POSITION PAPER

6 September 2018

The Role and Importance of Science, Technology, Engineering and Mathematics (STEM) Skills

KEY MESSAGES

1 STEM skills are increasingly required by employers across a broad range of sectors. These skills help to foster systemic and critical thinking in a number of areas and are not confined to four subjects alone. Due to the increasing digitisation of society and the world of work the demand for STEM skills will only intensify.

2 There is a need to increase the number of STEM-qualified people in Europe with employers highlighting a specific shortage of people with these skills. This is particularly apparent as concerns engineers, computer scientists and data analysts. To achieve this is it necessary to raise awareness of the STEM-related careers that are available and to promote participation in STEM courses and studies, notably among women.

3 Employers and education and training providers, both through their individual and joint actions, have a key role to play in fostering STEM skills acquisition.

WHAT DOES BUSINESSEUROPE AIM FOR?

- More STEM-qualified people in Europe to underpin Europe's future industrial development.
- Mutual learning and the exchange of practices at EU level on initiatives that aim to promote STEM skills. This includes learning how to change occupations, qualifications and education and training curricula in an effective manner in response to labour market needs.
- STEM skills and digital skills are closely associated and STEM skills should be embedded in European and national initiatives that seek to develop digital skills.

BUSINESSEUROPE a.i.s.b.l.
AVENUE DE CORTENBERGH 168 – BE 1000 BRUSSELS – BELGIUM
TEL +32 (0)2 237 65 11 – FAX +32 (0)2 231 14 45 – E-MAIL main@businesseurope.eu
WWW.BUSINESSEUROPE.EU – Follow us on Twitter @BUSINESSEUROPE
EU Transparency register 3978240953-79

BUSINESSEUROPE

POSITION PAPER

6 September 2018

THE ROLE AND IMPORTANCE OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS SKILLS

Introduction

1. This paper outlines BusinessEurope's views on the role and importance of science, technology, engineering and mathematics (STEM) related skills, with a particular focus on the importance of engineering and engineers, computer scientists and data analysts to Europe's industrial development.

General comments

The growing need for STEM skills

2. There is a growing need for people with STEM-related skills and competences across the EU, in different sectors and in companies of all sizes. Therefore, these subjects need to be more prevalent at different levels of education and training. Closely associated with STEM skills is the growing need for digital skills. Skills strategies at EU and national levels should address both of these needs in a coordinated way.

3. Engineers, in particular, are an essential component of Europe's industrial strategy and are increasingly required across all areas of the economy and in different roles;

4. The European Centre for the Development of Vocational Training (CEDEFOP) forecasts that by 2025 employment in STEM-related sectors will have increased by around 6,5% compared to 2013. In this respect Europe does have a competitive advantage compared to the US where just 4.4% of undergraduate degrees were in engineering, compared with 13% in Europe. However, the figure jumps to 23% in Asian countries[1];

5. At the same time, while the majority of the demand for STEM skilled workers is met by university level graduates, CEDEFOP identifies that currently around 48% of STEM-related occupations require medium level qualifications for which vocational education and training can play an important role;

[1] US National Academy of Engineering, 2014

BUSINESSEUROPE a.i.s.b.l.
AVENUE DE CORTENBERGH 168 – BE 1000 BRUSSELS – BELGIUM
TEL +32 (0)2 237 65 11 – FAX +32 (0)2 231 14 45 – E-MAIL main@businesseurope.eu
WWW.BUSINESSEUROPE.EU – Follow us on Twitter @BUSINESSEUROPE
EU Transparency register 3978240953-79

6. STEM skills are often thought of as being acquired at upper secondary and tertiary levels of education. However, these skills can be acquired at all levels of education and training, including at primary and secondary school, and through general or vocational education;

7. STEM-related skills foster systemic thinking in a number of areas and are not confined to four subjects alone. The earlier people acquire these skills the better the prospects they will have for continuing their education and training and in their future career;

