



FEANI POSITION PAPER
EDUCATIONAL POLICY

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Position Paper on Educational Policy by FEANI

- Science and technology should be presented in a modern, practical and attractive manner in primary and secondary education
- The quality of engineering education needs to be improved
- The funding of education and research in technology must be increased
- Special attention should be paid to attracting girls into engineering
- Positive attitude towards lifelong learning (LLL) should be nurtured during education
- Engineering needs to be communicated in a positive and inspiring way

Education is the way to innovation

According to the European Commission, Europe has to become a truly knowledge-based and innovation-friendly society where innovation is not feared by the public but welcomed, is not hindered but encouraged, and where it is part of the core societal values and understood to work for the benefit of all its citizens.¹ This requires in particular a reallocation of resources to education, Information and Communication Technology (ICT), research and to the creation of high value jobs and growth.

Although FEANI represents the engineers and thus is not directly linked to the primary education system, it is well-known that interest in science and nature and education within these fields is a golden key to interesting, challenging and often well-paid jobs and opportunities worldwide.

It is FEANI members who develop and refine the pillars of our society – literally speaking. Not only do they build bridges and roads, they also pave the way for new communication solutions and technological solutions to for example care for the elderly. The foundation of our welfare societies is increasingly built on advanced technology and knowledge of the natural sciences.

This is why we want to ensure, that young people will obtain a solid education in the natural sciences in primary and secondary school, to lay the foundation for a lifelong interest and engagement with technology, nature, physics and chemistry.

Change is a challenge

Quite a number of challenges can be identified, if Europe is to become this highly competitive, innovation-friendly knowledge society, envisaged by the political leaders. From a FEANI perspective the challenges can be summarized under three headlines:

- Increasing interest in science and technology among the youth

Failure in addressing the problems of education of professionals with a sound understanding in Science and Technology, will inevitably lead to an inability to capitalize on technological developments. The problems are not solved with a narrow focus on the higher education institutions' ability to attract and educate young people in science and technology. There is a general need for pupils in primary and secondary education to have a better understanding of and motivation or interest in working with technology. Generally there seem to be an old-fashioned perception of what it means to be working with technology

¹ COM 2006 (502) " Putting knowledge into practice: A broad-based innovation strategy for the EU"

among pupils and to some extent also in the general public. Instead we need a new positioning statement which can communicate the solution-oriented nature of engineering and the fact that engineering has to do with finding creative new solutions to society's challenges.

- Increasing public understanding of the influence of technology

Societies depend on technology. Power supply, various types of infrastructure, communication technology, and medical services are all taken for granted. As technologies have an increasing influence in our lives and on our way of living, everyone needs a more profound understanding of technologies and their advantages and risks, in order to participate in the democratic process. With no ability to understand developments and consequences in genetic science, biotechnology and even power production, there is a real threat of unwarranted fears and a growing division between science and public.

- Enhancing sustainable development with technology

The environmental challenges that mankind has to face in the foreseeable future can only find their solution within or in relation to science and technologies. It is accepted that people who abuse technological solutions have played their part in creating the problems, but technological development has also brought the societies to the living standards that we have now. Technology has to be further developed to answer to the problems created. But the environment is not the only area where technologies have to be enlisted to help addressing challenges. In the western hemisphere, there is a general problem of an ageing population, with a comparably diminishing workforce to support the elderly.² Working more effectively and increasing productivity in both an environmentally and socially sustainable manner requires further development also related to technologies.

These problems manifest themselves in many symptoms that can already be seen in the societies today. In headlines some of these are:

- Lack of professionals with sufficient skills in science and technology
- Young people, and especially girls, are not sufficiently interested in science and technology
- Science is presented to young people in an out-of-date manner
- Teachers in primary and secondary school do not have the sufficient competencies in S+T
- Young people lack knowledge of the possibilities in the technology profession
- Not enough young people enrol in higher education to keep EU a competitive economy, and the drop-out rate in secondary school increases the challenge
- Pass rates in higher education are too low
- Attractiveness and quality of engineering education in Europe need to be improved
- The skills for Lifelong learning (LLL) and possibilities to Continuing Professional Development (CPD) need to be increased
- The gender bias in technology needs to be addressed

² Communication from the Commission. Green Paper "Confronting demographic change: a new solidarity between the generations" COM(2005) 94 and "Mathematics, Science and Technology Education Report", European Roundtable of Industrialists, 2009

What can be done?

