

Chairperson: Dr Mark Lang

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8th June 2016

Re: Consultation on Statement of Strategy 2016-2018.

To Whom It May Concern:

The Institute of Physics in Ireland welcomes the opportunity to respond to the Department of Education and Skills Consultation on Statement of Strategy 2016-2018.

The Institute of Physics in Ireland is a scientific membership organisation devoted to increasing the understanding and application of physics in Northern Ireland and the Republic of Ireland. It has over 2000 members, and is part of the Institute of Physics (IOP).

The Institute of Physics has a world-wide membership of over 50,000 and is a leading communicator of physics-related science to all audiences, from specialists through to government and the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

This submission was prepared in consultation with the IOP in Ireland's governing committee, and with input from members of the Institute working in education at all levels and in industry.

The attached document highlights key issues of concern to the Institute.

If you require any further information or clarification, please do not hesitate to contact the Institute at the above address.

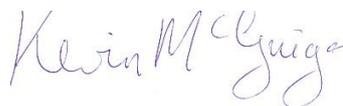
Yours sincerely



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Prof.. Kevin McGuigan
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Department of Education and Skills

Consultation Paper – Statement of Strategy 2016-2018

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The Institute of Physics in Ireland (IOPI) is a scientific membership society devoted to promoting physics and bringing physicists together for the benefit of all. We have over 2000 members and are a part of the Institute of Physics (IOP), a charitable organisation and leading scientific society.

The Institute of Physics in Ireland operates in the Republic of Ireland and Northern Ireland on an ‘all island’ basis. We aim to promote the role of physics in society, covering education, health, the environment, and technology. Our membership is wide-ranging and multidisciplinary, including the education, industrial and medical sectors and the general public. We also seek common purpose with other organisations to promote science and science-based learning and to influence science policy in both the Houses of the Oireachtas and the Northern Ireland Assembly. Special emphasis is placed on supporting physics teachers by promoting in our schools the value, joy and benefits of a knowledge of physics and its applications.

The Institute of Physics in Ireland welcomes the opportunity to respond to the Department of Education and Skills request for submissions on its Statement of Strategy 2016-2018.

This response focuses on issues relating to the teaching and learning of physics and related skills at all levels.

1. How well does the Education service meet the needs of children and students?

Across Ireland, physics and physics-trained people underpin a wide range of technologies and sectors, from medical technologies to ICT and from web services to many areas of finance. Physics-based sectors contribute more than €7bn annually to the Irish economy – 5.9% of total economic output – and support more than 86,000 highly productive jobs.¹ The teaching of physics at second level is also crucial to equipping students from engineering programmes at third level and therefore is also of importance to the wider engineering sector.

The robustness of this sector has played a significant role as Ireland emerges from the economic crash of 2008. Hence it is of critical importance to secure a pipeline of well-trained people with expertise in physics. It is of note that skills shortages are emerging in certain areas and occupations, including in advanced manufacturing and Information Communications Technology (ICT), as indicated in the Department of Education report Ireland’s National Skills Strategy 2025.² Investment in physics is a key element in addressing these shortages.

1(a) What improvements can be made within existing resources

¹ Institute of Physics. *The importance of physics to the Irish economy*, 2012: http://www.iopireland.org/publications/iopi/page_59020.html

² Department of Education and Skills. *National Skills Strategy 2025*, 2016: https://www.education.ie/en/Publications/Policy-Reports/pub_national_skills_strategy_2025.pdf

There are a number of areas of critical importance to the teaching and learning of physics where improvements are needed. These include:

