Baltic and Nordic K-12 Teacher Perspectives on Computational Thinking and Computing

Arnold Pears, pears@kth.se
Valentina Dagienė, valentina.dagiene@mii.vu.lt
Eglė Jasutė, egle.jasute@mii.vu.lt

NordNICE - Nordplus Network on Innovative Computing Education -

Project period: 07/2015 - 11/2017

Universities

- Aalto University (FI)
- Åbo Akademi University (FI)
- Uppsala University (SE)
- KTH School of Education and Communication in Engineering Science (SE)
- University of Latvia (LU)
- University of Tartu (EE)
- Linköping University (SE)
- **Vilnius University** (VU)

Schools

- Sotunki Upper Secondary School (FI)
- Lumo Upper Secondary School (FI)
- Vilnius Jesuit Gymnasium (LT)
- Vilnius Lyceum (LT)
- Söndrumskolan F-9 (SE)
- Trönningeskolan F-9 (SE)

Aim of the project

- To **expand collaboration** between school teachers and researchers in the fields of computing education and teacher education.
- To develop frameworks for computing teacher training in the partner countries.
- The network activities were designed to facilitate extensive collaboration between educators, teachers, and researchers in computing teacher education, both in pre-service and in-service training.

Workshops for teachers and schools visitations

- Challenge: CS in primary education in Lithuania
- Challenge: CS as separate subject in Sweden
- Tools – MOOCS - for teaching CS in Finland
- Tools for teaching CS in primary school in Lithuania
- Good practices in Tartu schools, Estonia

Aim of the study

- To obtain a broad picture of the attitudes and associations of teachers in relation to central **concepts in computational thinking** and **computing**

Status of Computing in School Curriculum

	Status	Topics	Exams
Lithuania	Compulsory in 5-10 grades (in the future 1-10 grades)	Computer literacy and applications, programming	One part (over 50%) is allocated to programming, while the rest concerns the issues of computer literacy and application
Finland	Integrated in all subjects	ICT-related skills and programming (from 2016)	-
Sweden	Parts of other school subjects (like Technology and Mathematics)	ICT training focuses on equipping students with the ”how of information”, how to use digital technology, how critical thinking can be applied to the information available on the Internet, etc.	-

Surveys

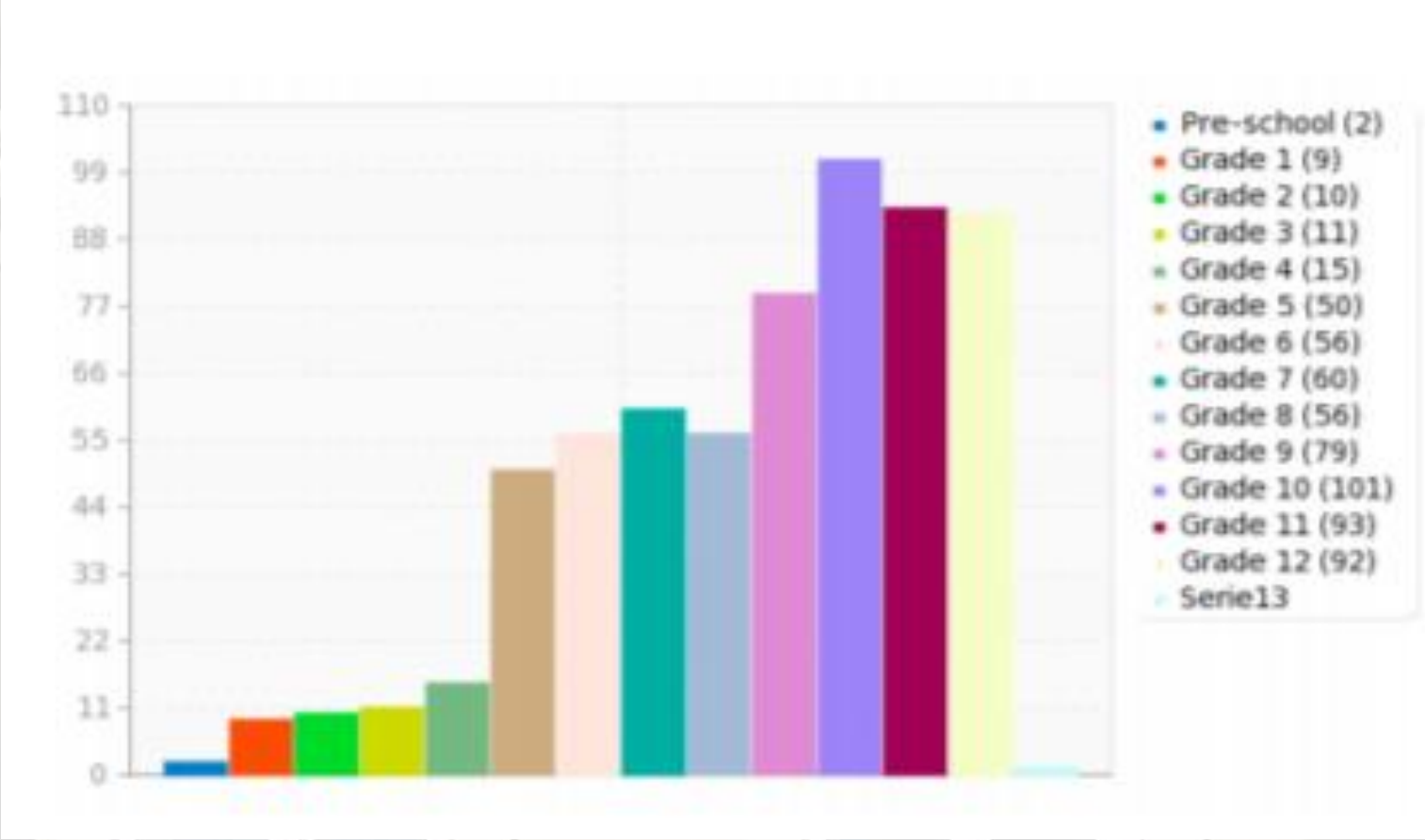
- **Survey I:** to obtain a broad picture of the attitudes and associations of teachers in relation to central concepts in computational thinking and computing identified in prior research.
- **Survey II** uses a purposeful sampling approach with the intention to select responses which represent a heterogeneous (maximum variation) sample.

