire competencies on T/L quantum mechanics and transform a research proposal.

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Pre-secondary School Teacher Professional Development on Optics

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ABSTRACT

A study on multidimensional competence gain in optics of 79 in-service pre-secondary school teachers of 5 different Italian towns is carried out in a yearlong project by means of different instruments and methods integrating Metacognitve, Experiencial and Situated models in research based 8 phases intervention module. The study focalizes on how teachers take ownership of content and innovative research based proposals offered them in formative intervention modules and transform it into suggestions and materials for teaching. The study investigated how teachers deal with conceptual difficulties in the module and how they adapt it to their school situations with data being gathered through a variety of tools. It emerged that the main difficult concepts that teachers encountered at the formative stage were those they most often incorporated into their materials. A collaborative discussion among the teachers themselves on the materials they had produced evidence the steps taken in this process of appropriation and on the ways in which teachers perform their professional development in a framework aimed to produce in classroom activities for children active role in the construction of their own scientific knowledge.

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Constructing a training program about light and color concerning pre- and in-service teachers

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ABSTRACT

Attracting students to university Physics departments is or should be a long process that takes place at all educational levels, from the level of pre-school education to the secondary level. This process may also take place not only during the Physics courses by science teachers, but also during other courses where teachers are required to teach elements of Physics. In some cases, as in the case of primary or pre-school teachers/educators, often teachers/educators are not properly prepared for this. The result is that students are disappointed and lose contact with the field of Physics. A way to properly train the different categories of teachers involved in the teaching of Phys-ics is to attend trans-disciplinary training programs where Physics is not treated mere-ly as a specialized subject, but as a cultural entity.

In this study we will present the principles and the structure of a trans-disciplinary training program concerning the concepts of light and color, which is addressed to three categories of teachers/educators: (a) science teachers, (b) art teachers and (c) primary teachers or/and early childhood educators who should teach physics. More specifically, we will describe a methodological framework for analysis and designing educational programs influenced by the constructivist approach of teaching and learn-ing. As regards the analysis level, we will emphasize on the alternative conceptions that the three categories of teachers (in the pre-service level) have about the concepts of light and color. More specifically, we will present certain results of an empirical re-search regarding these conceptions and we will show that all three categories of teachers/educators have unclear ideas about these concepts, due to an indiscriminate use of two different conceptual frameworks: that of science and that of the visual arts. Concerning the planning level, we will refer to the structure of a sequence of teaching units. This sequence is based on an educational environment where the teach-ers/educators could (a) (a) explore the limits of the validity of their unclear ideas when they resolve light and color problems and (b) construct and use new operational ideas about light and color based on both the discrimination and the relationship between the conceptual frameworks of science and the visual arts.

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Rasch analysis of the hope-SSQ questionnaire

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ABSTRACT

The data arising from the HOPE WG1 - SSQ - Questionnaire, gathered on almost 1500 students in 27 sites around Europe, have been analyzed using Rasch models, in order to extract and measure factors inspiring to study Physics. In particular, using a Rating Scale Model (Wright & Masters, 1982) and Principal Components Analysis (PCA) of standardized residuals, we identified and measured two main latent traits that can be interpreted as ATTITUDE towards research in physics and MOTIVATION. These are clearly non-cognitive skills as defined by Heckman et al. (2014) which, interacting with other personal factors as cognitive skills may influence performance, decisions, goals, motivations, and preferences valued in the labor market, in school, and in many other domains. We then applied multilevel multivariate logistic regression models with SIMEX correction (Lederer & Kchenhoff, 2013) using the estimated latent traits as explanatory variables: the results show that these are significant and relevant factors explaining the decision to study physics, the level of cognitive skills in physics and the wish to become a physics teacher, identified respectively by question C24, C19 and C18 of the questionnaire.

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The FAM students: a case study in Ticino, CH

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ABSTRACT

During the 3th year of the second level of the secondary school (the so called "Liceo", which lasts 4 years), the 16-17 yo students from the Swiss Canton Ticino who want to keep on study Physics, usually choose a curriculum called "FAM", i.e. Physics and Applied Mathematics, strongly focused on physical and mathematical modeling. Nevertheless, not all the "FAM students" will study Physics at the University, because to study Sciences, students from Ticino usually go to the ETH in Zurich or the EPFL Lausanne, devoted above all to Applied Sciences, so that also students interested in Mathematic only or Medicine or Engineering are attracted by FAM. So, even if they are a peculiar case in Europe, the FAM students are a relatively easy-to-study sample to understand the expectations of young people toward Physics and Applied Physics, because they are interested in it but not yet strongly oriented to choose it at the University, and because they know from the beginning that to study Physics they will be anyway in a condition very similar to that of every young European researcher, changing place, language (Ticino is the only Italian-speaking Swiss Canton), competences. After the preliminary results showed in the Helsinki meeting, this study is therefore devoted to the ideas of the FAM students about studying Physics after choosing the FAM curriculum.