- The rapid full implementation of the new Junior Cycle Science curriculum. The present curriculum has an outdated emphasis on verifying established truths rather than on genuine investigation of the unknown and there is a distinct failure to integrate the sciences. The new curriculum has more emphasis on practical work, but across Irish schools the lack of "hands-on" science is mainly due to years of under-funding for equipment. This under-funding must be addressed.
- The need to reverse the reduction in class contact hours for the majority of students at Junior Science in the new Junior Cycle commitment. Science is a highly practical subject and needs more teaching time than an average subject. It is also of note that no other subject at Junior Cycle level effectively encompasses three major areas of study – in this case physics, chemistry and biology. In the UK these would be taught as separate subjects which results in increased teaching time.
- The urgent introduction of the revised Leaving Certificate syllabus. This proposed update has been on hold for so long that it may need to be reassessed and its implementation then fast-tracked.
- A need to review Project Maths and its impact on other parts of the curriculum given the changes in areas such as calculus which have a direct relevancy to physics.
- A need to address the lack of use and training in computers. This should begin at primary level and continue right through second level.
- Extending the provision of physics at Leaving Certificate level to all second level schools. Currently, the subject is not available in around 25% of schools.³
- Extending teacher continuing professional development (CPD) in physics, particularly to those Junior Cycle Science teachers whose degree qualification is not in physics. CPD needs to be broad in the area of science and teachers should be fuelled with passion to bring into their classroom and convey to their students.
- Updating school labs and employing lab technicians. A third level programme of training should be introduced so that lab technician is seen as an attractive and realistic career choice.
- Ensuring schools are encouraged and provided with the financial means to make labs available after hours for CPD and science courses for communities.
- Addressing the gender imbalance issues in schools through a whole school approach.
- Rapidly implementing recent announcements relating to Ireland joining CERN and the European Southern Observatory to provide benefits at second, third and fourth level.
- Providing sustained funding for fundamental research initially at a level of at least 10% of the overall science research funding.

³ Central Statistics Office:

http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=EDA86&ProductID=DB_ED&Language=0

1(b) What improvements can be made through new provision

No comment.

2 Comment on work currently being undertaken by the Department in your area of interest and/or expertise. (What are we doing well, what could we do better)?

School level

For more than ten years there has been a sustained effort at government level, and from a variety of government agencies, to increase awareness both in the value of science and with the wide variety of interesting careers that flow from studying the sciences. For example, Science Foundation Ireland and Smart Futures have undertaken much work on this and the IOP welcomes the proposals within Innovation 2020 in this regard. The IOP has placed significant resources into providing support for the teaching of physics through its teacher networks and in the provision of accurate and engaging careers materials. We have noted a significant increase in the demand for such material over the past couple of years. The IOP welcomes the plans in the National Skills Strategy 2025 to review guidance services, tools and careers information for school students and adults.

However, while there has been a welcome rise in the numbers taking physics at Leaving Certificate level (up 18% in 2015 from 2012) the overall numbers taking the subject are still low, representing just 13% of the Leaving Certificate cohort. Of particular concern is the fact that over a quarter of schools do not offer the subject at Leaving Certificate level, restricting the opportunity to study physics for a majority of students, and the continuing gender imbalance with girls who only comprise 25% of the physics Leaving Certificate cohort.

Teacher Professional Development

Central to improving the uptake of physics at school level is the experience of students in their first three years of post-primary education. The IOP welcomes the introduction of the new Junior Cycle Science curriculum but notes that it must be accompanied by sustained investment in teacher CPD as indicated in the National Skills Strategy. This is particularly important for physics as the majority of Junior Cycle Science teachers are qualified in biology and not the physical sciences.

Specialist physics teachers have been shown to improve both progression rates⁴ and achievement⁵ of students in physics.

The IOP has been running its Stimulating Physics Network (SPN) in England since 2009, providing bespoke support for more than 420 schools to improve physics teaching. Our analysis has shown that better physics teaching has been shown to improve the number of students going on to study A-level physics.⁶

In the IOP SPN partner schools:

⁴ Alan Smithers and Pamela Robinson. *Physics in Schools IV – Supply and Retention of Teachers*, 2008: <http://www.gatsby.org.uk/uploads/education/reports/pdf/16-physics-in-schools-supply-and-retention-of-teachers-june-2008.pdf>

⁵ Ofsted. *Successful science. An evaluation of science education in England, 2007-2010*, 2011. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/413802/Successful_science.pdf

⁶ Alphaplus Consulting. *The evaluation of the Stimulating Physics Network (SPN) Programme*, 2015: <http://www.stimulatingphysics.org/pdfs/Institute-of-Physics-SPN-Evaluation-interim-report-2015.pdf>

- The increase in the number of pupils progressing from Key Stage 4 to AS-level physics has been more than double the national rate;
- The participation of girls in post-16 physics has doubled compared to the national average;
- In 2012, 82% of pupils achieved grades A*-C in physics GCSE, compared with 69% nationwide.

