

## **SUPPORTING SCIENCE EDUCATION RESEARCH THROUGH AN INNOVATIVE NEW MASTERS PROGRAMME**

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Science education in Ireland is facing a number of challenges. Delays to curriculum reform at post-primary level and increasing numbers of responsibilities for scientists in higher education are becoming considerable obstacles to progress in this area. The growth of higher education over the last few decades has been particularly nuanced in the area of science education as scientists are being tasked with not only their educational responsibilities but also with driving economic growth through research and development and the commercialisation of ideas. Science teachers are expected to utilise an outdated curriculum to provide the next generation of scientists to sustain a ‘knowledge-based economy’. To help scientists and science teachers overcome these barriers, an innovative new masters programme has been established at Trinity College Dublin. This course aims to give its participants the practical and academic skills needed to critically analyse the role of science in society and to cope with the growing challenges facing the field of science education.

### **CONTEXT OF THE COURSE**

The past century has seen a global trend towards boosting the number of people in higher education — “developing countries now have higher enrollment rates than European countries did only a few decades ago, and currently about one-fifth of the world cohort is now enrolled in higher education” (Schofer & Meyer, 2005). For science education it has been especially pronounced as education in this area has come to be seen as crucial for helping drive innovation and economic growth. Ireland witnessed a rapid expansion in the number of students studying science at post-primary and third-level in the mid nineteenth century when free education, coupled with an emphasis on technical education (areas outside the arts and humanities — primarily technology and science), led to numbers soaring. Support from the government ensured that Irish education became the foundation of economic growth, shifting the focus away from manufacturing and agriculture and moving towards a ‘knowledge-based economy’: “the Irish state made a long-term commitment to investment in education from the 1960s, largely absent in the first generation of independent statehood, which was sustained over the following two generations” (Loxley, Seery & Walsh, 2014). Research funding from the European Union added momentum to this movement and science education, especially at third-level, was required to expand in order to produce more “technically qualified people to support industrial development” (Harkin & Hazelkorn, 2014). The Programme for Research in Third-Level Institutions funded €1.2 billion for basic research from 1998 onwards as Ireland capitalised on massive foreign investment in research and development. This led the Irish government to improve support for science and education at all levels, resulting in Ireland achieving a significant proportion of graduates in science, technology and engineering — 23% compared with the EU average of 9.3% (European Commission, 2004). The financial crisis and the subsequent recession in Ireland caused a sea-change in Irish state investment policy towards science. Massive cuts were made to basic research funding while the government prioritised 14

narrow research areas that were most likely to lead to short-term commercialisation success (Butler, 2015). This put additional pressure on early career scientists in higher education competing for dwindling amounts of basic research funding. The focus on securing research funding has seen this become the most important objective for new scientists to the detriment of their contribution to science education. While most scientists in higher education in Ireland are expected to teach, supervise and assess students, the time constraints imposed by seeking funding, administrative duties and other responsibilities has seen teaching and learning reduced to an inconvenient hindrance rather than a priority for career progression and promotion. We have developed a Master of Education (M.Ed) course at Trinity College Dublin (Figure 1) in order to help science graduates, science teachers and early career researchers to cope with the demands of working in science education.



Figure 1: The Master of Education (M.Ed.) in Science Education is organised by the School of Education at Ireland's premier university, Trinity College Dublin. Founded in 1592 with a 47-acre campus situated in the centre of Dublin, Trinity is Ireland's top ranked university and the only Irish university in the world top 100 universities (78<sup>th</sup> position — QS World University Rankings 2015/2016). Source: Trinity College Dublin.

## AN INNOVATIVE NEW PROGRAMME

Trinity College Dublin is the ideal home for an innovative new masters programme in science education — M.Ed(Sc). As well as having a respected international reputation and resources (Figure 2) it also has a recent history of supporting progressive and sometimes radical new course development, including its pioneering partnership with Google Ireland in order to instigate change in secondary school teachers' interactions with technology (Roche, 2014). The M.Ed(Sc) can be taken on a one year full-time basis or on a two or three year part-time basis. It includes a taught component comprised of four modules, each including 25 hours of direct contact time. It also contains a research component that involves carrying out a research project and writing a dissertation under the guidance of a supervisor in a relevant area of educational research. Independent learning, at both personal and group level, is actively encouraged. The course is designed around four modules: "Science in Society", "Communicating Science", "Learning Theories" and "Frontier Research and Current Debates", while the overarching aim of the course is to give participants a critical understanding of the role of science in society. A