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Inspiring Secondary School students to study Physics in the University of Aveiro

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ABSTRACT

The Physics Department of University Aveiro has been organizing for several years a series of activities aimed for attracting and involving Secondary School students, hoping to be able to inspire them to study Physics.

These activities are integrated in the Universitys Summer Academy, last for 5 days, in average, and take place in July.

The 2016 edition themes were:

- Biomedical Engineering and the quality of Human Life
- Talks with Physics people
- From particles to the universe: to think, to experiment, to compute
- Materials: from microscopy to Physics
- Coastal Erosion
- Micro and Nanotechnology Physics
- The weather, the oceans and climate changes
- The Physics show

These activities reflect not only the Physics Department areas of research, but also the interaction and interdisciplinarity achieved through the interaction with other departments within the University, which will also be put forward, as it widens the scope and diversity of fundamental concepts in Physics in its relation with daily life and current top issues in the media. In this work it is meant to present the activities that were put forward this year, its structure and content, the profile of the students and teachers involved, and illustrate the activities.

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Report on Factor Analysis for HOPE University Students Questionnaire: The case of University of Patras, Greece

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ABSTRACT

Factor Analysis (FA) is a statistical method, branch of multivariate analysis, that is concerned with the internal relationships of a set of observed and correlated variables, in terms of a potentially lower number of unobserved variables called factors. In our case, the observed variables are the students responses to the items (closed-type questions) of HOPE University Students Questionnaire, which we classify into broad categories (unobserved variables-factors). Those items, which correlate with each other, share to a great extent a common variance and therefore we can put together a group of common factors that encapsulates it.

We use Common Factor Analysis (CFA), as our main goal is to identify the structure of factors that have inspired physics students to study physics. The method of factors extraction is Principal Axis Factoring (PAF), for it is believed to be less restrictive in assumption of multivariate normality. Several tests have been conducted: Bartlett's Test of Sphericity, Kaiser-Meyer-Olkin indicators, Measure Sample Adequacy, Kaiser criterion and Cronbachs Alpha. The entire analysis was performed in SPSS.

As an applied example of our method, we present the results of CFA for one HOPE partner, University of Patras in Greece, which has collected a substantial sample of 107 students with at least 5 responses for each one of the 20 items of the questionnaire. Regarding the reasons that inspired young Greek students to study physics, CFA has resulted to 2 rather distinctive factors:

1. Informal learning that includes scientific TV documentaries, books or magazines, museums or exhibitions and websites.
2. Deep understanding that includes understanding of the world and the universe and the way things work.

Interpreting our results, young Greek physics students choices are clustered in Informal Learning as well as in Deep understanding. These factors both relate to personal choices and characteristics of the individual. In order to attract more students in physics studies, one could consider (a) further enhancement of the elements that constitute the extracted factors and (b) ways to improve those influences that have been excluded from the analysis, as they did not form a common factor.

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Qualitative and quantitative data analysis of the HOPE-SSQ questionnaire on the factors inspiring Secondary Students to study Physics

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ABSTRACT

The Hope-SSQ questionnaire aims to gain insight into the factors inspiring students to study physics and into the conditions of this choice, focussing on the transition school-university with attention to talent students interested to physics. For this goal, a work group has developed a questionnaire, administered by 22 partners of the HOPE-project in 19 countries. The questionnaire includes four parts: A) Several dimensions evaluation of the interest in physics (A1-9 Likert scale items); B) factors influencing the choice of a career as well content-related aspects as social aspects such as the image of a physicist (4 open questions); C) Factors inspiring young people to study physics (C1-20 items of the WG1-A questionnaire); D) Student gender, age, school, study intention. More than 1500 questionnaires were collected in 6 kinds of event: National Olympia; Full Immersion activity with national selection; Local selection full Immersion activity; IPPOG Masterclass; Educational Lab; School activity. The analyzed sample includes 1475 students 16 aged or older from 16 countries.