IOP employs two part-time teacher network co-ordinators to work closely with the Professional Development Service for Teachers to deliver workshops, talks and conferences across Ireland on cutting edge physics and its delivery in the classroom. However, it is clear from the work of the SPN in England how much more could be achieved with more resources in this area and what could be done with an analogous programme in Ireland.

Subject availability at school

Nearly one in four of all second level schools do not offer physics at Leaving Certificate level, thus preventing a substantial proportion of students from having the chance to further their experience and interest in and knowledge of physics and potentially denying physics-based businesses with a huge number of talented employees. By missing out on this opportunity, many students will not be able to pursue highly valuable careers in this area.

In order to achieve a sustainable and long-term increase in the numbers of under 18 year olds taking physics, significant support must be given to schools who are under pressure to drop physics altogether. In particular, consideration should be given by the Department of Education to relaxing the conditions with regards to teacher allocation in schools where there is a danger that the subject will be dropped at Leaving Certificate level. For example, physics teachers could be regarded as "ex quota", meaning they would be above the official staffing allocation for the school based on its enrolments. This would allow schools to continue to offer the subject even if class sizes are small.

Gender Imbalance

The IOP has produced a range of reports that look into the factors which influence the uptake of physics by girls.⁷

This research has found that:

- Students' interest in science declines as they progress through school, and the decline appears to become steeper after age 14, particularly for girls, and particularly in physics;
- Girls, more than boys, experience a difference between their personal goals for learning and the learning objectives of the physics curriculum. As a consequence, they are less inclined to opt for physics, even if they achieve high grades and enjoy the subject.

The key influences on students' attitudes to physics have been identified as:

- Self-concept – that is, students' sense of themselves in relation to the subject, the value they place on the subject and their willingness to engage with it;
- Views of physics – that is, how students experience physics at school;

⁷ Institute of Physics; reports on gender balance, 2006-2015:
http://www.iop.org/education/teacher/support/girls_physics/reports-and-research/page_63816.html

- Teacher-student relationships – that is, how personally supportive students find their physics teacher.

Following from this significant body of research, the IOP has recently published a guide to good practice in countering gender stereotyping in schools.⁸ It should be possible to learn from this and implement strategies in school to support the uptake of girls and physics.

Some essential features of good practice include:

- Identifying a gender champion within the school senior leadership team to bring together the whole school on this issue;
- Providing gender awareness and unconscious bias training for staff;
- Introducing a strict policy that all subjects are presented equally to students in terms of their relative difficulty.

It should be possible to learn from these reports and implement strategies in school to support the uptake of girls and physics.

Physics at third and fourth level

The numbers of students graduating in physics at undergraduate and postgraduate level have increased by over 58% in the past five years.⁹

While this increase is very welcome, it has coincided with a period of severe financial restrictions in the colleges which has had an impact on the recruitment of staff and has resulted in a much increased student-staff ratio, a matter of considerable concern given the practical nature of physics education.

Alongside this increase in student numbers has been a decrease in the level of funding available for research, particularly in relation to basic research which is an essential element in the education of both undergraduates and postgraduates.

A key component of the Irish third level education system is that degree programmes are taught by academics who are research-active. Their research informs their teaching and students gain knowledge at the very cutting-edge of science. In many cases undergraduate physics students undertake original research projects in their final year as part of the research activity of their department. However, if academics who are already in position are not able to access research funding they will either become research inactive or more likely will leave the country in order to work where they will be properly supported.¹⁰ This may lead to a significant loss of local talent and degree courses may then suffer, with the knock-on effect of decreasing numbers taking physics. When research groups are splintered it is very difficult to reinstate them even if more research funding becomes available at a later date. Sustainable and stable levels of funding are important for the research community to effectively plan and prioritise. Without this secure funding, researchers will not be able to be as productive and there may be deleterious consequences for long-term economic development.