8. STEM skills and critical thinking feature prominently in the proposal to revise the key competences framework for lifelong learning and need to be further promoted and introduced into curricula;

Addressing gender stereotypes in STEM is a priority

9. There continues to be a perception problem within Europe when it comes to attracting people to study STEM subjects. For example, in the EU28 there are twice as many male graduates in maths, science and technology as there are female[2]. Additionally, in the EU in 2015 only 17% of ICT students were women;

10. These figures demonstrate both the need for, and the potential to have, more STEM qualified workers, including engineers, notably more women, in European labour markets and stronger cooperation between business and education can play a vital role in achieving this, including through addressing gender stereotypes in STEM;

11. A Gender Toolkit that was developed by the European social partners through a previous social dialogue project activity presents a number of examples of how social partners and companies are working to better engage girls and women in STEM subjects;

12. One example is Intel, which has launched several initiatives including the "Women in Technology" scheme to encourage a new generation of high-achieving women to pursue a career in STEM industry;

13. Another is from The German Employers' Confederation (BDA), which is a partner of the Girls' Day in Germany. Every year technical enterprises, enterprises with technical departments and technical training facilities, universities, and research centres are invited to organise an open day for girls – Girls' Day. Under this initiative a large campaign was launched in which a wide range of professions and activities are presented to girls from the age of 10 and upwards. For companies, Girls' Day has evolved as an important instrument of their recruitment policy, including for traineeships, dual study programmes and in encouraging future job applications.

[2] 22.9 male graduates per 1000 people aged 20-29 compared to 11.2 female graduates per 1000 females aged 20-29. Latest data from 2012 (Eurostat).

14. The Accenture research series “Attracting More Young Women into STEM” in Ireland (2013, 2015, 2017) explores attitudes towards STEM & the factors limiting take-up among girls, to help the debate around STEM. The research was endorsed by the Minister for Education and Skills in Ireland and has helped inform decisions made at a policy level to make STEM as inclusive as possible to all.

15. A key finding from this research indicated that young girls are not aware of the opportunities STEM careers can bring and role models are not visible to them. The report also identified that parents hold an influential role in their daughters’ education and career choices, yet lack information about career options.

16. Some of the key recommendations of the 2017 research included – early intervention: the importance of starting STEM schooling earlier; parental ownership: it is essential for parents to be well-informed to guide their children with these career choices; and collaboration: teachers, industry and government working together to effect change at a national level.

Educating about STEM

17. It is BusinessEurope’s view that the earlier pupils start to acquire STEM knowledge and competences the better. Following playful didactic approaches in kindergarten, inspiring STEM education should start with pre-school, primary and secondary school and continue throughout general or vocational education. The Federation of Austrian Industries together with the ministry of education and other partners established the “STEM seal of approval” in 2016. Within two years more than 200 kindergartens and schools with inspiring and professional STEM education have received the new certificate, thereby acting as role models for other educational institutions in Austria;

18. To promote STEM-related skills and competences there is a role for education and training providers and employers to illustrate the concrete employment opportunities associated with STEM skills and their enormous relevance for today’s economy;

19. One initiative contributing to this goal is Science on Stage Europe. This international science teacher network from STEM teachers for STEM teachers at all levels aims to improve science teaching by inspiring and supporting educators and spreading innovative STEM teaching concepts. Since its launch in 2000, Science on Stage has reached about 100,000 teachers and teacher trainers in 32 countries. The initiative enables students to gain the skills they need in the future world of work and to encourage them to consider a career in science, ICT or engineering;

20. Employers can also facilitate the teaching of STEM-related skills and competencies in early education through contributing to the design and delivery of primary and secondary school curricula, as well as in VET, notably apprenticeships and tertiary education;

    - One example of this is the initiative “STEM education in North Rhine-Westphalia” in Germany, which has the strong involvement of employers, and

which fosters a broad STEM education from pre-school to secondary education. This initiative is part of the nation-wide umbrella organization "SCHULEWIRTSCHAFT Deutschland" ("School-Business Germany") which as a threefold target: enhancing the professional orientation at schools, fostering STEM skills and improve economic knowledge.

