



## Changes in Working Life Create Challenges to Engineering Education

MUSTONEN Lea (1), HEIKKILÄ Susan (2)

Häme University of Applied Sciences, Finland (1)

Häme University of Applied Sciences, Finland (2)

### Abstract

*The changes in working life require new kind of skills from engineers. Alongside the traditional technical knowledge engineers now, need language and communication skills, the ability to negotiate, make connections, work in groups and adapt to changes. Being able to use these so-called meta skills strives for the employees having ability to adapt to constantly changing tasks. This gives engineering educators new challenges. Häme University of applied sciences Electrical and Automation degree programme aimed to improve these skills with a new teaching implementation. First year students were given a development project in which they studied basics of programming. Most important part was the method of implementation: small heterogeneous groups of 3 – 4 persons were formed. Every group had foreign and native students. Their education background also varied: some had high school degree, and some had graduated from vocational school. Different cultural and educational backgrounds created challenges for the students in their problem-solving situations, but also possibilities for new kind dialogue and learning. Teaching staff mainly acts as supervisor for the process and not as the knowledge sharing party. At the end of the course students were asked with a survey about their opinion how the new teaching implementation had improved their meta skills.*

**Keywords:** Engineering Education, Meta skills, Pedagogy;

### 1. Introduction

The rapidly changing working life needs engineers that know how to utilise so called soft skills, such as teamwork and communication skills and working in multicultural groups. The purpose of this article is to present an example how these skills are being taught in the Häme University of Applied Sciences Electrical and Automation engineering study programme. This article explains the methods that have been used and the feedback collected from the students.

The main question is: Is it possible to develop better meta skills by assigning students to very heterogeneous groups based on their backgrounds and how do students feel about this?

### 2. Literature review

“What Skills Will You Need to be Employable in 2030?”, asks the headline of MIT Technology Reviewer. And what are the answers? Because of the robotization and artificial intelligence, future work needs different kind of skills than today. According to the British innovation foundation Nesta and University of Oxford five most important skills century skills - are judgement and decision making; fluency of ideas; active learning; learning strategies; originality. [3]

Expectations of skills change, because the work changes. There is a need for a new kind of services and functions in the future. The study mentioned before describes trends that will change working life. One of these is technological change, that bring up the often highlighted and even feared automatization. However, interesting is also that, technology can improve people's performance in some occupations and create entirely new professions. According to the study the significance of technology will be large: “Creative, digital, design and engineering occupations have bright outlooks and are strongly complemented by digital technology.” But to be successful, the future expert must also incorporate the previously mentioned so-called 21<sup>st</sup> century skills. To reach these, education sector has to be a part of the change and the change is a one-off long time frame. [1]

According to study by Union of Finnish work highlighted qualities in future employees desire to learn and develop yourself (55%); flexibility in working hours and work tasks (48%); readiness and adaptation to changes (45%). Interaction, communication and cooperation skills were also thought as important (11%). Percentages represent answers given by representatives of employers. [6]

The globalization of working life has sped up the expanding of needed skills for professions. This includes engineers.



“One of the most global of professions is engineering”, says Douglas Bourn. When operations of companies become more and more international, engineers are expected to have skills to work in the global market. Engineers need to understand different cultures and their effect on their jobs. In turn, engineers are expected to have similar type of skills all around the world. Basic are build up of technical skills, but teamwork and communication skills are highlighted more and more. Bourn summarizes the industry from literature skills for ‘global engineer’, which are “a sense of ethical social, moral and civic responsibility; ability to lead and influence, a sense of entrepreneurship, have skills in public speaking and be self-confident; ability to work in teams, be adaptable and have strong project management skills; being able to work with people not only from different cultures, but to be sensitive to different cultural approaches, recognizing the impact this has on one’s own cultural outlook; critical thinking and being prepared to re-consider one’s own worldviews and approaches to engineering.” The concept of ‘global engineer’ must be expanded and notice must be taken on how globalization changes the engineer profession and how engineers act as agents of change. [2]