⁸ Institute of Physics. *Opening Doors: A guide to good practice in countering gender stereotyping in schools*, 2015: http://www.iop.org/publications/iop/2015/page_66430.html

⁹ Higher Education Authority data: <http://www.hea.ie/en/statistics/overview>

¹⁰ OECD. *Policy Briefing: The Global Competition for Talent*, February 2009

The IOP recommends that the government commits to a sustained programme of investment in research. Innovation 2020 recommends the introduction of new funding instrument from the Irish Research Council for Frontiers Research. However, as yet there is no indication as to the size of this funding. As noted in the IOP submission to the Consultation on the Successor to the Strategy for Science, Technology and Innovation, across knowledge-based economies it is common to find funding for fundamental research comprising around 20% of the annual science research budget.¹¹ We suggest that in the first instance the Frontiers Research fund should be supported with a budget of at least 10% of the annual science research budget and ring-fenced for at least 15 years. This is essential to allow for the development of a workforce possessing the physics-based skills which are vital to the Irish economy.

3. Are there opportunities (e.g. new areas of work) which the Department should consider when developing the 2016 - 2018 strategy which would advance the achievement of our mission, vision and objectives across the continuum of education and skills?

With regard to the uptake of physics at second level, the IOP recommends implementing a programme similar to the successful model in England – the Stimulating Physics Network. Such a programme would provide bespoke CPD to teachers of physics in their schools. This programme has been shown to lead to a significant increase in the numbers studying physics at school.¹²

To improve the proportion of girls taking physics, the IOP recommends implementing the suggestions within its Opening Doors report on a whole school approach to gender imbalance.¹³

At third level, the recommendations from Innovation 2020 should be fully implemented to introduce a new funding instrument for Frontiers Research. This should be at a level of around 10% of the total annual budget for science research and ring-fenced for at least 15 years.

4. How should success on achieving our strategies be measured.

No comment.

5. Comment on any issues relating to the continuum of education and skills, in addition to your particular area of interest and/or expertise

No comment.

6. Any other observations that you would suggest the Department should consider in the formulation of our strategy for education and skills 2016 – 2018

No comment.

1. Prioritising Early Years

1(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

1(b) How should progress on Prioritising Early Years be measured?

¹¹ IOPI. *Response to the Consultation on the Successor to Strategy for Science, Technology and Innovation*, 2015: http://iopireland.org/policy/submissions/file_65353.pdf

¹² [Alphaplus, 2015](#)

¹³ *Opening Doors: A guide to good practice in countering gender stereotyping in schools*, 2015: http://www.iop.org/publications/iop/2015/page_66430.html

No comment.

1(c) What would you consider to be the priority actions and outcomes in this area?

No comment.

2. Tackling Disadvantaged

2(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

No comment.

2(b) How should progress on Prioritising Early Years be measured?

No comment.

2(c) What would you consider to be the priority actions and outcomes in this area?

No comment.

3. Diversity and Choice for Parents

3(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

No comment.

3(b) How should progress on Diversity and Choice for Parents be measured?

No comment.

3(c) What would you consider to be the priority actions and outcomes in this area?

No comment.

4. Promoting Excellence and Innovation in Schools

4(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

The IOP would like to see explicit mention of physics teaching and learning as a priority. This has been highlighted in other reports such as the National Skills Strategy 2025 and teacher professional development in this area is essential. The Programme refers to the need to have a wider range of subjects available to students and indicates that this might be possible through the Digital Strategy. Given that physics is not available in around a quarter of all second level schools at Leaving Certificate level the IOP considers that action in this area is critical. The proposed Local Education Clusters of schools may be useful way of promoting a whole school approach to gender imbalance with schools sharing good practice in this area.

4(b) How should progress on Promoting Excellence and Innovation in Schools be measured?