- The initiative puts into practice different measures and instruments, such as training courses for pre-school teachers, scientific experiments for children, technology days and an excellence network of schools with outstanding STEM teaching.

- This best practice could be promoted by the Commission to support other EU countries making progress with the setting up of effective actions of a similar kind in their own contexts

21. Looking beyond initial education and training, it is also important to see STEM skills as part of a life-long learning perspective in which people can develop these skills throughout their career. In this way, further training combined with occupational mobility can play an important role in helping to address the demand for STEM qualified workers. Geographic mobility could also help to ensure a better matching of skills supply and demand;

22. It is also promising to see that the European Commission has highlighted the importance of STEM skills (and STE(A)M) in its communication on "A new agenda for higher education";

23. Digital skills are increasingly required across all sectors of the economy, in new occupations, such as data managers and cybersecurity specialists, as well as in everyday working life. However, while 90% of jobs require digital skills, currently 37% or 93 million people in the work force do not have basic digital skills;

24. Identifying the digital skills and competences that are needed by employers is a challenge both for companies and education and training systems;

25. The European Commission should embed the STEM skills narratives and necessary actions into the digital skills agenda to ensure coordinated progress on both fronts.

26. Despite the high demand for engineers, companies face several challenges in recruiting them. One challenge is the attractiveness of engineering to young people combined with the retirement of older workers;

27. The other is the process of digitisation and the frequent introduction of new technologies that are changing the way in which companies function.

28. The European federation of professional engineers (FEANI) is working to respond to the demand for engineers by raising the profile of engineers and the prestige of engineering. One important initiative is the Engineering Card that shows a person's education profile in a clear and comparable way and which can be important tool for employers and facilitate the mobility of engineers;

29. The EUR ING title[3] can also be a positive brand for promoting engineering in terms of fostering the recognition of qualifications;

Specific comments

30. It is BusinessEurope's opinion that companies and education and training institutions have a key role to play to bring forward solutions to these challenges:

Company and employers' organisation-led solutions

31. Companies are best placed to identify the skills, competences and qualifications that are necessary in new and emerging occupations, which is particularly important in responding to digitisation;

    - An example of how to address this is the use of technology road mapping[4] to define future competence needs, as is done by several manufacturing firms in Denmark, such as Danfoss, and Grundfos.

    - Another example of how companies are meeting this challenge is in the ICT sector where IBM has developed a "hybrid" skills profile for their staff which includes technical skills, data analysis and interpretation and communication skills;

32. Company-led solutions also involve a greater role for employers in educating and training people. In this respect, greater emphasis could be placed on STEM-related vocational education and training (VET) at both the level of initial VET and continuous VET / employee training, taking into account employers' skills needs. In particular, apprenticeships can play an important role in training people in STEM skills through the mix of transversal and occupation-specific training that they provide.

33. To promote STEM-related skills and competences there is a role for education and training providers and employers to illustrate the concrete employment opportunities associated with STEM skills and their enormous relevance for today's economy. Employers can also facilitate the teaching of STEM-related skills and competencies in early education through contributing to the design and delivery of primary and secondary school curricula, as well as in VET;

34. Modis, which is a professional solutions provider as part of The Adecco Group, is experiencing an increase in global demand for STEM qualified workers. Due to the scarcity of these profiles in Europe, Modis has set up its own academies

[3] The EUR ING title aims to facilitate the movement of practicing engineers within and outside the geographical area represented by FEANI's member countries and to establish a framework of mutual recognition of qualifications in order to enable engineers who wish to practice outside their own country to carry with them a guarantee of competence.

