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Horizons in
Physics
Education



Lifelong
Learning
Programme

Newsletter HOPE Network December 2016

Results on New Competences for Physics Graduates, Fostering Innovation and Entrepreneurship

HOPE network

HOPE is an “Academic Network Project” whose purpose is to enhance the impact of physics within the European socio-economic area. It is co-funded by the European Commission in its “Life Long Learning” Programme and by the Partners of HOPE which are mostly Physics Departments of universities in Europe. Its purpose is to create value for its stakeholders by investigating issues of importance to university physics departments. In particular, the HOPE project aimed to investigate

New Competences for Physics Graduates, Fostering Innovation and Entrepreneurship



Physics education aims to produce graduates who are able to contribute to economic growth through technological innovation as well as through advancing scientific understanding.



In particular, physics plays a vital role in our responses to the major challenges facing the world such as climate-change, electrical energy production and new technology for health care. Good physics education is the bedrock of a technologically advanced economy and is vital for producing the highly trained workforce that Europe needs. And yet, in many European countries physics is not well appreciated by young people and there are still serious shortages of well-trained physics teachers and professionals. Physics university education should better prepare students for the new needs of society and for present and future economic challenges. The Horizons in Physics Education (HOPE) project sought to investigate the underlying factors in all of the above and to make recommendations to improve physics education so that new demands and requirements are met and to suggest ways to improve the production of well-trained physicists.

Investigating the competences perceived important in the world of work



Employers ranking of skills

The task was to investigate the competences that are perceived to be important in the world of work outside academia. Questionnaires for recent alumni and employers were developed to access the relative importance of a range of different skills and abilities. The survey was established with the following aims:

- To investigate how important a specific set of competences is for graduates within the context of their current job, and to then compare this with how these skills were developed during their studies.

- To investigate how important this same set of competences is (again within the context of current roles) but now from the perspective of their employers. Additionally, the views of the employers themselves were sought relating to the development of these skills, or perhaps more correctly, the opportunities for specific skills development within undergraduate physics degrees.

Key Findings

In physics programs competences like Problem Solving, Analytical Thinking and competences leading to innovative thinking are trained well, even though alumni and employers suggest that improvement of this training is welcome. This is typical for physics: fundamental scientific reasoning to understand nature and pave the road to new developments. Striking is that for the employability of physicists in sectors different from academia, a lot more attention should be paid to soft skills as Teamwork, English language, Searching for Information, Autonomy, and Oral Communication and Presentation Skills.

Look at the questionnaires for the [alumni](#) and the [employers](#) and the [full report](#).

Key figures



32 Partners participated to the activities
2 Meetings (Lille 2014, Hannover 2015)
1 Forum (Coimbra 2015, booklet [here](#))
3 [questionnaires](#) developed and distributed
19 contributions (see [here](#))
239 data collected
Final report [here](#)

How physics programmes develop skills preparing graduates for employment ?

The activity focused upon how to obtain information from across the HOPE partner network on how physics programs aim to develop the skills related to innovation and entrepreneurship amongst their learners. A [survey](#) was produced with the aims of:

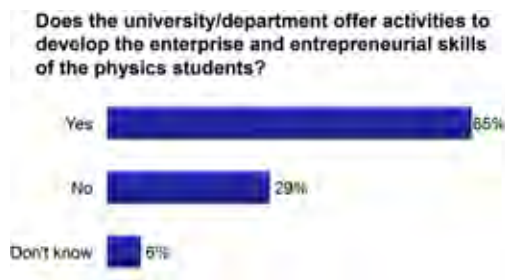
- Revisiting the generic competences made by the Tuning Project for Physics Graduates to explore whether new competences are required in order to prepare physics graduates for the workplace outside of research.

- Investigating the extent to which physics departments (or universities as a whole) have introduced the development of these new competences and how they are assessed.

- Investigating the feedback from physics academic staff on the relevance and importance and merits of these (new) competences to ensure physics graduates are prepared for the workplace outside of research.

