Slides: http://bit.ly/2ZNIqUo

EDUSPACE

Where educational innovators and science meet

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ESTONIA

Expert meeting CIDREE – 13th & 14h January 2020:

Robotics & STEAM education

The specific contribution of robotics to the learning and teaching of STEAM

TALLINN UNIVERSITY

About presenter

- **Janika Leoste** is currently a PhD candidate and early-stage researcher at the Tallinn University, Estonia. In her PhD theses she focuses on teachers' support strategies for integration of technology-based educational innovations into teachers’ classroom practices.
- The empirical part of her study is built on testing these strategies with **robot-supported math learning method (Robomath)** in basic school.
- She is the author of many open digital interactive learning resources about integrated use of educational robots in the kindergarten and general education. Since 2019 she is also a member of the International Program Committee of the Robotics in Education conferences

Robomath

- **Robot-Supported Math Lessons:** using an educational robot as an educational tool for visualizing abstract math concepts and creating meaningful real-life like context for applying math knowledge.

- Click on the link https://youtu.be/W90jldz-T54

Robomath publications: bit.ly/2N2N3ow
Robomath presentation slides: bit.ly/2r3IlyQ
Example lesson plans: bit.ly/2Q1n9AS

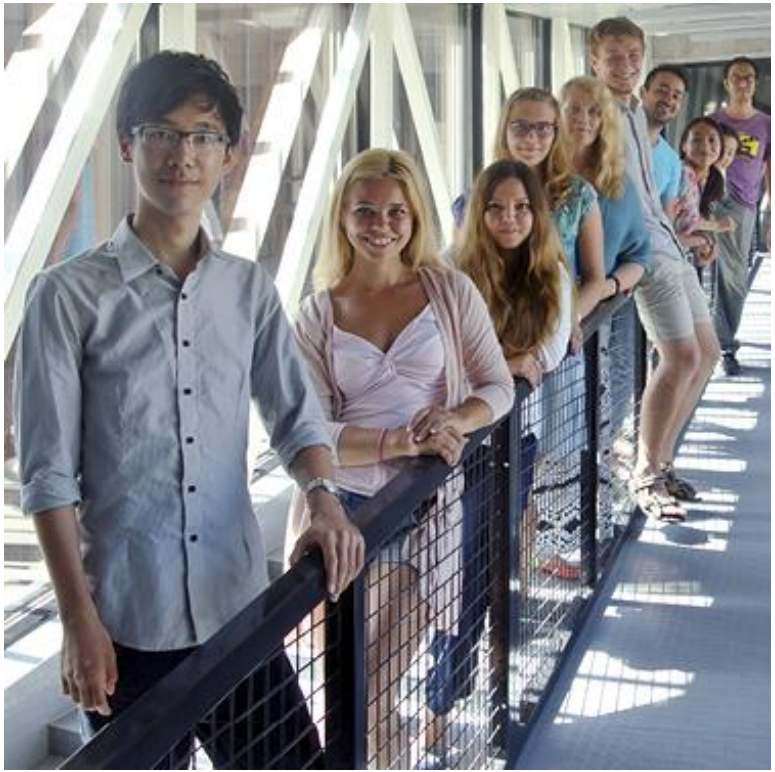
Estonian education in facts

- Population of 1.3 million. About 260 000 are under 18 years old.
- 479 schools, 555 kindergartens.
- One of the PISA top countries
- Biggest stakeholders: HITSA, Innove, ETAG

Tallinn University

- Tallinn University is the largest humanities university in Tallinn and the third biggest public learning, research and development centre in Estonia. We have more than **8000** students (with 5,5% of them international), and almost 900 employees, including over 400 researchers and lecturers (almost **1000** employees all together).

- For more information: http://bit.ly/2uIO8vt



Robots in formal education

- Over 90% schools and 60% kindergartens have robots or sensors or other educational technology (HITSA, 2019).
- 100% Tallinn's (the capital of Estonia, 1/3-rd of population) kindergartens have robots and STEAM kits.
- Tallinn has 2 dedicated robo-kindergartens with well-equipped labs and 6 EduInnolabs with robotics, drones, VR and AR etc. (https://www.tallinn.ee/est/Uudis-Innovatsiooniprojekti-EduInnoLab-tutvustus).
- Robotics, programming, STEAM, informatics courses on selective basis.
- Open repository for educational digital learning resources https://e-koolikott.ee/
- Only 8% of teachers have to tried robots or STEAM kits once in lessons (Leppik, Haaristo, Mägi, 2017).
- The average age of an Estonian teacher is 50 (Tõnisson, 2019).