This contribution summarizes the process activated to design SSQ, the community contributing partners, the data collection, the data analysis of A-C parts by means of different methods (elementary quantitative results, Exploratory Factor Analysis (EFA), Rasch method, the latter presented as a separate contribution), the qualitative data analysis performed by qualitative research criteria.

As concern EFA, the Kaiser-Meyer-Olkin measure of sampling adequacy (0.9¿0.5) and the Bartletts test (19391.83, p¡0.001) show that the factor analysis could be preceded. In the final EFA analysis with four factors, the total percentage of variation explained is 44% with 0.91 Cronbachs ? reliability test. The factors (latent traits) are: F1) Engagement (C1, C8, C13-14, C17-19, A1-3, A8), F2) Future Perspectives (C2-4, C7, C16 and C20), F3) Perception (A4-7 and A9) and F4) External Inspiration (C5-6, C9-11). We then applied non-hierarchical cluster analysis to identify groups of homogenous students with respect to the latent traits and profiled the clusters in order to characterize the groups. Different roles of factors emerge considering event of collection (different students involved) and countries

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(eg. concerning the role of future jobs in east/west Europa students). Statistically significant differences for factors F1, F3, F4 emerge for gender and decision status in applying to a physics degree.

The analysis of qualitative data confirms the great importance of elements characterizing F1, giving a better look. Emerging aspects inspiring to study physics are the epistemic characteristic of physics (17%), the explicit desire/interest for understanding phenomena and/or desire to enlarge the horizons of scientific knowledge (14%). These are related to the pleasure in study physics (12%) and to the role of school teacher, in reading scientific book, in visit scientific centre, Olympia (17%).

An interactive simulation of atomic beam spectroscopy

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ABSTRACT

Information technology and computational tools allow the setup of virtual laboratories where students can check and probe their ideas, according to the principles of inquiry-based science education. We have developed an interactive simulation, modeled after a real experiment of atomic beam spectroscopy, using the Easy JavaScript Simulations software toolkit, devised within the Open Source Physics project. The simulation has been tested on twenty Bachelors and Masters students in Physics at the University of Camerino. Data between pre- and post-tests have been compared in order to assess the educational effectiveness of the simulation.

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Improving physics teaching of undergraduate students through the use of video lectures

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ABSTRACT

We present a detailed analysis of the students' use of an e-learning platform containing the full video recording of the lectures of a Physics course in Classical Mechanics for first year undergraduate students enrolled either to the Physics degree or to the Mathematics degree at the University of Camerino. The use of the e-learning platform by each student has been analysed either quantitatively and qualitatively, and a detailed comparison with the students performance has been carried out. The analysis is still ongoing but preliminary results show that the support of recorded video lectures is of paramount importance especially for students with a lower level background and with a limited physics experience at the high school.

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The Voice of S&T Teachers first hand testimonies of good practices

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ABSTRACT

Teaching practices of Science and Technology (S&T) have an important value that comes from a professional knowledge laboured over generations of professionals in the silence of individual reflections, the solitary work in the classroom or home office. It is necessary to bring to light the work. Spaces must be created that foster the sharing of these experiences so they can be disclosed, appreciated, valued and perhaps improved.

A research group based in University of Trs-os-Montes e Alto Douro, UTAD, organized in the Laboratory of Didactics of Science and Technology, LabDCT, has done research work since 2000, focused on S&T teaching practices inside and outside the classroom in different areas, backgrounds, education levels and countries (Angola, Brazil, Portugal). These researchers also integrate the Research Centre for Didactics, Technology and Education of Trainers, CIDTFF, of University of Aveiro, UA, together with teachers from the UAs Physics Department.

Crossing that necessity and experience in teaching research focused on S&T teaching practices originated a first teachers meeting, where teaching practices from all the education levels were presented. As a sequence, an international meeting lasting two days will take place next November, in UTAD, whose aim is to present S&T teaching practices reports and research to a wider public. In particular it is intended to:

- Disseminate, appreciate, valorise and improve teaching practices of S&T teachers of all grade levels who teach these subjects, showing what is being done so that reflection and improvement can take place.
- Interact with researchers so that both teachers and researchers can benefit from working together.

In this work we present results of the first teachers meeting, with examples of good practices of the grade levels present and a critical constructive evaluation, and give an insight on the international event to take place later this year.

In particular, we will show how teachers innovate their teaching practices and how they learn interacting with colleagues from other scientific areas of S&T. We also will ilustrate how researchers and teachers benefit from this collaborative environment in which all assume the same status as learners from each other.

