All-inclusive outreach - A long-term co-operation process between a Finnish mid-sized university and a mid-sized town (Work in Progress)

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Introduction

This paper introduces an ongoing cooperation process between a Finnish university and the schools of a local town. The objective of the cooperation is to increase all the children's and adolescents' interest in science, technology, research, and sustainable business, develop their skills for academic studies, and enhance their opportunities to build a sustainable future. The activities also aim at engaging pupils' families to promote sustainability in their home city. First, the paper introduces the rationale behind the cooperation and describes the planning and implementation of the activities. After that, the paper focuses on the plans to monitor and evaluate the outcomes of the cooperation. The development of a survey to monitor the students' thinking is presented and other possible evaluation tools and needs are discussed.

Rationale for cooperation

There are several different motives for university-school collaboration resulting in many different types of cooperation programs [1]. The driving forces for starting the presented cooperation were the town school district's wish to better contextualise school teaching and make better use of the expertise available in local university, as well as university's hopes to serve the local community and to increase the local pupils' interests towards engineering and business careers and education at LUT University. Both parties also had the interest of enhancing the attractiveness of Lappeenranta as a place to study, live and raise a family. These aims resulted in a collaboration, which can be primarily regarded as a curriculum enrichment programme containing some elements of community support [1].

Earlier studies have noted that young people's attitudes towards science and technology in the Nordic countries are sceptical, which indicates that school science fails in many ways [2]. The school science has also been noted to cater only the interests of the minority who wish to study science or technology further and not to serve the more general development of scientific literacy among the pupils [3]. Stronger contextualisation of science teaching and opening up school curricula to the societal and cultural aspects of science and technology have been proposed to be solutions to these problems [2, 3]. One possible path to this is the schools' cooperation with universities, where the interplay between science, technology and society is researched and developed.

Successful university-school-partnerships build on trust, mutuality and reciprocity, benefit all members of the partnership, and have an impact [4]. Some of the recognised obstacles for success are the diverging goals for the partnership, contrasting perspectives about the role of the teacher, and the outside accountability measures directing the instructional practices [5]. Finding a balance between transformational goals and tangible outcomes and achieving simultaneously both long-term involvement and new innovations are also known to be challenges in university–community partnerships [6]. Acknowledging these issues in the planning and execution of the cooperation has been of great importance.

Development process and designed activities

The work started in 2017 with three objectives: 1) make Lappeenranta known nationwide for its specific focus on Finnish high-level expertise all the way from preschool to university, 2) increase pre-, primary, and secondary school pupils' interest in science, technology, research, and sustainable business, and give them good prospects to build a sustainable future, and 3) equip local upper secondary school students with the best knowledge and skills for academic studies in the country. From the very beginning, the aim was to establish a permanent form of cooperation and to integrate it into the curricula of all the schools. The topics for activities were drawn directly from the research areas of LUT University: clean energy, clean water, circular economy, sustainable business, and entrepreneurship.

The content design started in autumn 2017 by assigning two working groups to the task. One team consisted of preschool and primary school teachers and the other consisted of lower secondary school teachers. The university named a coordinator, who worked with both teams. The coordinator was responsible for consulting and engaging university researchers in the design and development work when needed. During the academic year 2017–18, groups met about once a month. The activities were decided to be directed to preschoolers, third-graders, fifth-graders, eighth-graders, and upper secondary school students. The designed activities are described in Table 1. Activities were piloted during the academic year 2018–19 in one preschool, four primary schools, and two lower secondary schools. After piloting, concepts and learning materials were developed further, and support material and training activities for teachers were prepared.

Table 1. Topics and forms of cooperation activities by pupil groups

Group	**Topics**	**Activities**
Preschool	Clean water Clean energy Waste recycling	Ready-to-use educational kit with stories, games and activities on the topics
3rd grade	Clean water Circular economy	Lessons about the natural water cycle, protection of lakes, and wastewater treatment given by experts from the university and the local environmental agency Teaching materials on circular economy
5th grade	Sustainable business Entrepreneurship	Setting up small companies Fare-day at the LUT University to sell the products and services and give a marketing speech in front of a jury
8th grade	Clean energy Clean water Circular economy	Multidisciplinary project work on the topic "Sustainable Living" Workshops at the university Learning module on pupils' own consumption and ability to influence the environment Calculating a carbon footprint for one's family

In the academic year 2019–20, the activities for the preschoolers and third-, fifth-, and eighth-graders run on a full scale, resulting in about 400 preschoolers, 2100 school children, and 200 teachers participating in the cooperation yearly. The focus of development has now been turned to upper secondary school education. Also in this sector, the ultimate aim is to build the activities into the upper secondary school curriculum to ensure that they involve as many students as possible.