Robots in informal education

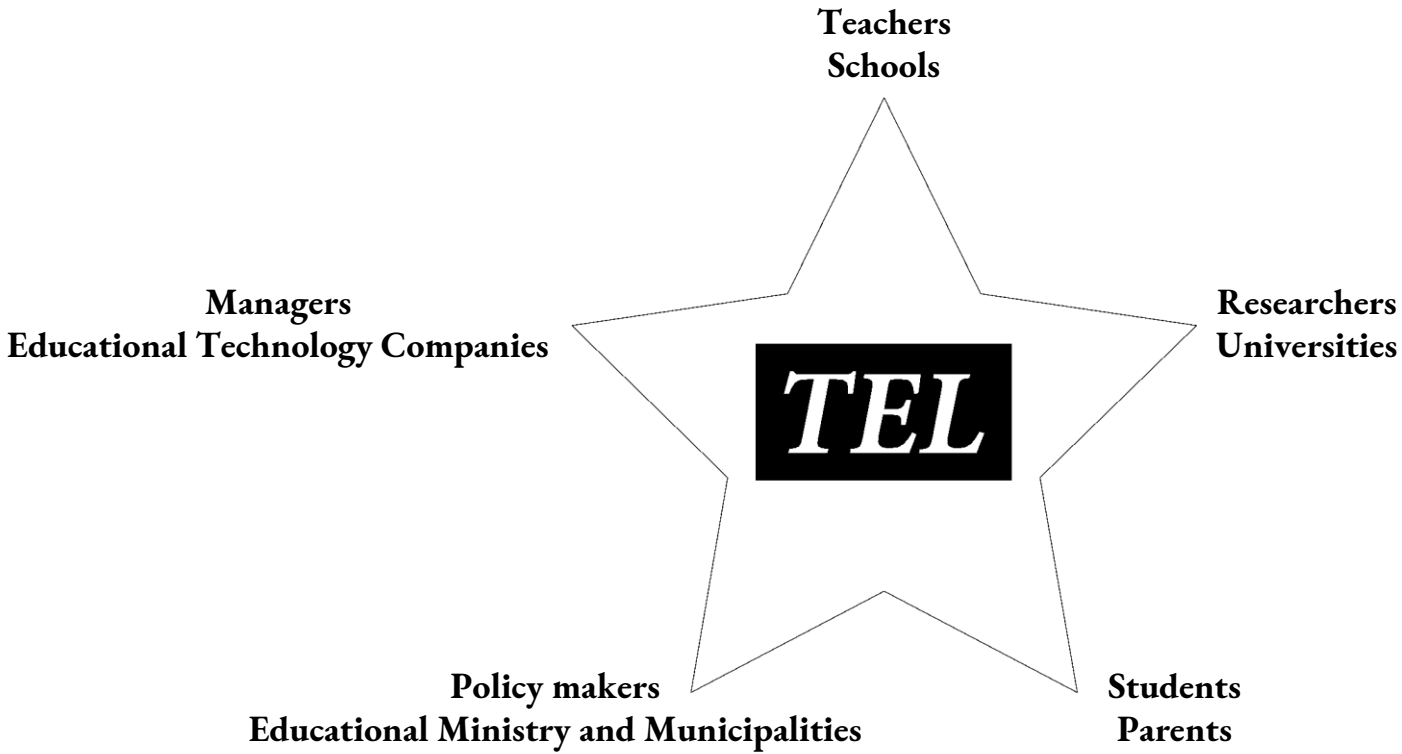
- Over 151 registered robotics clubs https://huviring.ee/huviringid + the majority of Estonian schools and kindergartens has robotics clubs.
- Robotex robotics competition will have its 20th birthday this year https://robotex.international/
- FIRST LEGO League has taken place since 2012 and Junior FIRST LEGO league since 2014 https://www.firstlegoleague.ee/fll/
- Several robotics labs and smart classes are provided by universities, public educational institutions and museums.

EDUSPACE at Tallinn University

The School of Educational Sciences at Tallinn University has recently created a concept of *EDUSPACE ecology*, where scientist's knowledge could meet the *field* experience of other stakeholders. For example:

- Scientists and teachers co-creating and co-researching new teaching and learning methods on technology-enhanced learning and teaching.
- Field testing and providing evidence when implementing new educational technology provided by manufacturers.
- Mentoring and supporting life-long learning and innovation implementation strategies when adult learning comes into play.
- Supporting coaching for other universities to build up their EDUSPACE-s.
- https://www.facebook.com/TallinnUniversityEduspaceLab/
- https://www.tlu.ee/en/eduspace