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Comparisons of Active Learning in STEM Education

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ABSTRACT

STEM education faces two major challenges: the declining interest in STEM subjects among youngsters and the transformation of the concept of learning for a knowledge-based society. Active learning is considered to be a remedy for these challenges.

The examination of STEM reform in the U.S. and Asia reveals that the emphasis of active learning is different in these two regions. The U.S. is suffering from the low quality of secondary education and is trying to retain students in introductory courses with active learning. Active learning in the U.S. is also based on the cultural tradition of discussion and hands-on experiences in learning.

Asia maintains the quality of STEM education with entrance examinations and is trying to foster generic skills such as communication skills and leadership with active learning. Since Asia has a long tradition of learning with books and lectures, its active learning has to meet the requirements of content coverage and disciplinary depths.

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Scientific Disputes and the Public

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ABSTRACT

In July 2015, the Institute of Physics, UK carried out a unique activity in Bristol, involving public in the scientific disputes /1/. It was initiated due to a long-lasting dispute between the Big Bang theory and the Steady State theory of the origin of universe. Of course, one can doubt the involvement of public in the dispute in advanced physics, like the origin of universe, On the other hand, I think, it would be useful in involving public in latent educational disputes among students. For example, students give contrasting answers to very simple question on circular motion reported first by John Warren in Physics Education,1971and by some others later. Contrast in answers can be attributed to contrast in the mode of evaluation of answers. Actually, wrong answer of students resembles with the pre-Newtonian idea, used by even Kepler. Hence, I think that organizers of future events can very well think of having a session focusing on the contrasting answers and involving public, especially teachers, students and parents with appropriate academic background for throwing light on such educational latent disputes. In request readers of SRT to read the main story entitled Settling scientific disputes in public (Physics World, 14 July 2015 and first comment dated: 15 July 2015).

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The integration of physics and technology in physics programs

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ABSTRACT

The interdisciplinary mutual impact both of physics and technology is obvious. Here the meaning of the word technology stands for all fields of technologies not only exclusively for IT as commonly understood especially in teaching and studies. Nevertheless, these subjects are taught very often separately. Our experience in teaching information technologies and physics show the possibilities to introduce topics of physics when teaching IT as well as to use the IT and other technologies to improve physics lectures and experimental demonstrations. Here some university physics studies programs and subjects are analyzed.

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Civics-Physics - a Key Tool in Promoting Both Civic Education of Students and Trainers and the Atraction to Study Physics

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ABSTRACT

CIVICS-PHYSICS may be defined as Physics knowledge applied in modeling the civic world. It may essentially help Civic Education by offering those acquainted with Civicsphysics, students and their trainers, powerful tools to observe, investigate, understand, explain, identify problems, find solutions, forecast the relationships between citizens and their communities.

Civics-physics might be introduced as early as introducing Physics, because, initially, it may be based upon simple Physics models, due to some similarities of civic phenomena with natural phenomena studied by Physics.

Physics teachers may introduce and require from learners to prepare Civics-physics models as direct applications for newly introduced physics models. The acquaintance of teachers of Civics Education with Civics-physics models and their use in civic education activities may contribute to increase the level and the appeal of Civic Education and also to promote and inspire Physics study itself, by offering Physics learners a large and variable surrounding civic world of simple and interesting applications.

The citizens or communities are not to be supposed as the bodies in Physics - as independent from the environment. The laws describing Civics-physics relationships are range limited (in space, time, domain, intensity) and approximate, but yet objective, local variations from ideal conditions having to be identified and considered. Interdependence and co-operation play important roles. Civics-physics laws may be approached as postulates (acceptable, based upon partially pragmatic check), offering a higher level of common sense.

The authors introduce a few Civics-physics versatile tools:

The Dimensional Analysis is essential when determining the Civics quantities, their equality and comparison and the conditions of application of Civics-physics models.

Basics knowledge of Processing of Experimental Data, of Averages and Errors may help in correctly defining the range of the application of Civic models and of their errors.

A pupil has to understand, from Newton IInd law of Mechanics (the postulate of "proportionality with action", PPA) that better rewards may be got only upon better work. Later on, he or she may become able to understand the roles of intense work and of developing personal talents in progressing in the hierarchy of values.