The challenges above require a long term commitment from decision makers, education planners, industry and the engineering profession. The aim is not only to ensure a sufficient level of technological knowledge in the public and a larger workforce able to develop the technologies, but failure in addressing the challenges will inevitably lead to high level jobs moving to other regions of the world, and hence impairing the European competitiveness on the global scene.

Dealing with the long term perspective does, however, not solve the problems at hand. Even if the European technical universities doubled the number of students tomorrow, the European need for engineers would not be covered before the end of this decade.

Therefore there is also a need of looking into short term initiatives. These initiatives are aimed at ensuring that those interested in technology are also given an education in the field, and that those already working in technology are given the tools and possibilities of developing their qualifications, in order to meet the current expectations.

Increasing attractiveness of science and technology in primary and secondary education

The international comparative research project ROSE (Relevance of Science in Education) meant to shed light on factors of importance to the learning of science and technology, as perceived by the learners – 15 year-olds from all over the world.³ The ROSE project revealed that young people, especially in developed countries have a frighteningly low and falling interest in science and technology. When it comes to students' agreements with the statement *I would like to become a scientist*, the score in the developed countries is extremely low, and the girls are even more negative than the boys. Responses to the statement *I would like to get a job in technology* are the same, only here the gender difference is even more pronounced. Following this challenge, it has been argued, that the problem might not necessarily be, that young people are not interested in science and technology, but that the way these subjects are presented today do not match the way young people form values and concerns – in short how they construct their identities.⁴

FEANI recommends that:

- Modern communication initiatives on what makes an engineer needs to be integrated in educational material in both primary and secondary schools. Often the image of engineers portrayed in educational material is outdated, false or very stereotypical and does not show the variety of tasks possible for an engineer today. Communication initiatives should bear in mind, that young people today most often do not pursue a career and a choice of education on the basis of the question “what do I want to be, when I grow up?”, but on the basis of the question “*who* do I want to be, when I grow up?” Identity construction matters a lot when choosing an education today.
- Knowledge about the development of science and technology has to form an essential part in the extension studies directed to school teachers. These studies should be planned and realized in cooperation with professionals of Science, Engineering and Technology (SET).

³ <http://www.ils.uio.no/english/rose/>

⁴ <http://folk.uio.no/sveinsj/Values-ROSE-Schreiner-Sjoberg.pdf>

- The teaching methods of natural sciences at schools need to be developed into giving children a more contextual insight on these subjects. The practical applications of natural sciences in modern technology need to be made visible. The subjects should raise the curiosity, inspire and be fun, even if they require a lot of work. In order to facilitate this ready-to-use materials should be provided to teachers.⁵
- Technology education must be accorded much greater importance, either as a separate school subject or integrated within natural sciences instruction and proficiency training. In this technology-related instruction, hands-on experience and creative problem-solving should be given greater emphasis. At the same time, the application examples should be relevant to daily life and equally attractive for boys and girls. Above all, technology instruction should not be limited to explanations of function.
- Higher Education Institutions of technology should organize special events or courses for school pupils and teachers and advisors to give them a view of the possibilities and variety of working in technology and a positive experience about engineering.⁶ Science centers and similar facilities may also be used more actively as part of the school curriculum.
- The prototypical engineering profession no longer exists. Instead, the engineering profession is rightly perceived as a varied career field with primarily positive characteristics. The problem is thus not the image of the professional tasks of engineers, but primarily the image of the study of engineering. To this extent attention should be paid to a smoother transition from secondary to higher education. It is also important that pupils obtain a realistic picture of the requirements of study at the various institutes of higher learning. There is significant potential for improvement with regard to academic and career counselling.

The quality of engineering education needs to be improved

Approximately 1.5 million engineers graduated in the world in 2007 and the number is growing yearly.⁷ In global competition with China, India and other rapidly growing economies of great population Europe cannot compete with volume. In addition many European countries will face severe replacement problems in the labour market for engineers, since many of the present engineering workers will retire within the next 10 years and not enough young engineers will enter the labour market.⁸ The competencies required in Europe in the fields of science and technology can not be achieved only by increasing the number of students in these fields, but also by increasing the pass rates, mobility of both students and graduates and improving the quality of teaching. Even after increasing the amount of engineering education in Europe the main focus must be in the quality of education.