What does Finnish Energy registered association say? A summary of surveys concerning the requirements of working life made in 2017 and 2018 brings up following skills that future recruits should have. In addition to skills required by occupation: Ability to network, knowledge of digitalization and robotics; multilingual; negotiation skills; basic knowledge economic indicators; computer skills; sales and customer service skills; teamwork skills; communication and influencing; ability to adapt to changes; ability to integrate previous knowledge to new concepts; ability to realise the added value your skills and knowledge to company and customer. The data is based on Finnish Energy’s survey to their member companies. Members represent about 90% of all Finland’s energy sector companies. Results bring up a challenge how to upkeep already existing technological knowledge and how to build new at the same time because companies will be needing versatile and more profound knowledge from new areas. There is a rise for a need for the skills mentioned above, that are needed in almost all occupations. [4]

Although the sample is narrow take on all the literature written on the subject, congruent line can be seen. The so called ‘soft skills’ are needed more and more alongside technical engineering know-how. This transitions to reflecting on how engineering education answers these needs. With what methods can engineering students be developed to be the most employable professionals?

### **3. HAMK’s framework**

The vision of Häme University of Applied Sciences (later: HAMK) is to offer the most inspiring higher education and the most customer-oriented applications of research. The students are a central part in all activities. CBE, the competence-based education and student-centered approach are in the focus of pedagogical approach and teaching methods to be developed with the intention that they support the prerequisites of changing working life competencies. [5] Teachers work in teams and the education carried out in modules consisting of 15 credits.

Team teaching reinforces a teacher’s ability to cope with constant changes, provided there is trust between the members. In good atmosphere preparedness to try different pedagogical solutions increases. Overcoming challenges together strengthens the feeling of making progress together and that increases the feeling of works relevance and job satisfaction. At its best teaching team and students act together as developers. Teacher is also a learner in addition to being a teacher. [5]

In the Electrical- and Automation Engineering study programme team teaching has a solid foundation. Several methods of operating that have been found good have formed that have continued while making small changes. Good experiences and team spirit have increased readiness to try out and take controlled risks in teaching. Experimental culture has formed.

Learning and wellbeing are closely related with each other. Teachers have a central role creating a trusting relationship with students, the best possible prerequisite for learning. With increased collaboration of teachers a good foundation. [5]

This was seen especially important when designing the implementation described in the article, where some students were known to fall outside their own comfort zone. This was evident in careful planning of student teams, continuous monitoring for problems, and guidance discussions.



### 3. Description of implementation

The project to develop meta skills was implemented as follows: The programme for both English and Finnish language electrical and automation engineering studies begins once a year. Students may have a high school degree, a vocational degree or both. Traditionally, education for educational programs in different languages has been organized separately. For the student groups that started in the autumn of 2018, a pedagogical experiment was organized in which a joint implementation was organized, integrating an automation project, English, Finnish language teaching for foreign-language students and Finnish communication course for Finnish language programme. The studies were centred around a joint technology project lasting about four months. Students were assigned to groups of 3 to 4 students consisting of different nationalities and educational backgrounds. They were given a challenging project and while completing it they had the possibility for peer learning as well as encounter differences. They were encouraged to find the team's strengths and create a spirit of communion where they help others and learn together.

The aim was that through a joint project they would naturally learn how to work in projects, teamwork, problem solving skills, internationality and reporting, and interaction skills in English and Finnish. A survey conducted for students with the intention to find out about students' experiences about pedagogical experiment. The survey was conducted about two weeks before the final presentations and the deadline of the reports.

### 4. The results

The questions were based on the needs to develop engineers' meta-skills mentioned in the article in the literature review. The survey was answered anonymously. Only recognizable was the language of education: 30 answer from Finnish programme, 15 from English. One of students did not want to share background information. Of the 51 students, 46 responded to the survey, so the response rate is 90%. There were 6 questions. Results are seen in figures 1 - 6.

