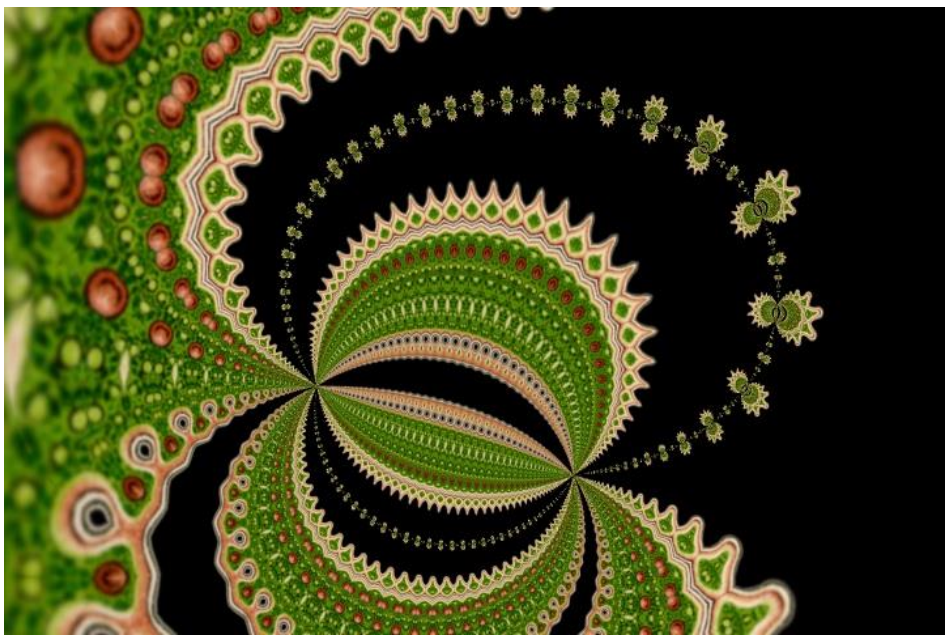
27. 04. 2017.

University of Jyväskylä - Cambridge Mathematics Mathematics Education Research Kaleidoscope

Venue: FI-40014, University of Jyväskylä, Mattilanniemi 2,
Agora Building, Auditorium 1 (morning), Auditorium 2 (afternoon)

Vladimir Bulatov: Hyperbolic Kaleidoscope II.



Cambridge Mathematics (www.cambridgemaths.org) is a **University of Cambridge** project in partnership with **Mathematics and Education Faculties, Cambridge University Press** and **Cambridge Assessment**. Between **April 25-29, 2017, Cambridge Mathematics (CM)** is hosted by **University of Jyväskylä** and **Experience Workshop Math-Art Movement (www.experienceworkshop.org)**. In addition to **University of Jyväskylä, Cambridge Mathematics** visits **University of Helsinki** and **Heureka Science Center**. Through speaking to policy makers, subject specialist curriculum designers and educational researchers **Cambridge Mathematics** aims to learn about: how the Finnish mathematics curriculum was developed and written (especially primary and lower secondary). Whether there is an emphasis in learning through play, exposures or experiences in mathematics? Any recent innovations in the mathematics curriculum and related research findings? How IT is embedded into the maths curriculum and its assessment?

Venue: Agora, Auditorium 1

9.00 Opening

- Professor Pekka Neittaanmäki, Dean of Faculty of Information Technology in University of Jyväskylä
- Fenyvesi Kristóf, Researcher of STEAM Learning, Department of Music, Art and Culture Studies, University of Jyväskylä

9.15-12.30 Exploring development of curriculum frameworks: Cambridge Mathematics & University of Jyväskylä

Chair: **Osmo Pekonen, Mathematician & Science Historian, University of Jyväskylä**

Speakers:

- **Lynne McClure, Director of Cambridge Mathematics**
- **Rachael Horsman, Member of the Writing Team at Cambridge Mathematics**
- **Vinay Kathotia, Member of the Framework Design Team at Cambridge Mathematics**
- **Darren Macey, Member of the Writing Team at Cambridge Mathematics**

9.15 Introduction.

Aims, principles, rationale, elements and contributors

Cambridge Mathematics is a collaborative partnership between the University of Cambridge Mathematics and Education faculties, Cambridge University Press, and Cambridge Assessment. During this first session we will introduce the Cambridge Mathematics team, explain the aims of the project, our principles and rationale. We will also share how external contributors have helped the development of Cambridge Mathematics to date.

9.30 Cambridge Mathematics Framework

Design principles

Cambridge Mathematics is developing an innovative curricular framework for presenting and organising the domain of mathematics (early years through high school). We are exploring ways of structuring this framework so as to emphasise the connectedness of mathematics. It will not be tied to the curriculum needs of any single jurisdiction, but we expect it to support curriculum development efforts in jurisdictions across the world. This part of the presentation will centre around the underlying structure we have developed for the framework. This includes our ontology in terms of learning trajectories/pathways and exposures, and the use of a graph database to operationalize it. We will be interested in feedback from the attendees – on the utility and affordances of our framework structure, in particular for coordinating with and informing different curricula.