⁵ It is a challenge in many countries that lab time is out of fashion at many levels, probably due to cost. This is a problem since it is also one of the most efficient ways of getting the pupils interested. See for example: <http://teachers.egfi-k12.org/>

⁶ An example of this kind of activity is given for instance by the Johannes Gutenberg University of Mainz: http://www.uni-mainz.de/eng/downloads/image_engl.pdf . The EU young scientist competition is another relevant example:

http://ec.europa.eu/research/youngscientists/index_en.cfm

⁷ OECD Statistical Database

⁸ European Engineering Report, Institut der deutschen Wirtschaft Köln, 2010

The structure, content and methods of engineering education must be built to meet the requirements for the expertise of engineers, based on comprehensive consideration on the current development of society and the desired sustainable development in the future. The high quality of engineering education and the competencies of engineers are a competitive advantage for Europe, which must be fostered and further developed.

FEANI recommends that:

- The quality of education should be used as one of the criteria for the public funding for HEIs. HEIs should be encouraged to focus on the quality of education by awarding for quality improvement.
- Special attention should be paid to the pedagogical skills of teachers, improving the student-teacher ratio and maintaining good quality of teaching even when the amount of engineering students is increased (and the in-take qualifications may be lowered). The theoretical subjects should be presented as more relevant to the student's future job.
- Close follow-up of students during the first year to coach them through mathematics and other theoretical subjects will increase the number to pass the exams and decrease dropout rates.
- The contents and methods of study programmes in engineering should be designed to meet the needs of the future labour market and society. This includes good basic skills and updated new knowledge, requiring continuous cooperation between all the stakeholders in the field of technology.
- Engineering education needs to prepare students to perform professional, ethical and social responsibility.
- The image of the engineering disciplines as a difficult, laborious and complex course of study must not be used to justify communicating the subject matter in a dry, excessively abstract and scientifically theoretical manner. This approach inevitably disappoints the hopes of first-semester students for an interesting course of study. The majority of engineering students are not ranked among the performance elite of the schools. The institutes of higher learning therefore need to compensate performance deficits through targeted programmes (e.g. tutoring) to a greater extent than to date and place much more emphasis on practical applications, especially in bachelor courses.

The funding of education and research in technology must be increased

Technology increasingly forms the base of the European economy and has a highly important role in the functioning of the European societies. Moreover, technology has a growing importance both in the competitiveness of Europe at global market and in the sustainable development of the planet we inhabit. If Europe does not invest in science and engineering education, it will have a subversive impact on the economy and wellbeing of people and the environment.

FEANI recommends that:

- Funding and resources for education and research in the field of technology must be in cohesion with the significance of technology for the European society. This is not the case in the EU's budget today, where the Common Agricultural Policy and the Structural Funds

take up almost 80 % of the EU budget of 133, 8 billion euro in 2009. In comparison in 2009 11, 8 million euro were allocated to research, education and development of ICT.⁹ A larger part of the budget should be reallocated to education and research.

Special attention to attracting girls into engineering

As the ROSE project made clear; there is a gender difference when it comes to young people's interest in science and technology. Many girls in industrialized countries simply do not want to work in technology. Having in mind that all over Europe girls today are bypassing boys in terms of participation in higher education (123 women enrolled for every 100 men), the "gender problem" calls for serious attention.

FEANI recommends that:

- We need to be more gender sensitive – a gender perspective should be incorporated in all development of school material on science and nature. Therefore the European Commission should develop a guidebook on how this could be done.
- Female pupils should be encouraged individually early on so as to make engineering and natural science studies and careers in mathematics, information technology, natural sciences and engineering more attractive for this group. Currently, women and girls are structurally disadvantaged when it comes to promoting technical skills. Here, it is primarily up to business and the political sphere to make working conditions more attractive for young women and to compel the restructuring of organizational and working culture in terms of gender and diversity management. Programmes to promote equality of opportunity should exist not only on paper, but be implemented consistently from top to bottom.
- With respect to the choice of study and career, it is crucial that greater emphasis be placed on communicating the social contributions of technology. These are more important to girls than to boys in forming their interest in technology and in their choice of a course of study.
- Female primary school teachers should be provided with special support in teaching natural sciences and incorporating its applications into teaching. This will provide a positive example for the girls.
- Good examples can be found in for example Norway where a research project is running that aims at developing tools and understanding that will help improving the recruitment and gender balance and reduce dropout in studies programs in math, science and technology.¹⁰
- We need visible role models for young people – both girls and boys and for minorities. Best practice should be disseminated.¹¹

⁹ http://ec.europa.eu/budget/index_en.htm

¹⁰ <http://www.naturfagsenteret.no/vilje-con-valg/> in Norwegian. There is also an international study starting 2010 called IRIS: Interests & Recruitment in Science <http://iris.fp-7.org/about-iris/> This is building on the ROSE project and Vilje-con-valg.