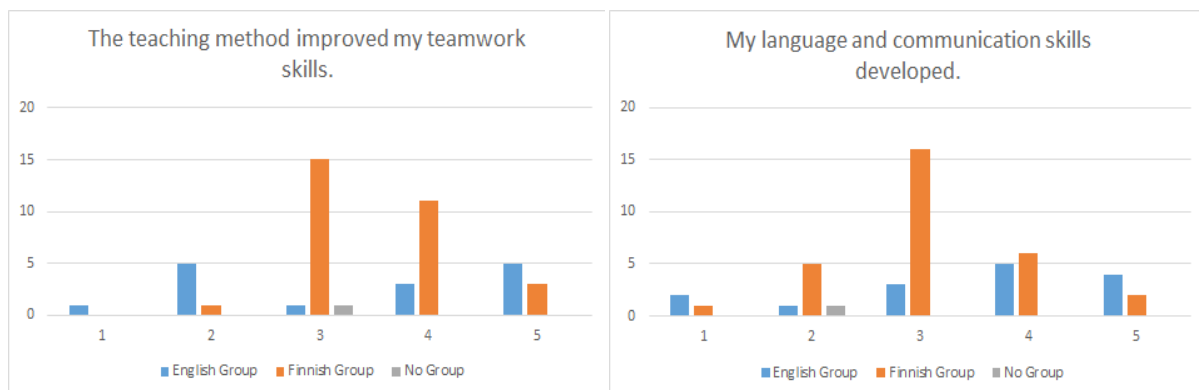


Fig. 1. & 2. Teamwork, language and communication skills development

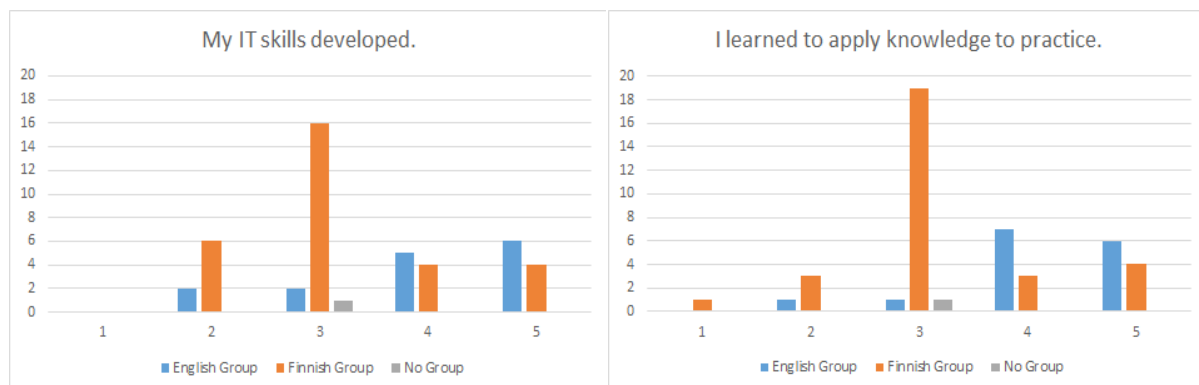


Fig. 3. & 4. IT skills and apply knowledge to practise development

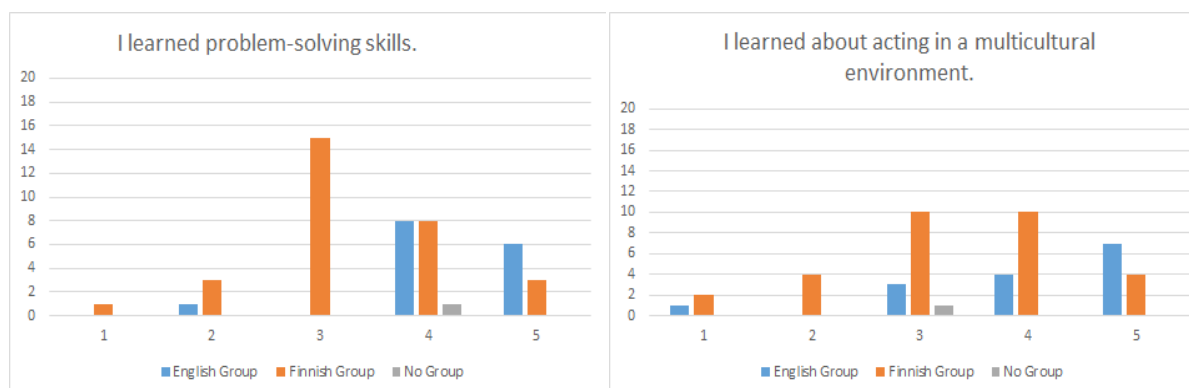


Fig. 4. & 5. Problem- solving skills and acting in multicultural environment development

Based on the results, it is recommendable to organize such implementations in the future as well. The positive feedback can especially be seen in questions 6, 5 and 1. Attention must be placed on the fact that the responses of English-language education students were more divided into extremes, while the Finnish-speaking group had more reviews of 3 and 4. In free comments, the module received both positive and negative feedback; for some students the module was either "super great!" or "not wise". The majority was positive feedback.

## 5. Conclusions

The method of implementation proved to be motivating for both students and teachers. For teachers, a new way of implementing means more work than before, because student teams should be closely monitored, and time should be reserved for guidance. Targets of development also exist. The survey may have been carried out too soon after the competition. Later in guidance discussions, it turned out that Finnish students were really anxious about the final presentation, that was held two weeks after the survey. After the presentations, the students seemed to be relieved and happy. If the survey had been held at that time, the results would probably have been even more positive.

The implementation as whole showed that it is possible to develop the meta-skills needed in working life through pedagogical means. Skills cannot be taught by lecturing or reading books. Development requires readiness to move to an area where there are no routines or ready-made responses that have been developed over the years. Above all it needs implementation of experimental culture by the teaching staff.