number of key areas are highlighted, such as investigating the scientific method, the history of science, science pedagogy, publishing, grantsmanship, policy, governance and communication. Understanding how and why the scientific method works can help identify its potential applications outside of the strict confines of scientific research and how it might support areas as diverse as education, politics, law and economics. The history of science is almost never considered on undergraduate science courses. As a consequence many scientists and science teachers often do not have a full appreciation of how their discipline came into being and what lessons can be learned from the past. Pedagogy is crucial to early career scientists as they are often expected to gain experience giving tutorials, assessing students, teaching, creating content and presenting lectures. What is often lacking is training or the provision of theory to aid young researchers in basing their own educational approaches on evidence rather than reverting to the approach that they received: “science faculty members have little, if any, professional training in teaching at the college level” (Sunal *et al.*, 2001). Publishing in any research discipline is a vital skill in order to contribute to the field and the community but increasingly it has become a metric for judging career advancement potential. Grantsmanship is the art or ability to craft successful research grants on a consistent basis. After the skills of utilising the scientific method and scientific writing, this is seen as one of the most important skills for a scientist to master. Science governance will be investigated so that students are better equipped for engaging in dialogue with policymakers and disseminating their research to help inform policy. Public engagement is becoming more important due to the European Commission including ‘Responsible Research and Innovation’ (RRI) as a cross-cutting action of its research and innovation programme, Horizon 2020 (Owen, Macnaghten, & Stilgoe, 2012). According to the tenets of RRI, scientists have a responsibility to ensure that members of the public are not only aware of the research they are carrying out but to strive to provide means for them to engage in dialogue around it and have their opinions taken into consideration by the researchers. The M.Ed(Sc) will provide students with the opportunity to critically analyse cutting-edge research in the field of public engagement as well designing strategies for current scientific research within the university, especially in the domain of informal learning and citizen science. Science communication is a well-established field with more than 50 years of research and theory (Bauer *et al.*, 2007; Trench, 2008). Yet despite all of this work and the obvious overlaps with the field of science education, there remains a gap between the two fields. Students taking the M.Ed(Sc) will learn from the field of science communication and have the opportunity to attend joint science communication/education symposia. The course will provide the opportunity to bring together different disciplines that all utilise science in education. Having primary and post-primary teachers taking the course alongside graduate science students will allow for shared learnings and best practice as Barinaga (1991) notes: “the close bond between teachers and working scientists is turning out to be a key in scientists' efforts to improve science education”. The decision to open the course to social science and humanities graduates with a professional interest in science means that there will be a rich and diverse range of participants on the course.



Figure 2: The M.Ed(Sc) will take place on the campus of Trinity College, which not only has iconic landmarks like the Campanile bell tower (left) and the Long Room Library (right) but its library contains 5 million volumes.

## DISCUSSION & CONCLUSION

The recent challenges to the field of science education are not confined to formal education. Public understanding of science and engagement with science are seen as crucial to societal progress. A key component of the M.Ed(Sc) is the relationship with Science Gallery Dublin — a world-leading public engagement space that will bring expertise and practical experience to the course for all participants (Figure 3). The research funding that is available in Europe will continue to target science and technology issues that are seen as economically and socially important (Stilgoe *et al.*, 2014). The European Commission's research and innovation programme Horizon 2020, will also see more emphasis on the development and promotion of innovative pedagogies in science and technology education (European Commission, 2014). The new M.Ed(Sc) will help prepare the field of science education for the challenges to come. The course will seek to not only attract Irish scientists and science teachers but also to reach out to the international science education community and invite them to join Trinity's vibrant and diverse community of almost 17,000 students representing 122 nationalities. While there are many challenges ahead for science education and researchers working in this field, innovative new courses like the M.Ed(Sc) can help ensure that society is prepared to face those challenges.



Figure 3: Science Gallery Dublin is the ideal partner for an innovative new course due to its record of producing “spectacular design and an imaginative theatrical script... an eclectic but strangely seamless mix of scientific demonstrations and art” (O'Neill & O'Farrelly, 2009) and supporting novel research initiatives in the area of science education (Roche, 2015). Source: Science Gallery Dublin.

### FURTHER INFORMATION

Applications can be made here:

[www.tcd.ie/education/courses/masters/science](http://www.tcd.ie/education/courses/masters/science)

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