Stakeholders around TEL black-box

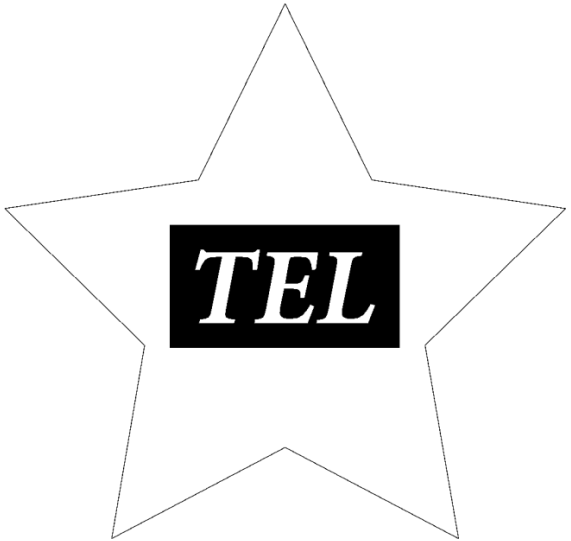


Challenges for Teachers/Schools

- Too many different technological sets – it is difficult to find the most useful ones.
- Not enough supportive courses to raise pedagogically meaningful ICT skills around TEL.
- Not enough teaching-learning materials and learning designs to adapt.
- The goals of aged curricula are easier to reach without technology.

Challenges for Researchers/Universities

- What should be researched?
- How should it be researched?
- What should be taught?
- Whom should it be taught to?
  (students, teachers, scolars, people from industry)
- How should it be taught?
  (separate courses, integrated courses, long-term development programs)
- Who should teach it?
- What is needed for teaching it?
  (equipment, course programs, educators, dedicated physical space)



Challenges for Students/Parents

- Lack of knowledge about how to use specific device or software.
- Does *playing around with technology* really helps me to achieve learning outcomes?
- How can I use these *things* outside of school?

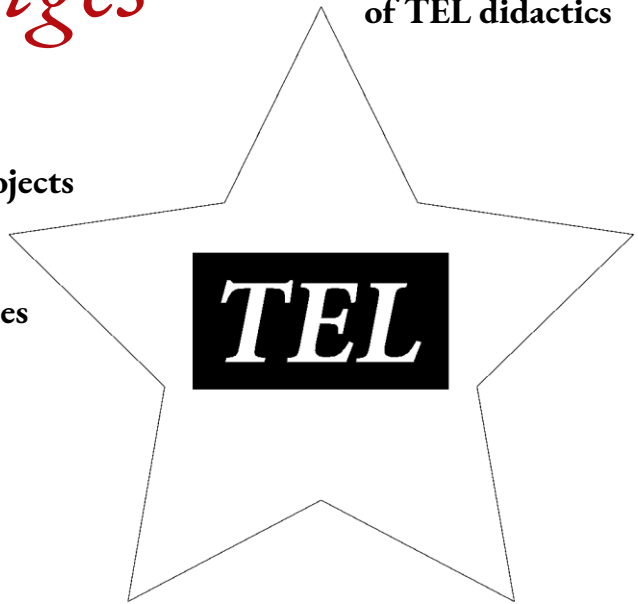
Challenges for Managers/Educational Technology Companies

- New devices need to be pushed to the market, otherwise the market share will be lost.
- Product life cycle is too short for studying the product's impact scientifically.
- Producing independent general learing designs for the products helps to claim their educational suitability.

Challenges for Policy Makers (Educational Ministry and Municipalities)

- How does TEL contribute to learning outcomes?
- Should curriculum be changed to accommodate TEL approach?
- Should more investments be made in technology?
- Perhaps more investments should also be made in teacher training?

EDUSPACE framework to address these challenges



Knowledge base
of TEL didactics

International and national research projects
on TEL influence on learning
Research on-demand
for educational technology companies

Open learning resources
of TEL learning designs

Research groups on different TEL branches

TEL didactics courses for students and in-service teachers
Open laboratory space for all stakeholders

EDUSPACE as a physical space

- Equipment: robots, sensors, STEAM sets, VR+AR, recording devices, cameras, tablets etc.
- Staff: Laboratory assistants, lecturers, educators, stakeholders' coordinators etc.
- Content: courses, presentations, research projects, creation of learning resources, licensing.

