

[National Assembly for Wales](#)

[Enterprise and Business Committee](#)

[Follow-up inquiry into Science, Technology, Engineering and Mathematics \(STEM\)](#)

Evidence from the Institute of Physics – STM 05

Institute of Physics Response to the National Assembly for Wales Consultation on Follow-up inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills

Please find attached a response from the Institute of Physics to the Follow-up inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills. The Institute of Physics is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 50,000 (1,000 in Wales), working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

The Institute of Physics in Wales aims 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, medical, and general public sectors. We also seek common purpose with other organisations to promote science and science-based learning and to influence science policy. 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 Wales welcomes the opportunity to respond to this consultation.

If you need any further information on the points raised please do not hesitate to contact us.

Yours sincerely,

Professor Peter Main (Director of Education and Science, Institute of Physics)

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Professor Andrew Evans (Chair, IOP Wales)

Dr David Cunnah (National Officer for Wales, Institute of Physics)

a) What impact has the Welsh Government's strategy *Science for Wales* and Delivery Plan had on science, technology, engineering and mathematics (STEM) skills in Wales?

The Institute of Physics in Wales welcomed the *Science for Wales* document when it was released, and supported the formation of a new Chief Scientist's Office.

Perhaps the weakest element of the *Science for Wales* delivery plan was the point on education and training:

"- seek international excellence via education and training, through our schools, further and higher education sectors, and through the training provided in the work place in apprenticeships and other work-based learning schemes."

Perhaps because the document focused primarily on other areas, we felt that this element was perhaps not as clear as it might have been with regard to delivery.. This was reflected in the eventual creation of the National Science Academies where, in our opinion, allocation of funding has not been sufficiently prioritised to address the most pressing issues in education and skills.

While the principal of attracting top quality researchers to Wales through the Sêr Cymru was a good one, this was never going to have much impact at the grassroots level. There is also a very real risk that those attracted by the money on offer simply leave after a few years, meaning that an expensive bidding war results in no real gain.

Ultimately, if Wales is to increase the STEM pool, a number of fundamental issues will need to be addressed, and we consider some of those in our response to the questions below.

b) What progress has been made in addressing the issues identified in the Enterprise and Learning Committee’s 2011 inquiry into the STEM agenda, including:

- i) The adequacy of provision of STEM skills in schools, further education colleges, higher education and work-based learning (including apprenticeships);**
- ii) Value for money from the additional funding to support and promote STEM skills and whether the current supply of STEM skills is meeting the needs of the Welsh labour market;**
- iii) The supply of education professionals able to teach STEM subjects and the impact of Initial Teacher Training Grants and the Graduate Teacher Programme on recruiting STEM teachers and education professionals;**
- iv) The effectiveness of education and business links between education institutions and STEM employers.**

Our specialisation lies in physics, hence our answer will focus on its delivery. However, it is worth bearing in mind that the provision of adequate physics teachers and the resulting improvement in physics A-level uptake will inevitably have an impact on the availability of STEM graduates in Wales. Our research (http://www.iop.org/publications/iop/2012/page_55899.html) has shown that almost 100% of students who study physics A-level go on to university, the vast majority of them to study a STEM subject, and that physics A-level is second only to mathematics in terms of facilitating entry to HE courses, as shown in figure 1.

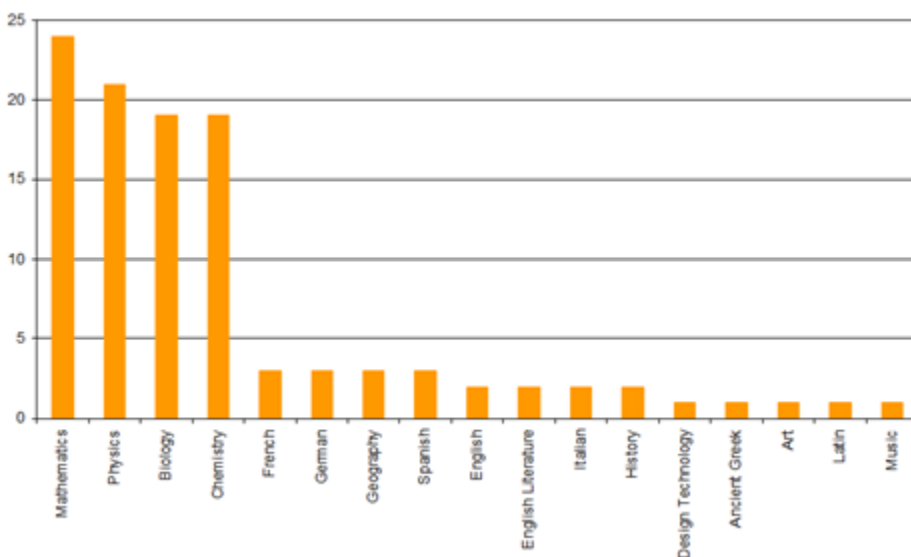


Figure 1 - Number of Higher education courses requiring A-level courses in Russell Group Universities (<http://russellgroup.org/Informed%20Choices%20final.pdf>)

Since 2011, there has been an increase in the recruitment of physics teachers in Wales. While this is very welcome we note that only 40% of the teachers in Wales who were teaching physics in 2013 were trained in the subject according to the General Teachers Council for Wales.