## References

- [1] Bakhshi, H., Downing, J. M., Osborne, M. A. & Schneider, P. (2017) The Future of Skills. Employment in 2030. London: Pearson and Nesta. Retrieved 15 November 2018 from [https://media.nesta.org.uk/documents/the\\_future\\_of\\_skills\\_employment\\_in\\_2030\\_0.pdf](https://media.nesta.org.uk/documents/the_future_of_skills_employment_in_2030_0.pdf)
- [2] Bourn D. (2018) The Global Engineer. In: Understanding Global Skills for 21st Century Professions pp 201-219. Retrieved 12 November 2018 from [https://link.springer.com/chapter/10.1007/978-3-319-97655-6\\_9](https://link.springer.com/chapter/10.1007/978-3-319-97655-6_9)
- [3] Condliffe, J. (2017) What Skills Will You Need to Be Employable in 2030? MIT Technology Review. Retrieved 15 October 2018 from <https://www.technologyreview.com/the-download/608981/what-skills-will-you-need-to-be-employable-in-2030/>
- [4] Korhonen, M. (2018) Energiatieteollisuuden osaamistarpeet. A summary of surveys concerning the requirements of working life made in 2017 and 2018 by Finnish Energy. Unpublished conference presentation material.
- [5] Kunnari, I. (2018) Teachers changing higher education: From coping with change to embracing change. University of Helsinki. Retrieved 29 November 2018 from <http://urn.fi/URN:ISBN:978-951-51-4551-2>
- [6] Suomalaisen työn liitto (2016) Työnantajilla ja työntekijöillä poikkeavat näkemykset tulevaisuuden työstä, työnantajista sekä työntekijöiden ominaisuuksista ja taidoista. Retrieved 10 November 2018 from



<https://suomalainentyo.fi/2016/07/12/tulevaisuuden-supertyontekijalta-odotetaan-monipuolista-osaamista-tyonantajilta-vastuullisuutta-ja-eettisyytta/>