New laboratory will open on May 7

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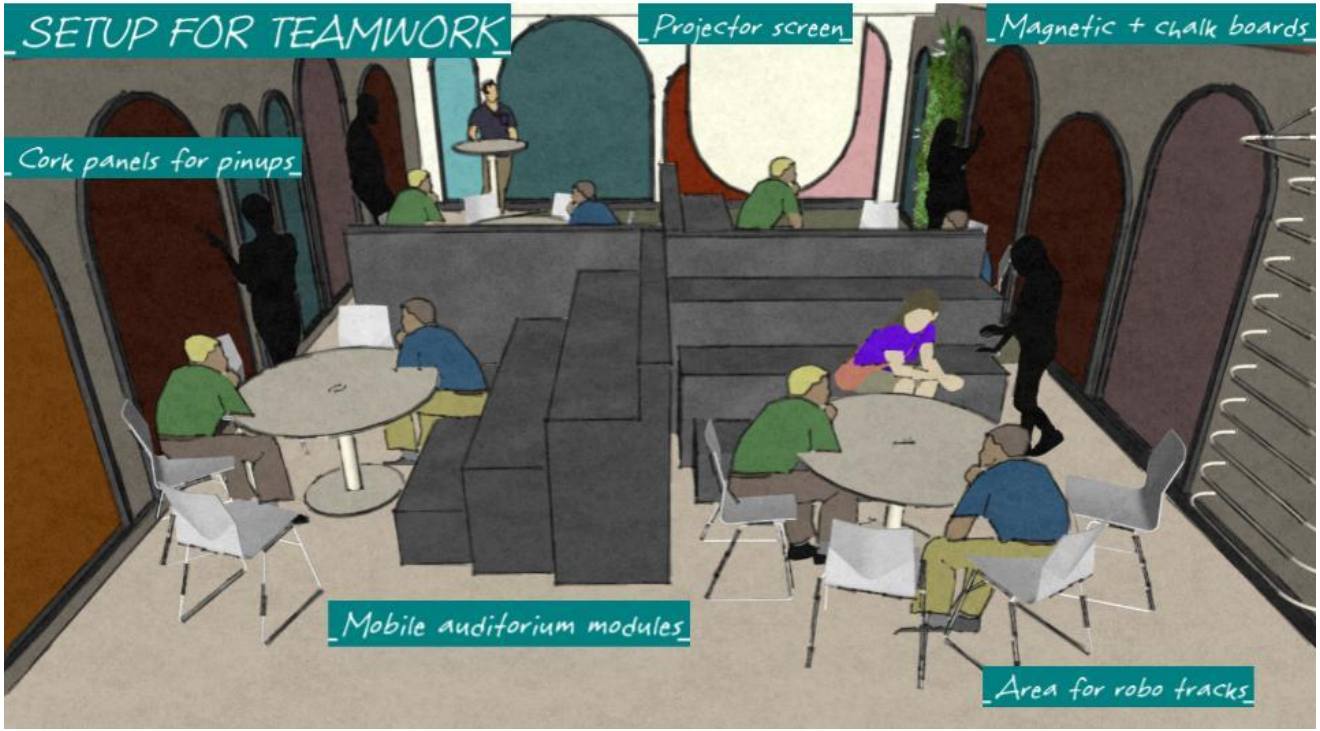