The Institute of Physics has some concerns about the recruitment and retention of physics teachers which we outline here. Note that the most recent complete set of recruitment statistics from HEFCW is currently 2010/11 but we have seen numbers from more recent years which suggest that the overall uptake is similar. Figure 2 shows that, despite an overall upturn in students starting the physics PGCE in Wales, the number with a 2:1 degree or better has not increased at all, but has in fact decreased slightly since 2004.

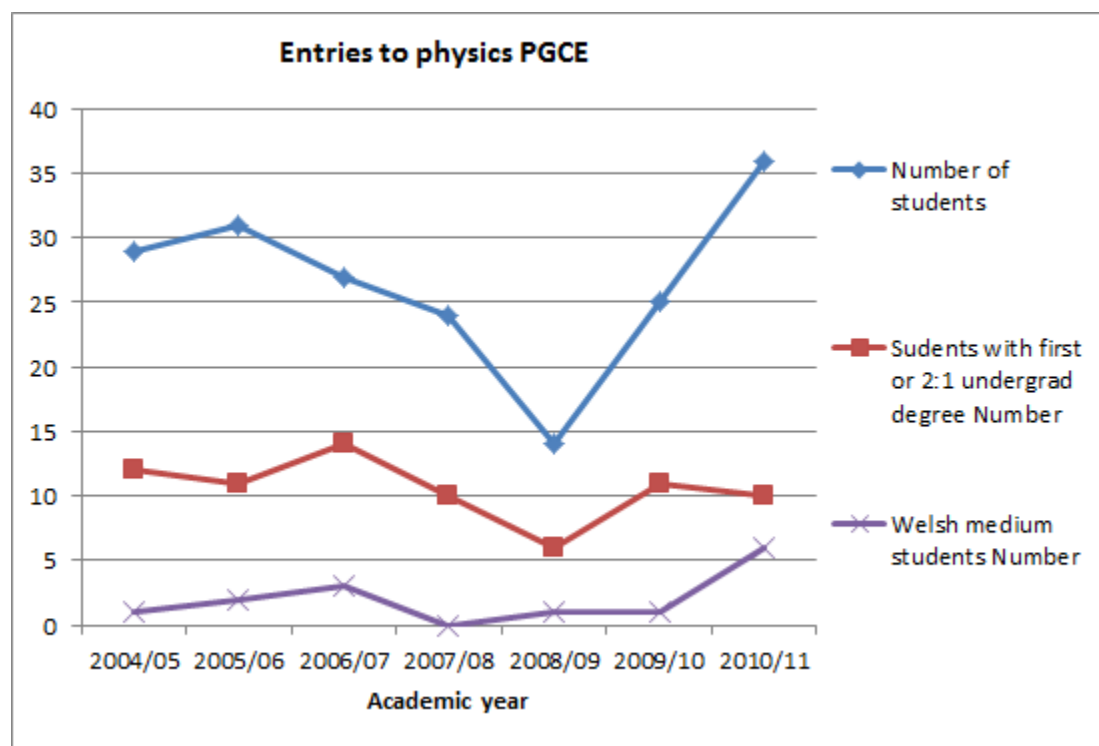


Figure 2 - Entries to Physics PGCE courses in Wales 2004-2011. Source: HEFCW http://www.hefcw.ac.uk/about_he_in_wales/statistics/itt_statistics.aspx

The IOP welcomes the fact that the Welsh government intends to match the bursaries offered to students in England studying physics PGCE from next year and to waive their fees. However, there is a very clear problem with physics teacher retention in Wales, as can be seen in figure 3. We also conducted our own poll of Welsh physics teachers to confirm the observation that teachers in the 35-40 age group have left the profession en masse during the past four years. The reasons for this are still unclear, and we at the IOP are carrying out some investigations research to try better to understand this trend. However, if the trend continues and the current dip is not matched by career-changing entrants, the shortage of physics teachers will reach

crisis proportions with serious implications for the teaching of the subject, particularly up to GCSE.

