

The preparation of teachers for STEM education in Ireland

Presentation by Tomás Ó Ruairc, Director, Teaching Council to Public Consultation Forum on Review of STEM.

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Space and time. When you hear those words, which of the following do you associate with them – STEM, or teaching? The instinctive reaction may be STEM – as words they could fit easily into the scrolling yellow text of Star Wars movies! But the truth is that space and time are concepts that are equally central to both STEM and teaching. STEM can stand for *Supporting Teaching of Excellent Methodologies*, as much as it does for *Science, Technology, Engineering and Mathematics*. And these explanations are complementary. The first speaks to the importance of the *how*, which is central to effective teaching, and the second speaks to the importance of the *what*. The reason that I give slightly more prominence to the *how* is that without that, the richness of the *what* cannot be unlocked for others. In other words, if we want excellent **STEMs**, (Scientists, Technologists, Engineers and Mathematicians), we need excellent **STEM** - Supporting Teaching of Excellent Methodologies.

The link that binds STEMs and STEM, the *what* and the *how*, together is the concept of the reflective practitioner. This concept is at the core of all teacher education, from a Council point of view, including STEM. It resonates strongly with the spirit of STEM as captured in the terms of reference of this review – enquiry-based learning. Reflective practice, like scientific and technological experiments, takes time and is highly contingent and uncertain. I saw recently

how researchers working off data from a telescope in the South Pole confirmed some exciting findings about the first few trillionth seconds of the Universe. And how long did they spend confirming and reviewing the data before publishing the findings? Three years!

So when the Council says that our first focus is on the education of teachers, and then of subjects, this is not an either / or situation, or a demotion of one area of learning under another. It is to acknowledge that all teachers are teachers, first and foremost. If they are to teach key areas of learning effectively, such as STEM, they need to get their heads around the complexity of their profession first, and acquire and embed the key skills of teaching and learning.

As concurrent programmes of ITE show, this need not be a strictly sequential or chronological process. It is possible to study the foundation studies of education along with the subject discipline. Many students also pursue the consecutive route to teaching, where they study the subject to degree level first, and then pursue the professional qualification.

The mistake that many people make is to say – Right, quality of teaching is really important. Let's fix Initial Teacher Education! Firstly, ITE is not broken.

Secondly, this thinking, while well intentioned, is missing the bigger picture. And we call that bigger picture the Continuum of Teacher Education. What this means in practice is that there are 87,000 teachers currently on the register, who will be in the system for some time to come. As these statistics from our register show, the majority of STEM teachers are aged between 21 and 40. So they will be in the system for anywhere between 20 and 40 years. The

Continuum also means that all of these teachers must always learn so that they can always teach.

What this means in practical terms for the preparation of teachers for STEM is that CPD will have to become a much bigger part of the picture. If we want to support and elevate the profession, as Steven Duggan from Microsoft said at a recent conference, ALL of the profession, then by definition ITE on its own will not get us to where we want to be. We in the Council will be launching our first phase of consultation on CPD later this year, so keep an eye out for that.

We have a policy on the Continuum of Teacher Education. It is rooted in the 3 I's – Integration, Innovation and Improvement. These concepts should resonate strongly with the STEM agenda. But note that as a Council, they apply to the education of all teachers. All teaching and learning should be as integrated as possible; we should all be innovating in what we do; and just as scientific and technological innovation seeks to improve the human condition, so does teaching – we always ask, how can we do it better?

Kevin Jennings from Google spoke to this point at the recent conference organised by the American Embassy on “Smart People, Smart Economy”, where he said

We need to teach meaning as opposed to functionality in ICT.

There was a clear consensus between teachers and techies that skills are key, not the devices. For those, like me, who do not fully understand the world of Google and Microsoft, but really enjoy playing in it, this was a great breakthrough. It's not just the profession that is saying this! A focus on the

core skills of high quality teaching and learning will unlock learning and creativity in all areas of endeavour, including ICT.

Does this mean that content and subject knowledge are not important? Of course it doesn't. In fact, what it says is that if we are serious about lighting the fires of enthusiasm in our learners for the riches of learning that we know await them, then we have got to up our game in how we facilitate their engagement with those areas. It may be counterintuitive – focus on the how and why in order to unlock the what – but when you think about it, it's almost common sense.

I don't think I fully realised all the opportunities we are missing with this strictly segregated approach to subjects and pedagogy until I read "Alex's Adventures in Numberland" by Alex Bellos. In this book, he describes in a most beautiful and engaging way how enlightening a mathematical perspective on the world can be – on the whole world. Not just STEM, but nature, gambling, even crochet. In fact, I was fascinated to discover that the only concrete manifestation we have to date of hyperbolic or folded space is crochet. Crochet can do what computers cannot! An integrated, holistic view of STEM in the overall context of teaching and learning, therefore, is not utopian mumbo jumbo – this is how the world is. This is how the world lives. This is how we all view the world in our daily comings and goings.

Impact of Teaching Council policies and work on STEM

The Council's Criteria and Guidelines for Programmes of Initial Teacher Education set out the standards that the Council has decided, on behalf of the profession and in the public interest, should apply to programmes of ITE. It is worth noting that literacy, numeracy and ICT are listed as three national

priorities. ICT in Teaching and Learning is a mandatory area for all programmes of ITE at primary and post-primary level. SESE is a core part of the Primary Curriculum. At post-primary level, we have recently approved new subject criteria for all Leaving Cert subjects, as well as ICT and CSPE.

In terms of the STEM subject themselves and dealing with the subject knowledge aspect we have:

1. Increased the ECTS credit requirement for all STEM subjects from 54 ECTS from 60 ECTS
2. In the case of Maths have updated the criteria to meet the specific requirements of Project Maths including increased emphasis on Statistics & Probability.
3. Are now making a methodology in Maths and Applied Maths mandatory.
4. A specific methodology is now required for Biology, Chemistry, Physics , Physics & Chemistry. Construction Studies, DCG , Engineering and Technology continue to require a specialist methodology.
5. We are also looking for evidence of practical/laboratory work throughout qualifying degrees.
6. ICT and the application of same forms part of the requirements for Business and Accounting.
7. Art now includes a requirement that teachers be competent in the areas of 2D and 3D and engagement with digital media.

Some HEIs have responded to the Council's requirements in ITE for STEM subjects in an innovative way, by offering a 3 + 2 or 4 + 1 year programme. In these cases, if a student completes the full length of both phases, they will emerge with a Professional Masters level qualification in teaching (Level 9 on

the NFQ). If they exit after the first phase (3 years), they will have an academic degree in the subject disciplines. Some providers offer a concurrent route for one subject over 4 years, which allows the teachers to gain initial registration and thereby make themselves available for employment, and then the option of studying for the second subject afterwards.

Conclusion

When I was doing my Junior Cert Maths paper, there was a question on it in relation to quadratic equations. It was in the form of a problem about a rocket whose path was mapped in the form of a quadratic equation. I remember being fascinated by this – in the middle of an exam hall! I had never come across a question like it in all my studying. You had to draw the graph, and then map various times and heights of the rocket from launch to land. Where has this rocket gone in terms of teaching and learning, including STEM? We need to bring STEM alive for all teachers and students. We need to reassure them all that STEM is not some esoteric pursuit by men and women in white coats and hair nets. STEM is a part of our natural world, it is a part of who we are and what we seek to do every day – improve the human condition, mind and body. This holistic, integrated view of STEM is central to the Teaching Council's philosophy and approach, and will remain so as we look towards the development of a national framework for CPD over the next two years.