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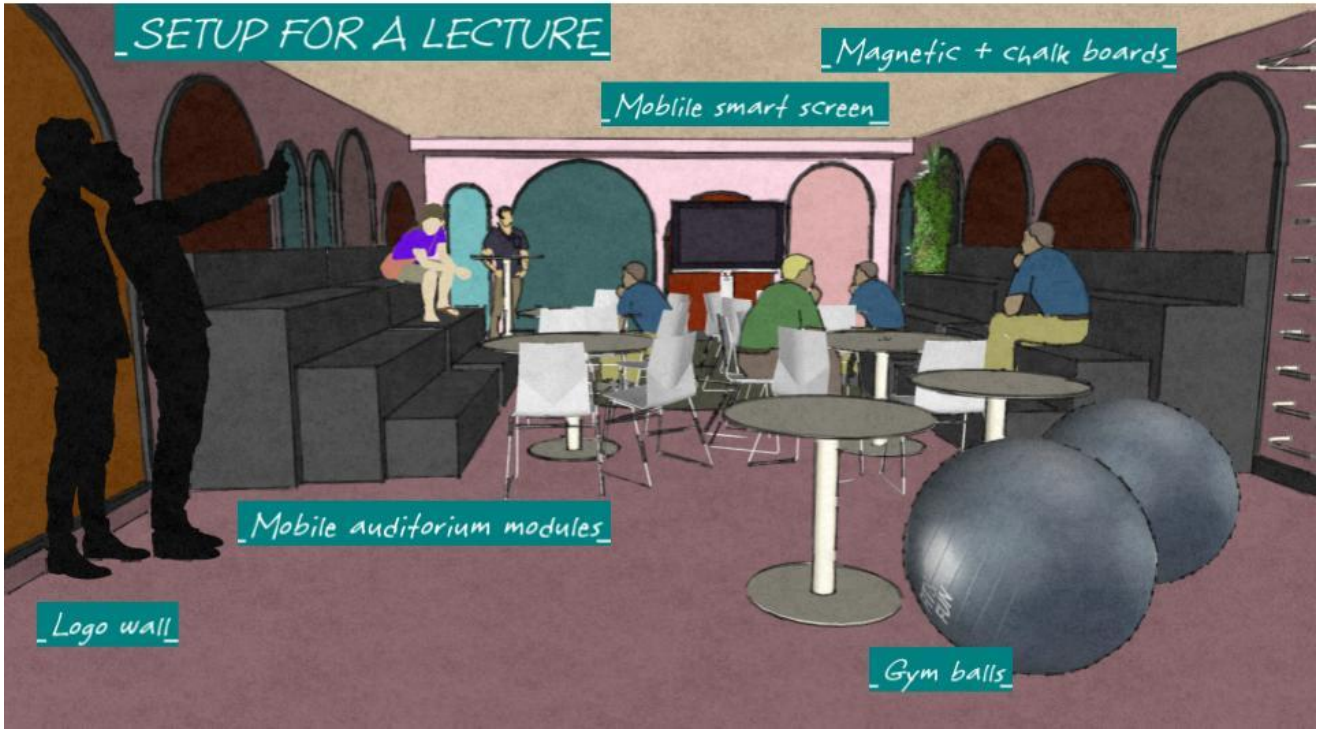
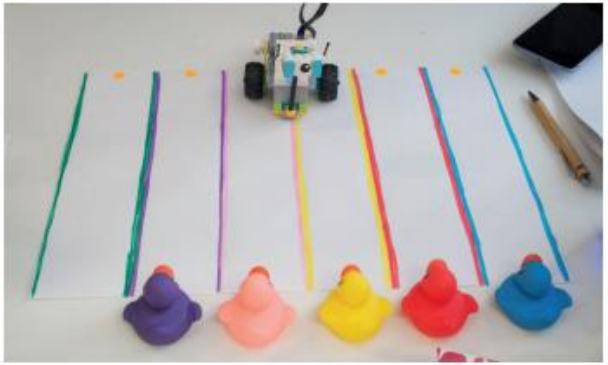


Some examples of courses in 2020

- Robot-supported learning in kindergarten and primary school (for Erasmus+ international students, MA level, 3 credits).
- Teachers Innovation Laboratories – long-term professional teacher development programs (for in-service teachers, 6 credits).
  - Digimath for gymnasium
  - Outdoor learning for higher grades of primary
  - STEAM in kindergarten
- STEAM K12 for non-ICT students, 6 credits (blended learning both in English and in Estonian).
- Educational robotics summer schools.

EDUCATIONAL ROBOTICS IN PRESCHOOL AND PRIMARY EDUCATION

20-24th of July 2020



Educational robotics is a promising tool for bringing excitement, motivation and growth of mathematics and other STEM skills into the classroom. However, a teacher needs solid proof that using educational robots in the classroom would improve students' skills or that they would work as motivational tools. For this reason, the course covers at least 5 different age appropriate educational robotics platforms and accompanying teaching practices in a practical hands-on-workshops format.

WHY CHOOSE THIS COURSE?

- Get hands-on experience on how to support computational thinking by using educational robots.
- Get to know the latest pedagogical trends that make use of technology enhanced learning.
- Find out how to design robot-supported learning environments, using a research-based framework.

CURRICULUM - PAST TRAJECTORIES AND FUTURE TRENDS

13-17th of July 2020

Perhaps even before but certainly after the appearance of major large-scale comparative student assessment tests such as PISA (Programme for International Student Assessment) in 2000 and the growing influence of supranational organizations such as OECD (Organization for Economic Cooperation and Development), we can observe the effects of globalization in the education systems and curricula of most countries. Under the conditions of international competition for an educated workforce, almost everywhere education is becoming more homogenized. However, education still contains regional and national differences.

WHY CHOOSE THIS COURSE?

- Every teacher at all levels of education is a curriculum theorist while interpreting and translating the official or planned curriculum for her/his class and students.
- Still there is an astonishing void in many teacher education programs to scrutinize the curriculum beyond what to do with pre-given subject matter. In order to be not only transmission of knowledge but transformative and educative as well, good teaching is a personal matter where academic and substance knowledge coincides with the subjectivity of the teacher.
- More generally, in the global world and cosmopolitan context, educators, teachers, and policy makers should be knowledgeable about the intellectual histories and present circumstances of education to be able to design nationally distinctive but internationally informed education policies and curriculum reforms for the future.