The Department of Education and Skills should set specific targets in the following areas:

- **Leaving Certificate physics numbers.** Currently 61% of Leaving Certificate students take biology, while only 16% and 13% take chemistry and physics respectively. A target should be set to increase the uptake of physics to around 20% of the Leaving Certificate cohort.

- **Schools offering physics.** Currently a quarter of schools do not offer physics at Leaving Certificate level. Reducing this number to near zero would have a significant impact on the overall numbers taking physics. Where it is not possible to offer the subject in school, all students should have access to the subject through distance learning or via clusters of schools sharing resources.
- **Gender Balance.** A target should be set to increase the number of girls taking physics from 25% of the Leaving Certificate cohort to at least 30%. Pilot projects by the IOP have shown that it is possible to see changes in female uptake by undertaking intensive interventions with schools.¹⁴

4(c) What would you consider to be the priority actions and outcomes in this area?

We identify two main priorities actions:

- Enhancing the teaching and learning of physics through targeted professional development of teachers, particularly those who are teaching outside of their specialist subject area.
- The rapid introduction of the revised Leaving Certificate syllabus for physics and the full implementation of the new Junior Cycle Science course.

5. Promoting Creativity and Entrepreneurial Capacity in Students

5(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

No comment.

5(b) How should progress on Promoting Creativity and Entrepreneurial Capacity in Students be measured?

No comment.

5(c) What would you consider to be the priority actions and outcomes in this area?

As referenced in the consultation document, the IOP is keen to see the forthcoming report of the Science, Technology, Engineering and Maths Education Review Group and urges that it is reviewed urgently by the relevant Oireachtas Committee with a view towards a National Strategy for STEM being implemented. Expertise on how to enhance STEM teaching and learning is readily available, with organisations such as the IOP already implementing good practice in the UK and elsewhere. A determined effort and resources must be made available if these recommendations are to be implemented.

6. Making Better use of Educational Assets within Communities

6(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

No comment.

6(b) How should progress on Making Better use of Educational Assets within Communities be measured?

¹⁴ [Alphaplus, 2015](#)

No comment.

6(c) What would you consider to be the priority actions and outcomes in this area?

Schools should be encouraged and provided with the financial means to make labs available after hours for CPD and science courses for communities

7. Special Needs Education

7(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

No comment.

7(b) How should progress on Special Needs Education be measured?

No comment.

7(c) What would you consider to be the priority actions and outcomes in this area?

No comment.

8(a) Comment on the approach contained in the Programme for a Partnership Government (are we capturing the essential issues, are there additional matters we should take into account).

It is essential that a sustainable level of funding for third level education is provided. The increase in undergraduate numbers in third level physics has coincided with a period of severe financial restrictions in the colleges which has impacted on recruitment of staff. The resultant drop in the staff:student ratio is a matter of considerable concern given the practical nature of physics education and the need for close student-staff working.

This increase in student numbers in physics has coincided with a decrease in the level of funding available for research, particularly in relation to smaller grants (of around €150k over 4 years) supporting a broader range of physics topics, including importantly, basic research. Grants of this type are important to ensure strong levels of research engagement across all staff and are an essential element in the education of both undergraduate and postgraduate research students in vibrant and exciting departments.

Sustained and stable funding of research, including especially the types of smaller grants indicated above, is essential for researchers and departments to effectively plan and prioritise. Funding should also be available across the broadest range of research areas to ensure that disciplinary sub-areas are well protected and interdisciplinary research is best promoted – both important elements of an engaging student experience. The IOP recommends the urgent implementation of the Innovation 2020 recommendation regarding the introduction of a new funding instrument from the Irish Research Council for Frontiers Research. This must be fully supported with a budget of at least 10% of the annual science research budget and ring-fenced for at least 15 years. This is essential to support a sustained workforce possessing the physics-based skills which are vital to the Irish economy.

8(b) How should progress on Meeting the Skills Needs of the Future be measured?

8(c) What would you consider to be the priority actions and outcomes in this area?

At third level, fully implement the recommendations of Innovation 2020 to introduce a new funding instrument for Frontiers Research. This should be at a level of around 10% of the total annual budget for science research and ring fenced for at least 15 years.