SCIENTIX
The community for science education in Europe

EFFORTS TO INCREASE STUDENTS' INTEREST IN PURSUING SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS STUDIES AND CAREERS

National Measures taken by 30 Countries – 2015 Report

Caroline Kearney

EXECUTIVE SUMMARY

European Schoolnet

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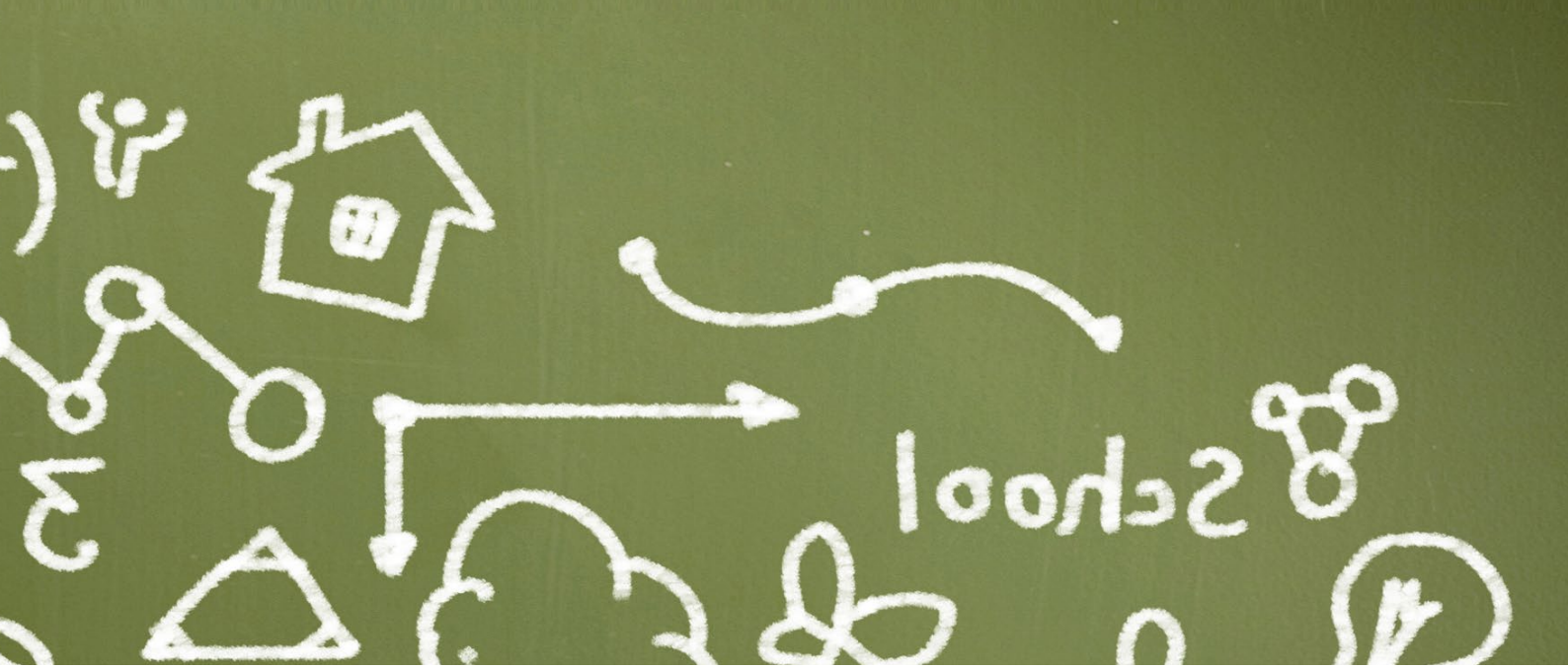
EXECUTIVE SUMMARY