More information here: http://summerschool.tlu.ee

Robot-supported learning in kindergarten and primary school

- **Course objectives in English:** Giving an overview of basic educational robotics tools suitable for integrating different subjects in the preschool and primary school context.
- **Brief description of course content:** the contact days include learning of robotics platforms (BeeBot, BlueBot, Ozobot, Dash, Edison, Sphero, Lego WeDo etc.), co-creating a learning resource (a structured document about how to conduct a daily activity or lesson using a robot as a learning tool), conducting a demo lesson to other participants, and reflection.
- Example learning designs created in the course (https://drive.google.com/drive/u/4/folders/1QBHNJmRL97iBHO_7BKaVYYrTGf7i8el-)

Additional information about course content and topics, incl dates of contact lessons in the form of seminars.	Contact day 10:15-10:30 Introduction about literature 10:30-11:15 Familiarizing with educational robots 11:15-12:00 Creating learning design for educational robots 12:00-12:30 Pause 12:30-13:00 Presentation and analysis of created learning designs 13:00-13:30 Presentation of creating H5P interactive materials 14.02 10:15-13:30 A-440 – Robots with controller. Dash, Sphero, etc. 13.03 10:15-13:30 A-440 – Robots with factory programs. Ozobot, Ediston, etc. 20.03 10:15-13:30 A-440 – Button-programmed robots. BeeBot, Matatalab etc. 03.04 10:15-13:30 A-440 – App-programmed robots. Dash, Edison, Ozobot, etc. 17.04 10:15-13:30 A-440 – Construction robots. LEGO WeDo 2.0 etc. 08.05 10:15-13:30 A-440 – Public presentation of coursework. 15.05 10:15-13:45 A-440 – STEAM tools. Sound recording pegs. LEGO Steam Park jt.

Some research directions

- Influence of robotics on student engagement in basic school, robots in math
- Robotics in kindergarten
- Outdoor learning
- Robot-supported digital storytelling
- Usage and influence of digital learning resources
- Teachers’ digital competences
- Collaborative learning

Factors Influencing the Sustainability of Robot Supported Math Learning in Basic School

Leoste, J., Heidmets, M. (2019). Factors Influencing the Sustainability of Robot Supported Math Learning in Basic School. *Robot 2019: Fourth Iberian Robotics Conference: Advances in Robotics*.

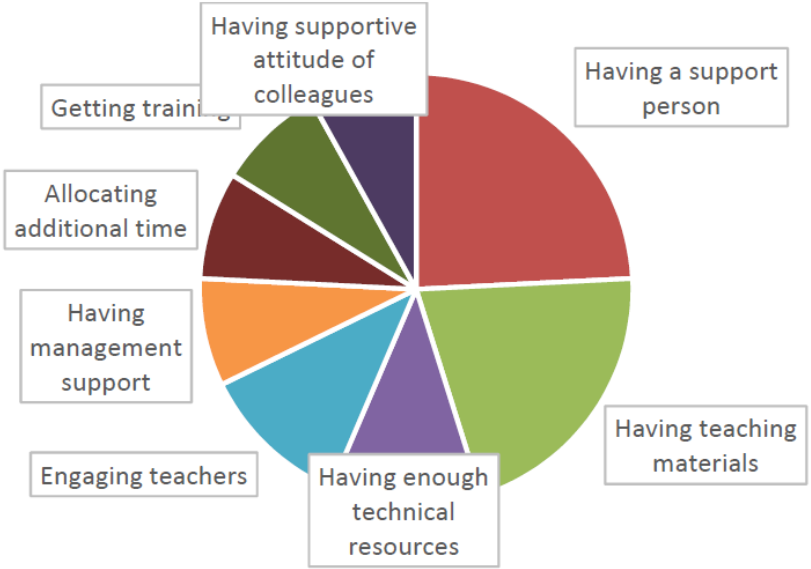


Fig. 4. Areas that need support when using Robomath method.

The Role of Educational Technologist in Robot supported Math Lessons

Leoste, J., Heidmets, M. (2019). The Role of Educational Technologist in Robot supported Math Lessons. *Robot 2019: Fourth Iberian Robotics Conference: Advances in Robotics*.