[4] A technology roadmap is a plan that matches short-term and long-term goals with specific technology solutions to help meet those goals. It is a plan that applies to a new product or process, or to an emerging technology.

to train its consultants with the STEM competences that are in demand. These academies allow Modis to quickly adapt the knowledge provided in the classroom to the skills required on the labour markets;

35. As part of new approaches to learning it is necessary to maximise the potential of digital platforms and learning programmes, which can help to personalise education and training in an effective and efficient way for students and teachers, for example:

    - Through its Growth Engine programme Google has trained 2 million Europeans in critical digital skills since 2015;

    - Another example is School 42 in France, which has been setup by a French businessman with the aim of developing young people's ICT skills through using an IT-based approach to problem solving. The problems that are solved by the students are real problems that companies are experiencing;

    - In the US Facebook has also developed, in partnership with schools, a free student-directed learning system, which aims to put students in charge of selecting the projects they work on;

36. Such examples can help to engage young people with STEM and engineering in particular, which will be essential for the future competitiveness of European companies;

37. Additionally, employers' organisations play a vital role in drawing public attention to the importance of STEM skills and raising awareness among young people about the career opportunities in STEM professions.

38. For example, in 2008 BDA and The Federation of German Industries (BDI), founded the initiative "Creating a STEM future". It is financially supported by Deutsche Telekom AG and other business partners with the aim to increase public awareness of the importance of STEM skills. The initiative also fosters networking between schools that emphasise STEM skills. In 2012, "Creating a STEM future" and acatech (National Academy of Science and Engineering) founded the "National STEM Forum": A network of over 30 institutions working together for enhancing STEM education in Germany. Gesamtmetall - the Federation of German Employers' Associations in the Metal and Electrical Engineering Industries has also taken the lead in developing "MINT-EC" the STEM excellence network for secondary schools, which connects 295 schools totalling 315.000 pupils and 25.000 teachers.

39. Another Gesamtmetall initiative of the same federation is "M+E-InfoTrucks" which informs young people about training opportunities and job profiles in the metal and electrical engineering industries. This involves ten vehicles, which provide 80m² of teaching space for a whole school class and are each equipped with 3D Monitors, various models of machines, hands-on experiments, etc. and offer 90 minutes long teaching units for secondary school pupils. On request, the Trucks come free of charge to schools, vocational information events or open doors days

run by companies.

40. In Denmark, companies, educational institutions, and organisations have formed the technological alliance “Engineer the future.” This bring together around fifty partners including the Confederation of Danish Industry and companies such as Siemens and Danfoss. The alliance aims to promote Danish engineers and technology experts and to lay the foundations to encourage future workers and specialists to the field of technological development.

41. In Turkey, Turkish Industry and Business Association (TUSIAD) has been implementing the “STEM+A Project” since 2014 based on 4 pillars: 1) empowering teachers by providing them STEM training programmes with universities; 2) devising coding kits to develop coding skills of students and teachers; 3) promoting the STEM concept by organising “STEM Days” for students, teachers and professionals, initiating a communication campaign for the public at large and broadcasting animated videos for preschool children and 4) advocating for STEM+A based curriculum with conferences and reports. Another initiative by TUSIAD is “What to Study - What to Choose as a Career?” video project which has a special focus to promote STEM professions where female role models are highlighted.

Education-led solutions

42. Education and training providers need to improve their capacity to adapt to rapidly changing labour market reality. First it is about adapting occupations, and then qualifications / education and training curricula based on changing skills demand. It is also important to allocate sufficient resources for teachers, trainers and lecturers to ensure that they have the appropriate level of competence to teach/train students in response to the latest technological and scientific developments.

43. This requires an effective partnership between governments and social partners in line with the diversity of education and training and industrial relations systems and practices. There is scope for learning at European level on how to change occupations, qualifications and education and training curricula in an effective manner.