The "Postulate of Action and Reaction" (PAR, corresponding to the III rd Newton Law) may help in realizing the connection of human rights with the implied human obligations. Together with the PPA, PAR may help in correctly establishing the marks, prizes, rewards, but also of penalties (type and range) for infringing obligations. They may help students to understand the connection between corruption, lack of transparency and wealth polarization in society. Students might evaluate themselves if the marking system used in school is satisfactorily applied orlater on if there be a positive or negative discrimination of rights or of obligations of a minority (of migrants f.e.) or of a majority.

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Physicists and the Great War: an historical - didactical exhibition

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ABSTRACT

One of the cornerstones of science education research is the study of the role of history of science to inspire young generations to enrol in science and mathematics classes and to help students to achieve a successful learning outcome while studying science. By leveraging on the possible contributions of history of physics to physics education, it is here presented an exhibition held in early 2016 in Parma, Italy, aimed at students of upper secondary school.

This exhibition focused on a physical method used in the Great War and developed in 1915 by Antonio Garbasso, one of the greatest Italian physicists of the beginning of Twentieth Century, promoter of the cosmic-rays physics in Italy in early 1930s, and eventually Senator of the Kingdom of Italy. To the development of this method participated also, in the initial phase, Pietro Cardani, Professor of Physics at the University of Parma and Deputy in the Kingdom of Italy for two terms (1904-1913).

Garbasso-Cardani method consisted in a sound ranging technique for locating the position of the enemy artillery units by the sound emitted by its fire. According to this technique, a sound detection device called by Garbasso phonotelemeter, made of a chronograph fitted with a timekeeping device (a conical pendulum) and placed in a central station, recorded the firing times communicated by at least three warning stations on the battlefield and allowed to establish the position of the enemy artillery by an analytical method.

By the development of this sound ranging technique, that Garbasso himself applied and headed on the whole Isonzo front, and that made possible the tracking of a large percentage of the enemy artillery units, Garbasso was awarded the Croix de Guerre.

The didactical exhibition consisted in a number of posters, interactive experiments and a battlefield model with the goal of reconstructing the working of the phonotelemeter and its versatility. It was also the starting point of an educational activity on the properties of sound, and the occasion of an interdisciplinary work between mathematics, physics, and history. The exhibition was designed with the grade-12 students of a class of a Parmas upper secondary school (Liceo A. Sanvitale). The exhibition was located in the same school, lasted two months and was seen by more than 1,000 visitors (over 800 primary and secondary school students and a general audience of over 200).

The educational benefits of this didactical project are here discussed.

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Analysis of innovative methods used in physics teaching at University and Secondary/Primary Schools: the case of Granada (Spain)

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ABSTRACT

The use of innovative methods in physics teaching for university and secondary/primary school students is clearly a way to attract students to the Physics Degree or to improve learning of physical concepts. In this context, research and innovation on methods in Physics education is a fundamental tool to achieve these goals and it is essential that these methods can turn into specific activities or strategies.

In this communication we analyze the groups of activities performed in the University of Granada and in the Science Park of Granada (Interactive museum of Sciences) both with the goal of turning innovation into practical activities:

1) In the University of Granada the Strategic Programs for Innovations in Undergraduate level has carried out to the implementation of 45 pilot projects in Physics during the last 14 years. These projects have a variety of focal points we can classify into four categories: a) Improving practical contents or simulation exercises (13 projects), b) Using ICTs, development of computer-based applications and online teaching material (13 projects), c) Improving teaching methods in classroom and new assessment techniques (15 projects) and d) academic support to students and analysis projects (4 projects).

2) In the Interactive museum of Sciences (Science Park) in Granada it has been created a space for schools called Research in the Classroom. This space is designed to expose research activities in the classroom with the objective to promote research as part of normal activity in science classes, providing teachers the opportunity to broadcast their work. This innovative research is focused in several subjects of Science. During the last 10 years, more than 55 activities have been performed for primary/secondary school students, Physics being the most important related subject with 32 activities. They are exhibited in panels and may be accompanied by supplementary information materials such as videos, models, computer programs, etc.

Our analysis of these activities shows that a very special attention is given to skills related to the knowledge of subjects related to environmental physics (energy and climate), information and communication technologies, optics, acoustics and astrophysics. In terms of transversal competences these activities focus on team working skills, communication skills at different levels, long life learning skills, and promotion of students entrepreneurship and job literacy. In general, all these activities look for making a connection between everyday experience and physics models. We can conclude that these activities constitute a good practice catalogue to be considered for a global strategy of designing new forms of curriculum development in initial and continuous training for physics teacher education and an effective way to enhance the role of university physics departments in connection with sciences museum in helping the teaching of physics at all education levels.

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