10.05 Cambridge Mathematics Framework

Content and functionality of Iteration 0

We will share the first draft (Iteration 0) of the Framework for the primary years. The Framework is intended eventually to be a flexible tool to support curriculum design (including design of learning activities and of teaching units/schemes), assessment, professional development and understanding mathematical learning. During this section of the presentation we will demonstrate some of the functionality of our graph database and discuss how it could support a variety of users.

10.45-11.00 Break

11.00-11.20 Deepening mathematical thinking, enjoyment and engagement by Laura Tuohilampi, Mathematics Education Researcher, Department of Teacher Education, University of Jyväskylä

By providing collaborative learning circumstances with open math problems, it is possible to deepen sophistication of mathematical thinking, as well as enjoyment and engagement in mathematics. In Finland, there has been special worry about how to transform mathematical knowledge into mathematical doing: from a theoretical possibility of being able to an actual

competence that students choose to use in their lives. In my presentation, I will describe briefly the frames Finnish curriculum give to math education in Finland, and present how the picture looks like in Finnish math classes at the moment. I will also give some concrete examples about how to make mathematics education meet the goals presented in the title.

11.20-11.40 A brief history and status update on mathematics curricula within the USA by Professor Christopher S. Brownell, Program Director, Mathematics & STEM Education Programs, Fresno Pacific University, USA

Since the dawn of the republic that is the United States of America, mathematics education can be characterized as living through constant swings of a pendulum. The two extreme states of Procedural emphasis and Conceptual emphasis have put educators in constant tension. This paper describes briefly some of the examples of these swings, the persons associated with them, and positions the swings in time. Culture, industry, economics, and social unrest have all had effects on the mathematical curriculum over the decades. We end in the present day with a first-time collection of standards, and a fractured state of discourse about the educational enterprise in America today. Efforts to alter the focus to student thinking, and away from teacher as dispenser of knowledge are underway and progress, while hard fought, continues.

11.40-12.00 Introduction of University of Jyväskylä's Educational Technology program by Leena Hiltunen, Researcher of Computer Science Teacher Education, Faculty of Information Technology, Educational Technology Program, University of Jyväskylä

12.00-12.30 Next steps

Discussion, Questions and Feedback. Moderated by Rachael Horsman & Kristóf Fenyvesi

Collaboration and consultation are core principles of the introduced projects. This is an excellent opportunity to discuss the status and direction of these projects so that our participants can benefit from the range of international expertise present.

12.30-13.30 Lunch

Venue: Agora, Auditorium 2

13.30-14.45 Opportunities for multi- and transdisciplinary learning in Finnish schools

Chair: **Kristóf Fenyvesi, Researcher of STEAM Learning, University of Jyväskylä**

13.30-14.00 Multidisciplinary Approaches and Phenomenon-based Education in the Finnish National Core Curriculum by Iida-Maria Peltomaa & Aki Luostarinen, Education Experts, Otava Folk High School

14.00-14. pm Kids Inspiring Kids in STEAM by Mirka Havinga, teacher in Laukaa School, Leena Kuorikoski, Merja Sinnemäki teachers in Viitaniemi School & Kristóf Fenyvesi, researcher in University of Jyväskylä

14.30-14.45 Discussion

14.45-15.00 Break

15.00-18.00 Collaboration, Technology and STEM to STEAM from Early Childhood to Secondary Education

Chair: **Leena Hiltunen, Researcher of Computer Science Teacher Education, Faculty of Information Technology, Educational Technology Program, University of Jyväskylä**

15.00-15.20 Mathematicising together - Children and Adults in a Pre-School Learning Community by Sinikka Kaartinen, Researcher of Mathematics Education, University of Jyväskylä

15.20-15.40 Technology education in Finnish basic education – Promoting equal possibilities for all pupils to discover technological topics

by Sonja Niiranen, Researcher of Technology Education, Department of Teacher Education, University of Jyväskylä

Technology education has been developed to help people with technology. It has a role in shaping future debates and discourses by developing technological literacy by encouraging critical thinking and by raising awareness of various dimensions of technology. In order to understand technology education in Finnish basic education, it is necessary to consider it within the subject of craft, especially technical craft. In Finland, there is no independent subject called technology education or STEM education in basic education; rather, the education on these topics is currently decentralised and taught through various subjects. Finland's new National Core Curriculum for Basic Education 2014 outlines the major change to integrate craft studies into a subject that includes both technical and textile crafts for all pupils in grades one to seven. It also addresses multidisciplinarity and integration between the subjects and seven overarching themes. One way to develop technology education, would be to broaden it towards so called STEM fields. This could mean that already project-based craft education would integrate and lean more strongly on using knowledge from science and mathematics in solving real-world technology and engineering problems. The hands-on nature of the craft subject helps students conceptualise scientific and technological knowledge and bring it into real world uses. Technical craft and technology education should be developed with an eye towards gender-sensitive learning experiences and pupils should be offered the support and encouragement needed to experience new learning habits. Technology education has the potential to foster pupils' technological literacy in ways that respond equitably to human needs now and into the future.