This publication is the latest in a series of reports about national efforts to increase students' interest in pursuing Science, Technology, Engineering, and Mathematics (STEM) studies and careers. The report is the result of an analysis of country responses to a survey launched in the summer of 2015, addressing recent, current or planned priorities, policies and initiatives aimed at improving the relevance and quality of STEM education to encourage more students to study and choose a career in the STEM field. This year sees the inclusion of the largest number of countries to have yet taken part in the survey. The report is written within the framework of the project Scientix – the community for Science education in Europe (**http://www.scientix.eu**). Scientix promotes and supports a Europe-wide collaboration among STEM (Science, Technology, Engineering and Mathematics) teachers, education researchers, policymakers and other STEM education professionals. The information provided in this report is based on the national contributions received from the Scientix National Contact Points (NCPs)[I] representing 30 countries[II]. This latest report in the series updates the information published on certain issues in the 2011 edition, provides further information where available about ongoing initiatives, as well as new information concerning the additional nine countries who have contributed to this year's report (***BG***, ***CY***, ***EL***, ***HR***, ***HU***, ***LV***, ***MT***, ***PL***, and the ***UK***). Moreover, this 2015 edition of the report has a special focus on teacher education policies and initiatives. This focus is the result of the previous edition of the report (covering a wide range of issues in relation to STEM education), which identified improving initial teacher education and continuous professional development at the heart of the drive to make STEM studies and professions a more popular option for young learners. This current edition looks more deeply into how countries are developing initiatives in these areas.

[I] The full list of National Contact Points and contributors can be accessed in the main report at this link **http://files.eun.org/scientix/Observatory/ComparativeAnalysis2015/Kearney-2016-NationalMeasures-30-countries-2015-Report.pdf**

[II] Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Greece (EL), Hungary (HU), Ireland (IE), Israel (IL), Italy (IT), Latvia (LV), Lithuania (LT), Malta (MT), the Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), Turkey (TK) and the United Kingdom (UK)



STEM education policies and initiatives continue to receive political and financial support in the face of underachievement and a lack of student interest in STEM studies and careers

Competing in the global, knowledge-based economy and adjusting to the digital age are long-term challenges Europe must continue to address. Investing in human capital is vital in meeting these challenges. High quality STEM education (as well as education and training in general) contributes to sustained economic growth, as well as sustainable development by fuelling R&D, innovation, productivity and competitiveness. However, **recent evidence illustrates that in both mathematics and science, underachievement of 15-year-olds remains above the ET 2020 benchmark of 15%, and most countries across Europe continue to face a low number of students interested in studying or pursuing a career in the STEM field.** As illustrated in this report, it is for these reasons, that not only do we observe ongoing strategies, policies and initiatives continuing to receive political and financial support, but also the creation of new ones, many of which have been launched within the last year.

The majority of countries consider STEM education a current priority and have or are developing strategies to improve teaching and learning and the uptake of studies and careers in this area

Around 80% of the 30 countries surveyed describe STEM education as currently a priority area at national level, at least to some degree. When comparing the results of the last edition of this report published four years ago, promoting inquiry-based learning still remains the most highly ranked issue with 80% of all countries stating it is addressed as a top priority or important issue at national level. All countries (except *AT*, *EL* and *TK*) are currently prioritizing STEM curriculum reform at either primary or secondary level, and this is often linked to incorporating inquiry-based methods and teaching socio-economic aspects of science. Around 70% of countries are prioritizing initiatives relating to the integration of the effective use of ICT in STEM education, while around 60% are focusing on the development of new or revised STEM teaching and/or learning resources, often to accompany a new curriculum. Around 50% of countries are placing particular emphasis on improving initial and/or in-service STEM teacher training. On the other hand, the majority of countries are not prioritizing the promotion of Responsible Research and Innovation principles and practices in STEM education, and the issues of gender balance and career guidance in relation to STEM education are also less high on most national agendas.