Assessment of outcomes and experiences

To evaluate the effects of the educational activities on children's thinking, a survey on conceptions of and attitudes towards science, technology, sustainability, and entrepreneurship was designed. The survey consisted of six content and two background questions. The first question monitored pupils' thoughts about science and technology with 28 statements, which the pupils rated on a 5-point Likert scale in terms of their agreement with the statements. The statements were derived from the Relevance of Science Education (ROSE) questionnaire, section G [7] and the short version of the Pupils Attitude Towards Technology (PATT) survey [8]. The second question addressed pupils' views on environmental issues and ecological sustainability. Similar to the first question, pupils were asked to rate their agreement with 30 statements, partly taken from the ROSE questionnaire, section D [7] amended with some statements created for this purpose together with the university's circular economy and sustainability experts. The third and fourth question of the survey targeted pupils' ideas about business and their orientation toward entrepreneurial learning. The respondents were first asked to evaluate the importance of 13 different aspects when doing business. Then, they were asked to assess how well the 17 statements described them and their behaviour. The 13 aspects and 17 statements were created together with the university's sustainable business and entrepreneurial education experts, and the development of the latter question was somewhat rooted in the EntreComp framework [9]. The fifth question asked about the pupils' short-term educational choices (what to do after basic education) and the sixth question about their long-term plans (the degree at which the pupils aim later in life).

The first version of the survey was administered to the ninth-graders in May 2019. The data were primarily gathered to develop (and shorten) the survey, but the data can also serve as baseline data, as the respondents of this first round had not been exposed to any of the cooperation activities. The final survey will be administered yearly to all the ninth-grade students in the town to monitor possible changes in the mindset and educational aspirations of the children. The first round yielded 191 answers, out of which 186 were of sufficient quality to be included in the analysis. The first four questions were factorized separately applying principal-component factor analysis and rotated with Kaiser's rotation. The results of the factorizations are outlined in Table 2.

Table 2. Results of the factor analysis by different questions

Question topic	**Factors**	**Cumul. expl.**	**Cron-bach's alpha**
Science and technology	Trust in science and technology (8 statements)	67.99%	0.881
	Faith in science and technology (5 statements)		0.856
	Criticism of science and technology (3 statements)		0.827
	Gender-relatedness of science and technology (2 statements)		0.891
	Talent requirements of science and technology (3 statements)		0.603
Environment and sustainability	Denial of environmental problems (6 statements)	62.59%	0.884
	Consciousness of environmental issues (10 statements)		0.911
	Hopelessness over the environmental situation (2 statements)		0.520
Sustainable business	Financial view of business and entrepreneurship (2 statements)	73.66%	0.833
	Societal view of business and entrepreneurship (8 statements)		0.933
Entrepre-neurialism	Resilient view of oneself (8 statements)	63.19%	0.889
	Primus motor view of oneself (2 statements)		0.762
	Anxious view of oneself (2 statements)		0.443

The factorized solutions for each of the questions were of reasonable quality. The overall Keiser-Meyer-Olkin (KMO) measure for the sampling adequacy was above 0.84 for all of the four solutions and the created factors explained more than 60% of the variation in all of the questions. The Cronbach's alphas for all but three factors exceeded 0.75. The final solution for Science and technology -question included 21 out of 28 original statements, the respective ratios for Environment and sustainability was 18/30, for Sustainable business 10/13 and for Entrepreneurialism 12/17.

Some of the identified factors were similar to previous studies that used ROSE and PATT. The denial and consciousness of environmental problems resemble the positive and negative attitudes towards environmental responsibility factors discovered by Uitto et al. [10], and the gender-relatedness and talent requirements of science and technology factors are presented also by Ardies et al. [7] with slightly different names. Although Lavonen et al. [11] did not present factors similar to our factors relating to different degrees of critical attitude to science and engineering (trust, faith, and criticism), they noted a gender difference with respect to this issue; girls, in general, being more critical than boys.

Based on the factors identified, the survey has the potential to be developed into a tool to monitor pupils' interest in and attitudes to the topics and further education and hence to assess the realization of the objectives 2 and 3. Some of the factors have a lower reliability than the others and the respective statements need to be developed further by adding or refining items. Still, it is a better option to develop than omit for example the factor "hopelessness over environmental situation," as maintaining an optimistic and trustful view of the future is one of the objectives of the cooperation, and an important outcome to be monitored. Removal of some of the most overlapping items within a factor will also be considered. This would help in shortening the questionnaire and making the answering easier.

Next steps

The next steps in developing the assessment is the reconstruction of the survey based on the results of the factor analysis. The items that did not load on any of the factors will be removed, which shortens the questionnaire and makes it easier to fill in. The statements loading on the factors will also be developed as discussed in the previous section. In addition to the ninth-grade survey, some other forms of data collection and analysis after the cooperation activities for different age groups will be developed. Teachers' experiences will also be systematically studied. This has already been started by drawing up feedback forms for teachers on different activities.

Assessing both, the development of student attitudes and the teachers' perceptions of the activities is crucial in making and keeping the cooperation successful. Continuously monitoring the impact of activities on students makes the transformational goals more tangible and helps in keeping the goals of the both parties aligned, whereas following the teachers' mindset keeps the role of the teacher and the possibly affecting accountability measures on the common table and enables the prevention of possible problems related to these issues. Keeping the development alive and producing new innovations is sought by establishing permanent forms and organs of cooperation (such as teams of developer teachers) but also by generating some turnover among the participants.

In the long run the successful implementation of the cooperation will result in increasing interest of local pupils to study engineering at LUT University. However, it will take a long

time before the full potential of the cooperation is in use, and therefore these other indicators of the effectiveness of the activities must be systematically developed and applied.

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