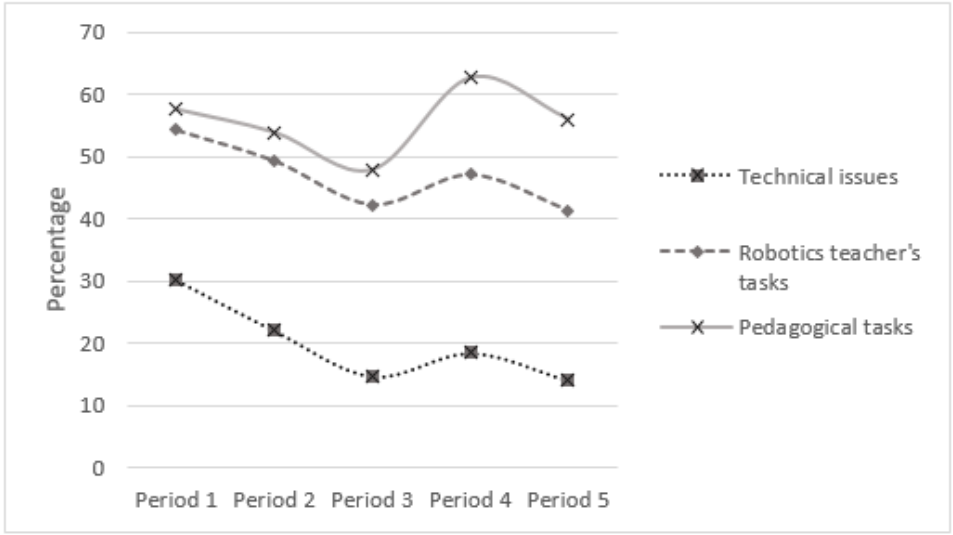


Fig. 1. Percentage of teachers, expressing the need for educational technologist's assistance during the robot-supported math lessons in the 3rd grade.

Using Robots for Digital Storytelling. Teaching Human Rights for Primary School Students.

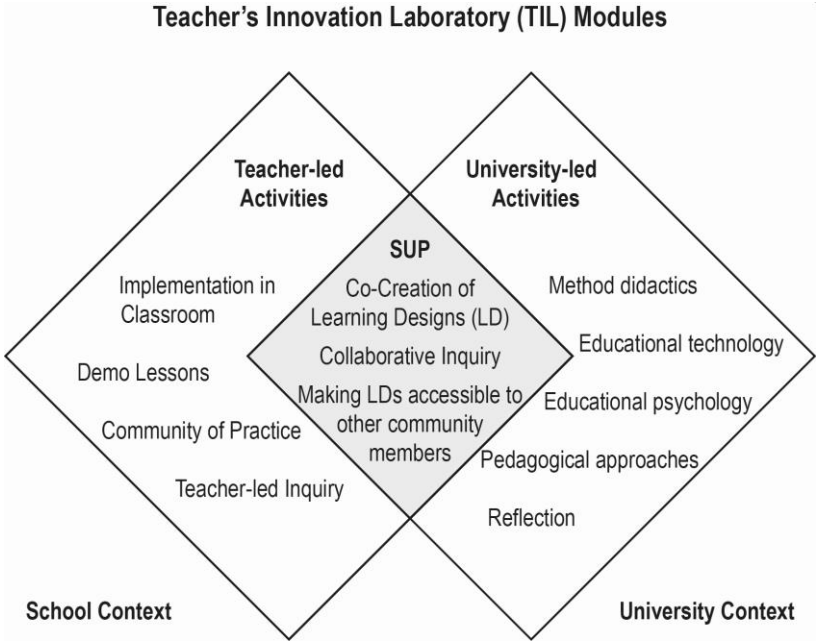
Leoste, J., Pastor, J., San Martín López, J., Garre, C., Seitlinger, P., Martino, P., and Peribáñez, E. Submitted.

- Telling stories and playing games are important for the development of children language, cognitive and social skills. Using robots as characters of digital stories and agents of embodied cognition will further advance children's creativity, teamwork and other 21st century skills. Additional use of gamification techniques improves emotional engagement and helps young children more easily grasp abstract concepts.
- In this study, we describe a general framework for designing robotics-based board games for primary school students.

Game design testing with children.