When asked whether a STEM education strategy exists at national level, just under a third confirmed this to be the case, which appears to be a low percentage considering it is a priority issue in most countries. However, once one adds the countries which mention other overarching strategies in which STEM education is highlighted, as well as the countries currently in the process of planning STEM education strategies, this amounts to 77% of all countries surveyed, confirming its continued significant position at policy level across Europe.

The majority of countries are paying more attention to improving the provision of professional development for in-service STEM teachers than investing in STEM-specific initial teacher training

All countries (except Hungary) mentioned that specific STEM-related professional development has recently been or is currently available for in-service teachers, and/or that there is a specific initiative related to this in place. Around one third of countries (*PT*, *RO*, *PL*, *TK*, *MT*, *HR*, *CY*, *SI*, and *UK* [Scotland]) have STEM in-service teacher education initiatives which have been implemented or are currently being led at central level, either directly through the Ministry of Education, or the national institution responsible for teacher training, often affiliated to the Ministry. Some of the initiatives reported are directly related to national curriculum reform or educational priorities leading to the need to update teachers' STEM knowledge and competences, enabling them to implement the changes in the classroom. On the other hand, 30% of countries report that various providers, including dedicated teacher training agencies, universities and private organizations (sometimes in collaboration) are responsible for the provision of teachers' continuous professional development in STEM teaching. 20% of countries (*IL*, *CZ*, *EE*, *MT*, *FI*, and *NL*) report that widespread reform has recently or is currently transforming their teacher professional development systems at national level. These general reforms in in-service teacher education have impacted STEM professional development in various ways. The Netherlands has launched a new STEM Teacher Academy which provides professional development in cooperation with industry, while France has expanded the reach of its existing La main à la pâte Foundation, by creating a national network of "Houses for science". Finland and Norway on the other hand have received dedicated funding from their governments to invest in STEM specific teacher professional development programmes.

Greece, Slovakia, Ireland and Croatia report professional development courses/conferences, specifically aimed at training in-service teachers in the effective use of technology for teaching and learning. A few countries (*UK*, *IT*, *PT*, and *FR*) have invested in carrying out large scale evaluations of the professional development available for STEM teachers at national level, and it would be of value for more countries to commission such evaluations to ensure that any future funding or measures are decided on the basis of grounded evidence. **Of particular interest are the professional development initiatives in Flanders, Denmark, Latvia and Sweden targeting in-service STEM teachers, which have a special emphasis on teacher collaboration and peer learning.** The focus of these initiatives is on the individual and joint reflective practice of teachers, and the active co-development of teaching methods and resources by

peers. In these innovative approaches to in-service education, the teachers themselves become jointly responsible for their own professional development. This approach to professional development is intended to have a lasting impact through the network of teachers established and the continuation of such collaborative learning within their schools and beyond, once the programmes have ended. Should these countries continue or start to invest in evaluating this new approach to professional development, other countries might learn and be inspired to also transform their professional development offer for in-service teachers, so as to include a more central role for peer learning and collaborative practices.

70% of countries (AT, BE, BG, DK, EE, EL, ES, FI, FR, HR, IE, IL, IT, LT, NL, NO, PL, PT, RO, SI, UK) report that they either have implemented, currently have or plan online professional development for STEM teachers, testifying to the increasing popularity and acknowledged usefulness of this mode of training. In the last edition of this report published in 2011, less than half of the countries surveyed reported any activity in the area of online learning for STEM teachers, and often this mostly focused on the availability of online learning resources for teaching. Since then, the range and sophistication of online professional development has dramatically grown, reflected by the sharp increase of countries reporting activity in this area. The format of online professional development offered by different countries ranges from short one-off webinars, to activities on e-learning platforms (such as Moodle), to full Massive Open Online Courses (MOOCs), which are increasingly being developed. Some countries also mention the use of blended approaches, involving online and offline activities. The STEM areas and topics covered by online professional development activities are varied, with the pedagogical use of ICT in STEM teaching and learning being particularly prominent. **Online professional development provides an excellent platform for the creation of professional teaching communities, allowing participants to continue to collaborate and learn from one another beyond the end of a specific online course.**

