Next practice case

Title:

From primary school to higher education, a KTH pilot study on systemically connecting education to industry

How to systemically connect industry's recruitment needs to the educational system on all levels? Presenting a KTH pilot study that focuses on shared resources, inspiring teachers and raising the bar on early talent nurturing from primary school to university.

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Background and objectives

The number of young students that are interested in technical subjects has decreased significantly the last years. At the same time, the industry innovation requirements that are urgently needed to meet the sustainability goals have significantly increased. Through technical universities, the education and research programs are becoming more focused on innovation and societal impact. However, not all sectors solely rely on university educated staff and their innovation capacity is not necessarily subject to market dynamics. Systemic changes are therefore needed to enable the nurturing of a new generation that is (i) able to handle cross-disciplinary solutions, (ii) is comfortable with a life-long learning support system and that (iii) can raise the bar of innovation, away from risk averseness and frozen market dynamics. Given the ability of universities to both think long term and take a systemic perspective, it should be part of their assignment to lead the change processes that are needed to establish a systemic integration of facilities, needs and possibilities. The knowledge triangle model should thereby be extended beyond academic education and should already start from primary and secondary schools. Connecting the programs of the various levels of education to each other as well as to industry and strategic partnerships, could keep a wider range of students engaged to technical subjects as 'role-models', 'networks', 'peer-mentoring' and 'industry case-studies' can be more easily integrated in the curriculum.

To begin to investigate how to do this, KTH started in 2019 a pilot project with one of its Competence Centers, named Road2Science, that focuses on the transportation infrastructure sector. This is a typical sector that does not have a natural innovation market mechanism, suffers from a recruitment problem and has high demands on their cross-disciplinary innovation developments to meet sustainability goals. The pilot focuses on the Nynäshamn municipality, which is home to the Nynas AB refinery (producer of asphalt for roads in the Nordic countries) and the Norvik port (the new Stockholm cargo port) being built by Stockholmshamnar AB. Together with the municipality, a local secondary school and two

primary schools were selected. For the pilot, a working group with representatives of all partners was formed and a common roadmap was defined at the start of the pilot.

The long term aims of the project were commonly defined as follows:

- Increase the number of students who (i) have an interest in our future transport infrastructure system; (ii) understands and can discuss the challenges of the system's sustainable development and (iii) selects related (technical) topics in its curriculum
- Provide teachers with the conditions to (i) lift the challenges of transport infrastructure in their courses and activities, (ii) increase students' interest in the subject and technical subjects, and (iii) aim for sustainable collaboration with actors
- Enable comprehensive conception of ideas, opportunities, needs and interests across schools, municipalities, academia and industry boundaries to create the next generation of innovation leaders in the transport infrastructure sector.

It was defined that, in order to reach these goals, (i) students/teachers must be in contact with industry actors in order to build up their own knowledge of the subject; (ii) student should be able to try out their own possible career paths within the subject, (iii) teachers should have access to various tools and networks and be able to use the collaboration as a ball plank and (iv) the collaboration must create a sustainable environment where all actors can meet and understand each other's circumstances and contribute their own thoughts.

Strategy and activities

The project initiated during the fall of 2018, when individual discussion between KTH and the industry partners and KTH and the Nynäshamn municipality were held about starting a common pilot. During December 2018 two start-up meetings were held in which the rectors of the primary and secondary schools were invited to, as well as teachers of the technical subjects and local key persons involved in educational programs. Individual interests and aims were discussed to create a common understanding about each other’s perspective.

The main interest of the industry was positive ‘advertisement’ of the companies in the community and at the schools as well as to get early access to talented student to recruit them to the company later on. The interests of the schools were in being able to attract and maintain more students, especially girls, to the technical programs. The teachers were also particularly interested in raising the levels of their schools and to give their students an early access to KTH to diminish the barrier to continue with higher education. Several teachers admitted that they themselves did not know much about transport related subjects and their teaching material was mostly unrelated to current sustainability challenges or specific industrial applications. Furthermore, no real connection existed between the primary and secondary schools, nor between the individual primary schools. In the second meeting, KTH, together with the local industry partners presented a roadmap of activities and a selection was made of subjects that the teachers viewed as interesting to integrate in their course material. A common view on what the short- and long-term goals of the project was defined.

The developed roadmap consisted of two main items: (i) incremental knowledge transfer and (ii) activities within the format of ‘Makerspace’ assignments, a project- based education structure in which programming and building assignments are central. In the first, activities

such as focused study visits, guest lectures, coaching (students and teachers) and links to ongoing activities was focused on. In the second, links to higher education and professions, introduction to new tools, and coaching and feedback from industry partners was focused on.

Outcome and impact

The pilot started with a full day kick-off workshop at KTH at the start of 2019, with selected students from the schools as well as industry representatives. KTH was represented by both academic staff, post-doctoral researchers, PhD students and M.Sc. students that are part of the student sections that organize activities for students. The workshop activities included presentations, visits to research laboratories where they could try out and there was a digital design game. Feedback from the day included that the students were surprised that KTH was not one building but 'like a whole city'. Teachers were impressed with the variety of things that were ongoing on campus. Learning point for the KTH staff was that it is not clear to primary and secondary school students and teachers what a PhD student is or what a Professor does (and how you become one). The need to develop a common vocabulary became quite clear from the first meeting.

After the kick-off workshop, KTH got several requests from the primary school students to do their PRAO (a two-week internship in practice) at KTH and several secondary school students asked for a possibility of a summer job/project at KTH. KTH PhD students were also invited to take part in the 'career day' event at the primary schools.

During spring 2019, focus was placed on the activities of Nynas AB. With material support of the company, KTH staff came to the primary schools to give presentations on sustainability questions surrounding asphalt production, material design and long-term road performance in the morning. In the afternoon, the students had a 'make your own asphalt' experiment session. During the sessions at the two primary schools, 7 students of the secondary school took part as teaching assistants in the experiments.

Before summer a half time evaluation of the pilot was done. Focus for the fall was on the other strategic partner in the project, Norvik port (Stockholmshamnar AB. During July-August, KTH organized a scale model of the cargo port, which after summer was used in the Makerspace sessions. During these, the primary school students had to learn how to automate the port by using Lego robots. Their teachers where coached by KTH staff in a separate workshop on programming. Additionally, a guest lecture from Norvik port was held at the schools, connected to a visit to the port before they started their assignments.

In December of 2019 there was a one-day event for all pilot partners at KTH, with presentations, debates, demonstrations and elevator pitch training for the students.

The pilot is continuing during the spring of 2020 and will close before summer, after which an evaluation will be done.

At this stage is hard to evaluate the long-term impacts of the project. But from discussions with the students it was clear that the percentage that would consider continuing towards higher education has increased during the project and we have received multiple requests for additional 'PRAO' positions and summer jobs at KTH, from the primary and secondary schools,

respectively. After the school breaks, teachers commented that many of the students were wearing their KTH sweaters to schools, which is furthermore a positive indication. From the KTH staff involved in the pilot there was a raised awareness of the opportunities and challenges in the different school systems, but also on the amount of 'low hanging fruits' where a possible interaction between industry, schools and KTH could make a significant contribution. During the project it became obvious that (i) an awareness of each others institutional reality (e.g. year schedules, national tests, budgets), (ii) personal engagements (e.g. key individuals that have a 'driving motor' role in their own organizations) and (iii) a healthy dose of finding practical solutions for short term problems to meet the long-term common goals, were key for the success of the collaboration.

Organisations involved

KTH Royal Institute of Technology, via Road2Science Center
Nynäshamn municipality
Stockholmshamnar AB
Nynas AB