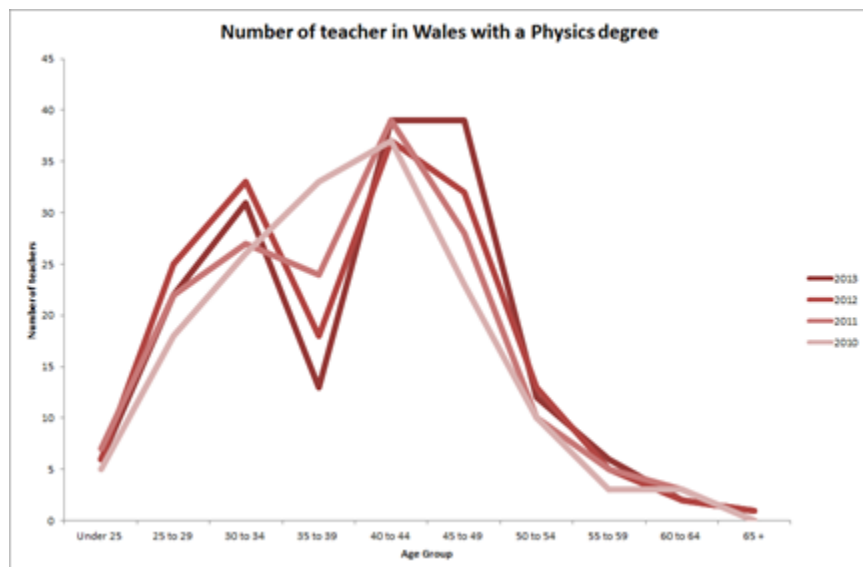


Figure 3 - Number of physics teachers in age ranges in Wales. Source: GTCW

c) Whether any progress has been made on addressing negative perceptions and gender stereotypes of STEM and promoting good practice to encourage women to acquire STEM skills and to follow STEM related careers.

The Institute of Physics has published two reports in the last two years looking specifically at the issues surrounding participation of girls in physics (http://www.iop.org/education/teacher/support/girls_physics/file_58196.pdf and http://www.iop.org/publications/iop/2013/file_62083.pdf). Although these reports were based on data from England (as equivalent data was not available in Wales), it is highly likely that their conclusions are also applicable to Wales. The first report showed that the kind of school that a girl attends profoundly affects her likelihood of choosing physics as one of her A-levels, implying that school culture plays a role. The second report looked at 6 subjects that suffer from a large gender bias (including three where uptake is low among boys). The clear message from both reports was that the whole school culture must be addressed if progress is to be made on this issue; in order for a school, on average, to exceed the already dimly low national ratio of girls progressing to A-level Physics, they have to be bucking the trend on most if not all the other subjects too. We also observe that, although a huge number of schemes have been run to increase the interest of girls in physics in the last 30 years, the ratio of girls of those progressing to A-level has actually decreased. For a more detailed report on the girls in physics situation in Wales, see the article in the Institute of Welsh Affairs Blog written by the Institute of Physics National Officer for Wales, David Cunnah: <http://www.clickonwales.org/2014/03/addressing-wales-broken-symmetry-in-the-sciences-2/>.

We note that much of the activities of Chwarae Teg have been dealing with whole school gender lensing, and the Institute of Physics welcomes the work that they do. We note, however, that many of the activities funded through the National Science Academies have been one off interventions and, while these activities are undoubtedly valuable in raising the profile of science in schools, it would be naive to think that they will make any difference to the gendered uptake in the physical sciences.

The gender divide in science is nowhere more evident than in physics. If the number of girls taking physics A-level in Wales were equivalent to the number of boys then it would go a long way to addressing the STEM skills shortage. The IOP has evidence that when students are taught physics by physicists and the culture of the school does not erect barriers, the gender divide in physics can be reduced. The Institute of Physics has been able to run a programme called the Stimulating Physics Network in England where non-specialists teaching physics are provided with ongoing targeted support through a Teaching and Learning Coach. This programme has produced tremendous results across the schools involved, and has had a profound impact on the uptake of physics by girls in the participating schools.

d) What progress has been made on learning STEM skills through Welsh medium education and training?

The teaching of Mathematics and Physics through the medium of Welsh at secondary school level has increased substantially since the 1980s (<http://www.wjec.co.uk/index.php?nav=164>). In recent years the disciplines have also seen a significant increase in the Welsh medium provision in higher education, driven largely by the Coleg Cymraeg Cenedlaethol (CCC). At Aberystwyth University, where there has been a long tradition of Mathematics and Physics tutorials through the medium of Welsh, the provision now offers a range of modules with elements in Welsh that include seminars, workshops, laboratory demonstrating, project supervision, lecture notes, examples sheets and assignments, student oral presentations, help desk and feedback. The provision at Aberystwyth is supported by three Welsh medium lectureships; two of these (one Physics and one Mathematics) are supported through the Academic Staffing Scheme of the CCC. There have also been significant developments at Cardiff University and Swansea University, with the CCC supporting Mathematics provision at both institutions and a recently advertised Welsh medium physics lectureship at Swansea. The Welsh medium lecturers are active in promoting the disciplines in outreach activities within Wales.