    - In this respect, a promising example in England is an engineering conversion course pilot scheme, which started last year and seeks to help around 1500 graduates retrain during the first 2 years of the scheme (Source: Higher Education Funding Council for England;

    - The scheme involves 32 universities who are receiving funding to develop and market a range of engineering and computer science conversion courses. These courses aim to attract people that have previously studied other subjects to move into an engineering / computer science-oriented career;

    - The intention is that through supporting innovative course developments the scheme will open up careers in engineering to a wider range of

graduates so as to benefit both students and employers in key sectors, such as manufacturing, food and agri-tech, data science, and energy;

- There are also several examples of distance learning provided by universities, such as Open University in England; National Distance Education University in Spain; or the FernUniversität Hagen in Germany. These institutions train students from all over Europe in digital skills. There are also massive open online courses offered by platforms, such as Coursera or edX, to provide engineering and computer science programmes.

44. It is also important to further promote the possibility for distance learning in VET as this can also facilitate the acquisition of STEM skills and competences;

Business-education partnerships

45. There is also significant scope for developing and strengthening partnerships and cooperation between businesses and education and training providers at all levels so as to raise awareness among, and deliver a wide array of opportunities for, people to lean about and study engineering or related subjects;

46. A closer, more systematic and continuous cooperation between companies and universities and technical research institutions could also foster stronger and more targeted efforts to utilise and further develop the technical and scientific skills already present in companies;

47. There are several examples of initiatives that highlight innovative approaches to promoting business-education cooperation in the area of STEM and engineering in particular:

- In the UK, the creation of The National Automotive Innovation Centre (NAIC) has been proposed. It aims to provide a critical mass of research capability combining automotive expertise nationally and internationally. NAIC will be a unique resource, with an environment to foster collaboration, cohesion and cross-fertilisation of knowledge. Academic and industrial R&D teams will work together using state-of-the-art equipment and facilities to develop breakthrough designs, technologies and processes. NAIC will address the shortage of skilled R&D staff across the automotive supply chain, developing the talent required for the demands of emerging technologies and engaging future generations of engineers. £150 million is being invested in the NAIC capital building and its research activities through a long-term commitment between Jaguar Land Rover, Tata Motors European Technical Centre, Warwick Manufacturing Group and the University of Warwick, along with an expanding network of supplier companies. The government (Higher Education Funding Council England) has also provided £15 million of funding to support the capital project;

- A collaboration between Tata Group and the Institution of Mechanical Engineers in the UK, recently led to a survey of engineers being

conducted to better understand what skills gaps exist; which sectors are going to grow in the years to come; and how to engage society with engineering beyond only seeing it as a profession;

- Tata Technologies is also using its new European Innovation and Development Centre to strengthen links with academic institutions through offering traineeship opportunities and through its graduate recruitment scheme;

- In Ireland, Accenture has teamed up with Dublin City University to create the "STEM teacher internship programme**"**. This involves a three-month internship programme, which enables trainee teachers to take up (paid) positions as summer interns within the company's technology practice, working on real-life client projects. The three months are a mixture of roles in data analysis, coding, testing and project development, providing exposure to all areas of Accenture's business to empower the teachers to confidently articulate the vast range of opportunities that a career in STEM presents;

- In Belgium, the employers' organisation in the chemical sector, Essenscia, is part of the Avogadro Project in which students spend 80% of the last year of their professional Bachelor degree learning about chemical process techniques in a chemical company;

- In Finland, the employers' organisation in the chemical sector, Kemianteollisuus, promotes STEM at comprehensive schools and high schools through careers advisors from the sector and also provides sector-specific training for teachers;

- In the Netherlands, the Technology Pact, which is a collaboration between the business community, education and training institutions and the government, aims to improve the alignment between education and training systems and the skills and qualifications that are needed in technology-based jobs. This is particularly important in view of a shortage of technically trained workers;

48. Collaborative and innovative efforts are needed. These examples show what is currently being done, but further impetus is needed in order to effectively respond to companies' current and future skills needs.

****