¹¹ See for example the Norwegian ENT3R project and the Alfa role model data base being build up, <http://www.renatesenteret.no>. Very practical oriented for mainly 10th grade)

- Recruitment programmes for female engineering students have proved successful. In Germany the MINT role models project, which aims at attracting more able young women into SET, brings together female role models and students via events and the media. Other countries have similar projects which should be continued or expanded.
- Mentoring programmes for female engineering students seems as an interesting way to keep good students. This should be started up and supported for example through European funding. An evaluation as well as description and dissemination of good practice are needed.

A positive attitude towards lifelong learning (LLL) should be nurtured during education

Every engineer and professional in technology needs to continue his/her personal and professional growth through continuing professional development (CPD). There is a need to develop individual qualifications both in technology and other competencies, like management, business or marketing skills. Currently CPD is often considered far too time consuming or costly, especially related to technology subjects. It is however imminent that this attitude needs to be changed. It is clearly in the interest of the individual to invest in CPD, as it enhances employability and supports personal career goals. Also industry, companies and other employers can benefit from well-planned and realised CPD as innovation and new products can be connected to new insight brought forward by individual staff members. Life long learning and CPD are essential parts of education as a whole, and therefore FEANI has a separate policy paper on CPD.

FEANI recommends that:

- Primary and secondary schools strive to instil in their students a passion for lifelong learning. Also, they ensure that students learn how to learn.
- Universities continue to support students in their quest for the most suitable ways to learn and encourage students to pursue continuing professional development (CPD) after graduation.
- Employers invest in the continuing professional development (CPD) of their staff. Having a highly competent staff is crucial for any employer wanting to succeed.
- Course providers should offer as great a variety as possible of innovative training products suited to meet the learning needs of engineers and professionals in technology as well as their employers.

Engineering needs to be communicated in a positive and inspiring way

We need to change the way we communicate about the engineering study and profession in order to break down the stereotypes of engineers as “nerdy” people removed from reality, not working with real “people’s problems”. We need to change both the tone and content of the conversation about engineering and develop new messages for improving public understanding of engineering. This is equally valid at school and in the public.

FEANI recommends that:

- The media are an important source of information. Young people are consciously aware of documentaries and general news on job market developments and trends. This also applies to the importance of technology for the economy, politics, society and culture. As this as-

pect is usually not dealt with in school, the importance of the media here is correspondingly greater. However, they often communicate isolated excerpts that entail the risk of a misperception. The educational mission of the media should be to present technology in its day-to-day significance and to explore the pros and cons as well as the opportunities and risks with respect to possible consequences. In this way, they can animate citizens to take part in decisions regarding the use, acceptance and consequences of technology.

- Great engineering achievements should be made visible in the same way as great architectural achievements. This could be done through PR, communication campaigns and the establishment of a European prize for engineers. For example the research at CERN is intensely covered by the media, while the engineering achievements at ESA are much less known in the general public.
- It needs to be very visible to potential engineering students how engineers contribute to human wellbeing and sustainable development of the whole society. This is especially important with regard to attracting girls and women into professions of SET.
- A committee or working group could be set up on a European level, which has the responsibility of finding and drafting engineering stories that can be communicated at national level, taking into account the above points. There is a need for a public relations “tool kit” for the engineering community. Feani is going to set up a European level task force to initiate this work.
- The international chemistry year 2011 could for example be used as a stepping stone to overcome some of the fears due to lack of knowledge

Short term

FEANI will review the recommendations for short term initiatives after two years to check how many have been taken up by either governments or institutions at European or national level and to measure the effect of the initiatives, which have been followed through.

Long term

Some of the recommended initiatives will take longer to have effect. These should be reviewed after a period of 5 years.

About FEANI

FEANI is a federation of professional engineers that unites national engineering associations from 30 European countries, bringing together more than 350 national engineering associations, all of which are recognised in their countries as the representatives of the engineering profession at the national level. FEANI represents the interests of over 3.5 million professional engineers in Europe.

For more information:

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