By contrast, only 50% of countries (AT, BE, BG, CZ, DK, EE, FI, FR, IL, LT, LV, MT, NL, NO, UK) mentioned that specific STEM-related initial teacher training has recently been or is currently available for prospective teachers, and/or that there is a specific initiative related to this in place. A small group of countries are developing new courses or special programmes for the provision of STEM initial teacher education. Malta and the United Kingdom are developing new degree programmes to facilitate and enhance the studying of sciences for prospective science teachers, while Lithuania, Latvia and the Netherlands have updated and modernized their initial teacher training courses to reflect STEM curriculum reforms in their countries and to introduce innovative content and methods. Israel has introduced special programmes to train future STEM teachers, including a school residency programme, and Finland has set up a STEM teachers education forum to promote cooperation between STEM teacher education units in different universities and jointly establish national quality standards for STEM initial teacher education. **Flanders, Estonia and Austria have reported that through collaboration in national or European projects (involving universities, teacher training colleges, teacher networks and other partners), new encouraging developments are entering STEM related initial teacher education at national level. These developments have included the incorporation**

of innovative pedagogies and resources into initial teacher training programmes, and have also given rise in parallel to the building of professional development networks. In view of certain countries being currently unable to invest in updating STEM initial teacher education at national level (whether for political, financial or other reasons), they might be well advised to focus their efforts in a first step on promoting the rich resources and innovative online communities readily available within Scientix, the community for science education in Europe, to their future STEM teachers at national level.

Respondents were asked to indicate whether initial teacher training and professional development provided at national level is sufficient or lacking with respect to 16 knowledge and competence areas, specifically relevant to STEM teachers. **A striking 15 out of 16 knowledge and competence areas for STEM teachers are not adequately covered at national level by initial teacher training (according to at least around 70% of countries), and professional development (according to around 55% of countries).** The only exception, is the most basic and traditional aspect of teacher training - professional content knowledge, which was considered to be sufficiently covered by initial teacher training (according to around 50% of countries: *AT*, *BG*, *EE*, *ES*, *FI*, *HR*, *HU*, *IL*, *MT*, *NO*, *PL*, *SI*) and professional development courses (according to around 70% of countries: *AT*, *BG*, *CZ*, *DK*, *EE*, *ES*, *FI*, *FR*, *HU*, *IL*, *IT*, *LV*, *MT*, *NL*, *NO*, *PL*, *SI*, *UK*). Moreover, strikingly 80% of countries agree that two closely related areas (namely: knowledge and ability to analyze students' beliefs and attitudes towards STEM and, knowledge and ability to teach STEM taking into account the different interests of boys and girls), are not addressed sufficiently in initial teacher education programmes or continuous professional development courses. This may help explain why at present, and since many years, STEM teaching often does not adequately take into account students' STEM-related beliefs and attitudes or their gender-specific interests (Rocard 2007, Osborne 2008, OECD 2015). **This report recommends that national and European policies and initiatives enabling prospective and in-service teachers to be made aware of the importance of attitudes and gender in impacting on students' motivation to study and pursue STEM careers, be developed, including the provision of specific guidance on pedagogical methods and resources available to address the issue in the classroom.**

The need to recruit more STEM teachers is an issue which faces various countries, with almost 40% reporting that initiatives are planned or in place to address the shortage of STEM teachers in schools, particularly at secondary level