Survey I respondents

- 144 respondents.
  - **Lithuanian** teachers dominate the sample, contributing approximately 2/3 of the respondents,
  - **Swedish** teachers comprise most of the remaining 1/3,
  - **Finnish** teachers approximately 6% of the total sample.

Respondents Teaching Level

The majority of the respondents were directly involved in teaching computing and IT concepts in their schools.

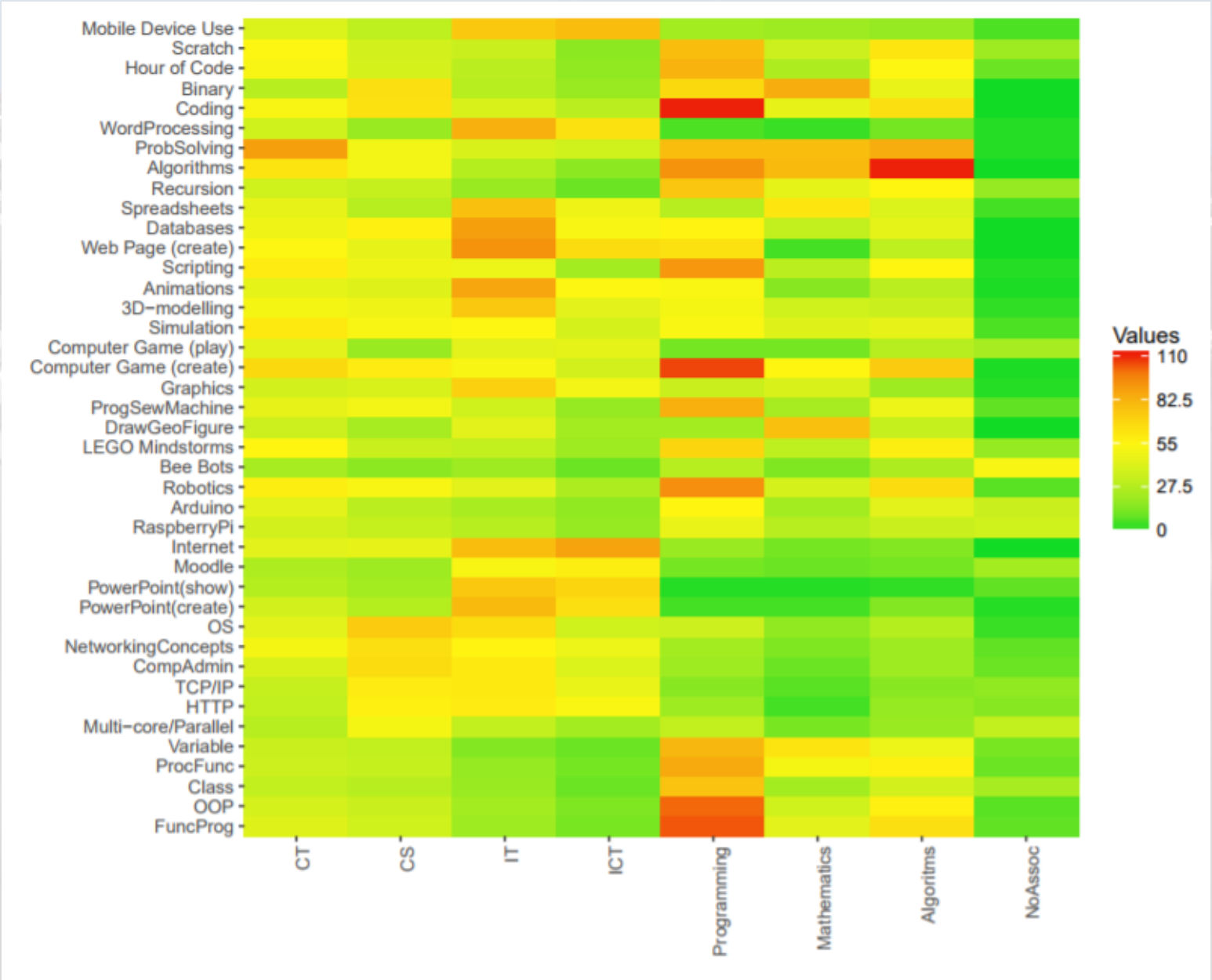


Question of I survey:

To what extent do students participate in the following activities in your classes?

- **Gathering and selecting information**
- **Making sense of data, finding patterns, drawing conclusions**
- **Representing data in graphs, charts, words, images, tables, etc.**
- **Breaking down tasks into smaller parts - decomposition**
- **Planning and organizing sequences of steps taken to solve a problem**
- **Reducing complexity to define main idea, finding characteristics and defining models**
- **Using or creating simulations, e.g. for running experiments**
- **Recognizing how technology can help to accomplish new tasks that would otherwise be too repetitive, infeasible, or difficult**
- **Organizing resources to simultaneously and cooperatively task solving**

Heat Map of Teachers' Concept Associations



Survey II sample

- Purposeful sampling approach with the intention to select responses which represent a heterogeneous (maximum variation) sample.
- 3-5 schools in each country using engagement with computing as a primary variable for selection.
- Teachers who are already actively teaching computing content as well as teachers in schools where teaching of computing content was not yet implemented.

Survey II respondents

Country	N	Teaching	Levels
Estonia	**9**	2@ < 5 years, 3@ < 5-10 years	Grades 2-12
Latvia	**6**	1@ > 11 years, 5@ > 20 years	Grades 4-12
Sweden	**9**	3@< 5years , 2@ > 5 years, 2@ >11 years, 2 @> 16 years	Grades K-12
Finland	**7**	1@ < 5 years, 2@ > 16 years, 4@ > 20 years	Grades 1-12
Lithuania	**14**	6@ > 5 years, 1 @> 16, 4 @> 20 years	Grades 1-12

Questions of II survey: **Identifying Challenges**

- Teachers were asked to **reflect on teaching challenges they had experienced** ...
  - How important do you feel it will be for your students to have computing knowledge in their lives and careers? How have you learned about computing? Which ways of learning about computing have you found to be most successful? What computing topics do you mainly teach? To what extent do students participate in the following activities in your classes?
- ... and **teaching practices** they adopted
  - Describe at least one teaching activity or lesson where you felt that you failed in introducing aspects of computing in your teaching. What made the experience feel like a failure? What did you learn from it?

Teachers:

- ”Younger students didn’t find appealing making graphs in Excel because they don’t know much about statistic in math yet. I must make graphs about topics that are relatable to their everyday.”

- ”I am not at all as in control of the situation as I usually am, since I am not a particularly good programmer myself. The students manage to solve most problems themselves, but sometimes it feels very frustrating not to be able to help them when they get stuck.”

Challenges and actions

- The NordNICE project established a number of direct actions to support the lack of support perceived by teachers.
- The project repository collects teaching materials from the project school partners helping to create a Nordic and Baltic repository of educational resources which can support teachers at all school levels.
- The project has developed translations of Bebras task cards for different age groups into several European languages, including Finnish, Swedish, English and German.
- While the NordNICE project conducted a series of in-service training activities for teachers, and organized network events where groups of teachers from the participating countries made site visits to each other's schools and met to exchange ideas, and observe practices, much more focus on such initiatives is needed.

Conclusions

- The increasing dependence of our society and citizens on digital services, products and systems makes the revision of curricula to include new skills which empower future generations to manage a digital world vital to our future wellbeing.
- This paper provides **Nordic and Baltic school teacher perspective on this challenge and in particular how well governments, the teaching profession and teacher training institutes are meeting these challenges**.

Suggestions

- It will be necessary to **restructure teacher training programmes in all subjects** to provide appropriate computational thinking and computing content knowledge to future teachers.
- Without such an investment the new curricula are at risk and pupils left without an appropriate high quality education.
- Failure to attend carefully to these issues, especially failure to invest in teacher training, places the future industrial competitiveness of the Nordic and Baltic regions at risk.

Future plans

- The NordNICE project is a first step towards an integrated approach that draws together expertise from Computing Education Research in Higher Education, in-service teachers as mentors and coaches, and teacher training programmes to generate new approaches and provide access to innovative materials.
- Larger national programmes should be created to support teacher's professional development over the next five years as the new curriculum is introduced.

Thanks

The authors gratefully acknowledge the support of the Nordic Research Council through the NordPLUS programme of transverse actions. In particular the funding of the two year network initiative, NordNICE, under project code NPHZ- 2015/10153.