- Obtaining information, including (case study) examples of current practice, from physics departments on the specific innovation, entrepreneurship and enterprise competences that they include in the educational experiences and learning opportunities offered to their physics students.

Key Findings on Departmental survey



The following conclusions from the survey can reasonably be drawn:

- Enterprise/entrepreneurial education is being driven by the institutions themselves and not by physics departments. This is evidenced by the fact that strategies exist at an institutional level (but not within departments), and that in many instances, approaches to delivery rest outside of the physics departments themselves.
- Enterprise/entrepreneurial skills are identified as being important, perhaps increasingly so, but not more important than traditional physics skills such as problem solving.
- There are examples of employers making a contribution to the curriculum, but it seems likely from the evidence that this is more related to employability than enterprise/entrepreneurship education.
- There are increasing examples of practice in the delivery of enterprise/entrepreneurship skills, some of which may merit more details case studies to form examples of good practice.

Look at the questionnaires for the [Departments](#) and the [full report](#).



Interview of P. Pereira Da Silva, CEO of [Renova](#) during the annual forum in Coimbra (sept 2015)

Valuable inputs from invited speakers



The speakers from industry (J. Peeters, Capricorn Venture Partners, O. Poulsen (on the picture), [Lindoe Offshore Renewables Center](#), P. Pereira da Silva, [Renova](#)) had a physics background themselves and although their

presentations represented their personal view as an employer, it was striking that their message was a fairly common one: Entrepreneurship requires a spirit of 'Dare to Venture' and a large amount of initiative. The difference between an entrepreneur and a manager lies in the fact that entrepreneurs starting a business puts at risk part of their personal financial resources. Qualities of a good entrepreneur include: leadership, the ability to adapt quickly to new situations, the will to take reasonable risks, the ability to attract good partners, to motivate people. This requires amongst others excellent communication skills. The academic environment being secure (almost no risk is involved), students have to learn to leave this comfort zone. Therefore, competences including all aspects of communication are essential for success. Knowledge of 'hard' physics is of course an excellent base for leading technological projects, but these have to be supplemented by soft skills as the ability to interact with colleagues and clients including strong listening skills, the ability to plan and think strategically and personal attributes like perseverance, reliability, and strong self and time management skills. One might conclude that to the opinion of those employers physics graduates in general are less well prepared for the entrepreneurial job market than from the providers (= universities) viewpoint.

Important "soft" skills needed are :

- Capacity to communicate in teams and networks
- Excellent written and verbal communication skills
- Strong self management and time management skills
- Ability to plan and think strategically
- Reliability and Flexibility

HOPE recommendations



It is clear that in the skills and competences needed for the job market outside academia and education, and certainly in an entrepreneurial environment, “soft” skills have become more important over recent years and will be part of the “skills for the future”. As a large percentage of the physics graduates will look for a job outside academia/research and education it is necessary that universities prepare the students for this type of jobs. To the opinion of employers, (physics) graduates are – in general - less well prepared for this job market than from the universities perspective. However, there is a growing awareness in universities of this and this is shown by various examples of good practice in different countries: innovative teaching methods and activities that promote the acquisition of these “soft” skills and competences.

HOPE recommendations

Recommendations to academia can be drawn such as :

Formulating a vision as a physics department of how you would like to prepare your students better for the future job market with respect to the acquisition of “soft” skills. Ideally this should be derived from a vision on university level.

Investigating if and how “soft” skills are acquired inside the physics curriculum at this moment.

If improvement is needed:

- Use the examples of good practice as inspiration
- Try to work together with other departments in your university: they might have the expertise which is not present in the physics department
- Try to integrate acquisition of “soft” skills in meaningful projects (not isolated)
- Involve your own alumni and employers of alumni.

The [final report](#) is collaborative work of H. Ferdinande, H. Geurts, M. Grove, W.G. Jones, I. Lopes, V.Nilsen, J. Rogiers, R.R. Trieling

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