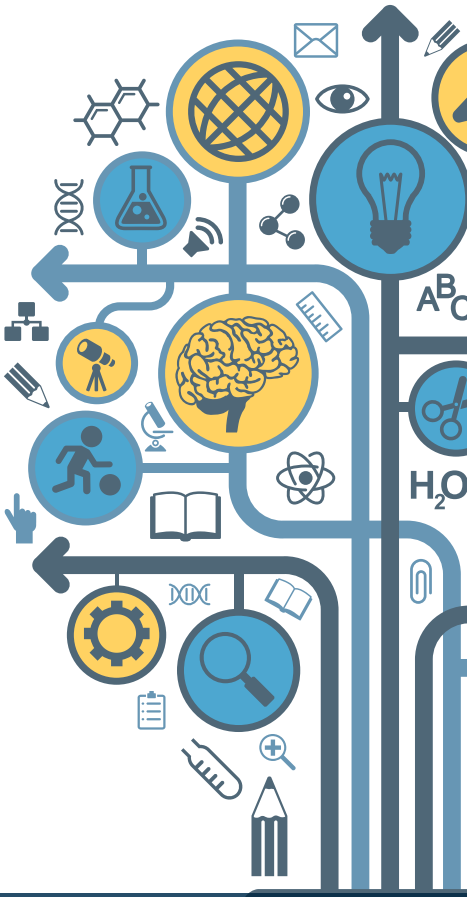
In the United Kingdom, Israel, the Netherlands, Bulgaria and Denmark, several initiatives are being implemented concurrently as part of a concerted effort at national level to tackle the shortage of STEM teachers. In Hungary, Switzerland, France, Israel, and Latvia a general lack of teachers of all subjects (including STEM) is reported, along with accompanying initiatives to address this via various actions. Initiatives range from scholarships and loans, to programmes facilitating students and professionals from non-teaching backgrounds to become STEM teachers, and in some cases allowing participants to combine working as a STEM professional and teaching in the classroom. Often these initiatives target high achieving students with a proven academic record. Additionally, Finland and Sweden report there is evidence available at national level supporting the need to invest further in the recruitment of STEM teachers.

The Responsible Research and Innovation (RRI) agenda has recently gained prominence at European level, and could play an important role in motivating students to pursue STEM studies and careers, by bringing the societal aspects of STEM to the forefront. However, currently, RRI mostly remains the concern of academia and has yet to be fully embedded within national school education systems

Responsible Research and Innovation (RRI) is a process where all societal actors (researchers, citizens, policy makers, business) work together during the entire research and innovation process in order to align outcomes with the values, needs and expectations of society. Overcoming complex societal challenges in an interconnected, globally competitive world, will require all citizens to have a better understanding of science and technology if they are to participate actively and responsibly in science-informed decision-making and knowledge-based innovation. Science education has a very important role to play in the promotion of RRI, yet it is an area which is still very much addressed solely by academia in most European countries. **A significant majority of 80% of countries stated that the concept of Responsible Research and Innovation in the specific context of STEM school education is not known or established at national level, and that the school education community is not familiar with the principles and practices of this approach and how it involves them.** Just under 15% of countries (*ES*, *IE*, *IL*, *SE*, and Flanders) stated that RRI is either to some extent or well established as a concept within the specific context of STEM education in their countries, and that it is addressed as a top priority or important issue at national level. In these few countries RRI is either incorporated into the curriculum, or stakeholders are involved in national or European projects which promote young people's direct involvement in scientific research for the benefit of society.

It is therefore unsurprising that an overwhelming majority of country respondents stated that teaching the principles and practices of Responsible Research and Innovation (RRI) needs to be more thoroughly addressed in initial teacher training (according to 98% of countries) and professional development courses (according to 88% of countries). **More awareness raising is needed, and countries would benefit from examples of how school education might best contribute to the RRI agenda. It will be interesting to monitor in the future how countries respond to the recommendations and actions suggested by the recent report 'Science Education for Responsible Citizenship' commissioned by the European Commission, and to observe how their implementation might contribute to firmly embedding RRI practices into the education system and lifelong learning process, for the long-term benefit of society.**

Finally, many of the strategies, policies and initiatives described in this report have only very recently been launched. It will therefore be useful for the national and European research and policy making communities to closely follow their development and monitor their impact to inform STEM education progress in the future.



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