15.40-16.00 STEAM: Bringing Science, Technology, Engineering, Arts and Mathematics near to families. An overview of early childhood

STEAM-activities in Mäki-Matti Family Park, Jyväskylä by Otto Virkkula, early childhood educator, Mäki-Matti Family Park – University of Jyväskylä

16.00-16.20 Developing GeoGebra textbooks in upper-secondary school mathematics education by Erkki Luoma-Aho, teacher in Cygnaeus School, Jyväskylä

16.20-16.40 Break

16.40-17.00 Teaching, Digitally Rich-Learning Environments and Institutional Innovation on the US West Coast: A Qualitative Analysis of Processes, Pedagogy, and Instructional Design Focusing on STEM by Professor Charla Griffy-Brown (a) and Professor Chihiro Watanabe (b,c)

(a) Graziadio School of Business, Pepperdine University, USA / (b) Faculty of Information Technology, University of Jyväskylä, Finland / (c) International Institute for Applied Systems Analysis (IIASA), Austria

Higher education is critical for innovation, particularly in the digital economy of the 21st century. This qualitative research builds on macro-level quantitative research by Watanabe, et.al. (2017) that explains the co-relationship between trust in teachers, higher education, and digitally rich learning environments enabling economic growth. This follow-up study builds on these findings providing micro-level examples that faculty and decision-makers can use. The qualitative research presented here focused on the following questions: How can faculty leverage digitally rich learning environments? What specific instructional design examples provide guidance and principals even for diverse student demographics? To answer these questions, we examined STEM curricula that leveraged digitally rich resources linking elementary school to high-school. We also examined a pathway program linking community colleges to undergraduate completion and ultimately graduate school (MBA with a Master of Applied Analytics or Digital Innovation Concentration). The schools and programs were selected because of the following

criteria: Achievement well above the national average, Increase in student learning outcomes, vibrant local economy, and/or an increase in rankings. Methodologically, this study was built on the qualitative methods of triangulation, structured interviews, curricular mapping and explanatory statistics. Interviews and data were collected from more than 80 faculty, administrators and business leaders across three institutions (elementary, middle school and high school), as well as the Northshore School District which consists of 25,000 students. University data were also included. This analysis validated the econometric dynamics described in Watanabe, et.al (2017) providing concrete examples. Additionally, instructional design was explored revealing principals for leveraging the digital environment. Problem-based team learning and industry collaborative learning were critical instructional design features. Finally, pathways for connecting learning within a flexible institutional system were explained. This research demonstrates the importance of transforming learning environments into creative, digitally-rich learning environments in order to enhance institutional innovation.

17.00-17.20 Co-evolution between trust in teachers and higher education toward digitally-rich learning environments

by Chihiro Watanabe (a,b), Kashif Naveed (a), Pekka Neittaanmäki (a)

(a) Faculty of Information Technology, University of Jyväskylä, Finland / (b) International Institute for Applied Systems Analysis (IIASA), Austria

Based on a powerful notion that the quality of higher education is crucial for innovation in digital economy and that such quality is subject to a conception of trust in teachers to deliver good education and advancement of information and communication technology (ICT), the dynamism of such trilateral co-evolution between them was analyzed. Using a unique dataset representing the above system consisting of the rate of trust in teachers providing good education in the context of quality of education and their social status, of the level of higher education and the state of ICT advancement toward digitally-rich learning environments, an empirical numerical analysis of 20 countries was attempted. In addition, scientific sources inducing this co-evolution was elucidated by bibliometrics approach. It was found that while ICT advanced countries have embarked on co-evolution of ICT, higher education and trust, ICT growing countries have not been successful in this due to a vicious cycle between ICT and trust. Finland's educational success can be attributed to its trilateral co-evolution based on a system enabling the stepwise inducement. The paradox of education productivity in ICT growing countries can be attributed

to disengagement. It is suggested that steady ICT advancement fully utilizing external resources in digitally-rich learning environments may be essential to ICT growing countries in achieving higher education. On the other hand, continuing transcending innovation to transform learning environments into new digitally-rich learning environments should be maintained in ICT advanced countries. A new approach for constructing the above-described co-evolution in a systematic way was thus explored.

17.20-17.35 How to make interactive math material? by Vesa Lappalainen

17.35-17.50 Introducing STEM-Network, Finland (LUMA) by Anniina Koliseva & Lassi Pyykkö (University of Jyväskylä)

17.50-18.00 Closing

18.00-20.00 Inauguration of University of Jyväskylä, Faculty of Information Technology's Agora Collection of Mathematical Art & STEAM Learning: Cocktails & Snacks

Inauguration talk by

Osmo Pekonen, University of Jyväskylä

István Orosz: Self-portrait with Albert Einstein.