

Finland drives at educating world-class engineers: competence is crucial

The special strength of Finnish engineers is their excellent problem solving capacity, which is based on in-depth knowledge of technology, and on their mathematic-scientific competence. However, Finnish universities' and polytechnics' current engineering education provision must be developed in a variety of ways, so as to optimally match future competence requirements arising in working life. The project was conducted as part of the National Strategy Project for Higher Engineering Education, with the purpose of developing higher engineering education. The aim was to define how education must be developed in order to meet the field's strategic objective (which was set by the *National Cooperation Group for Engineering Education* in 2008): Finland has the world's best engineering education.

Participants of this project consisted of central interest groups represented in the National Cooperation Group for Higher Engineering Education, plus some 60 central actors from the field of education, including teachers, researchers and developers. The project work was done in the form of two invitation seminars, web-based conferencing, a working seminar for business life representatives and Cooperation Group meetings. Ida Mielityinen from the Finnish Association of Graduate Engineers TEK coordinated the work and was responsible for reporting.

Engineering **competence** is the crucial element in the success of Finnish society and working life, now as well as in the future. The global competence competition requires that we further strengthen our core areas of competence, predict future competence needs and develop our higher engineering education accordingly so as to secure the well-being of people and the environment.

The premise for the 'Competence through Learning' project was an analysis of future engineers' competence needs. These were divided into four main groups: core competence in engineering; cross-disciplinary competence; interaction competence, international operating competence and organisational competence; values and attitudes. The competence areas, that were considered as the most important in view of the required change in education, were then included in those categories.

Even in future, the engineering profession's core competencies will concentrate on technical and mathematic-scientific competence. Technology, however, is always developed by people and for people, either directly or indirectly. There is a continual need to strengthen creativity and the students' capacity to call things into question, in addition to improving their problem solving capacity. Problems that are encountered at work can rarely be solved through a single correct answer, or by applying standard scientific conventions. This means that new solutions must be sought without prejudice – from various fields of technology, with competence combinations from other fields. Consequently, this also means that future engineers must have a better preparedness for collaborative learning and shared expertise. The field of technology needs applicable pedagogic models – for both curriculum work and teaching method development.

Values and attitudes apparently play a major role in good engineering education. They are closely connected to many problems in engineering competence. This means that the bodies responsible for curriculum work are facing a major challenge. They should reflect upon their own value basis, which steers education but often remains subconscious. Working life uses a variety of multicultural, global and cross-disciplinary teams, which requires engineers to have the capacity to identify their own value basis and attitude basis for work and thinking. Cross-disciplinarity and the appreciation of competence in other fields should be supported at an early stage, during the time of study when people's professional identity begins to take shape. Among other areas, these skills are connected to business success and the birth of new of innovations at the interfaces between various fields of science.

The viewpoints of individual and collaborative learning should be more comprehensively considered in engineering education. Success in the worklife and innovation activities require collaborative learning and networking. The whole publication is available in Finnish with English abstract at http://www.tek.fi/ci/tekstra/Mielityinen_Opetuksen_laatu_120509.pdf. More information ida.mielityinen@tek.fi