Teachers' Innovation Laboratory conceptual model

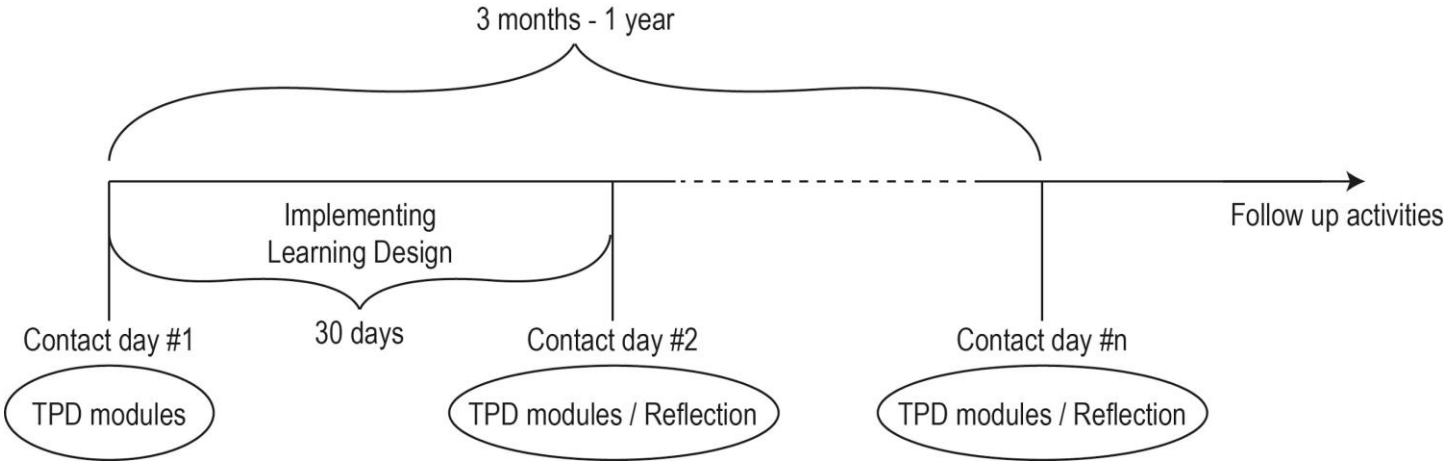
Leoste, J., Tammets, K., Ley, T. (2019). Co-Creating Learning Designs in Professional Teacher Education: Knowledge Appropriation in the Teacher's Innovation Laboratory. *IxD&A Interaction Design & Architecture(s).* http://www.mifav.uniroma2.it/inevent/events/idea2010/doc/42_7.pdf



Modules of the TIL Teacher Professional Development Program.

Teachers' Innovation Laboratory process model

Leoste, J., Tammets, K., Ley, T. (2019). Co-Creating Learning Designs in Professional Teacher Education: Knowledge Appropriation in the Teacher's Innovation Laboratory. *IxD&A Interaction Design & Architecture(s)*



Suggested timeline for TIL. See more on: https://edulabs.ee/eapril/

Open interactive digital learning resources to be created in 2020

- STEAM K12 for students and in-service teachers.
- Robots and STEAM in kindergarten.

STEAM K12 for students and in-service teachers

Motivation

- Graduating teacher-students tend to not have enough ICT skills to employ TEL in their learning practices.
- Teaching teacher-students on *how to use educational technology* doesn't contribute enough to their technological-pedagogical-content knowledge.
- Female students tend to be not enough interested in STEAM in general,
- Teaching STEAM and TEL is not something you can teach without hands-on experience - and for experience you need learning designs.
- When learning STEAM skills, teachers student has to sit on two chairs: a learner and a future educator.

STEAM K12 for students and in-service teachers

- **Aim:** Provide teacher-students with digital skills and courage to use different STEAM tools (robotics, sensors, virtual and augmented reality, electronics, and statistics) in their teaching practices. For fullfilling that goal we have planned to produce dedicated interactive digital resources.

- **Expected results:** Tallinn University's Institute of Educational Sciences has developed a compilation in English and Estonian, consisting of 20 learning designs. This compilation is based on 5 real-life interdisciplinary social challenges, for 4 school levels. The volume of each material is 4 academic hours. The materials are used for teaching teacher-students but also by them during their practice period when teaching school pupils.

Example of Kindergarten Learning Design

Topic: Santa Clause from Lapland
Robot: Ozobot as a line-follower
Aim: Engaging children to learn long poetry
The role of the robot: Robot as an embodied agent to get and keep children attention while learning
The development of different skills:

- General skills: Child practices teamwork: observes the movement of the Ozobot robot on board game and, together with team mates, recites a relevant verse.
- "I" and the environment. Child uses the Ozobot robot to reveal changes and differences in the nature of Estonia and Lapland during winter.
- Language and speech: Child learns a Christmas poem through game.
- Math: Child counts activities on the path passed.
- Art: Child makes a Christmas card for his/her family.
- Movement: Child moves with Ozobot on the game board
- Music: Child uses certain rhytm for reciting a verse.
- Check out the video on link http://bit.ly/2QkZhe1

An usual Christmas Eve in ordinary Estonian kindergarten

http://bit.ly/37vwHMW

Looking for research projects and international partnership in further developing the EDUSPACE concept emphasis on robotics and STEAM

and implementing it in other countries.

Slides: http://bit.ly/2ZNIqUo

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