

gePlenary talks

Jüri Kurvits

Assessing mathematics outcomes in the digital era

New digital tools and environments in many ways affect students' everyday life. But how do they change the process of learning and doing mathematics in schools? Has anything in mathematics education conceptually changed at all?

Researches are arguing that new pedagogy - pedagogy that corresponds to the digital era, is not just the collection of new methods and practices that teachers are using in the classroom. They claim that it has three major components:

- new partnerships between teachers and students;
- new type of learning tasks; and
- digital technologies for creating something qualitatively different in the classroom.

In my talk, I am going to consider two last components of new pedagogy, and I will focus on assessing mathematics outcomes in the digital era. Also, during the presentation, the new assessment model for Estonian mathematics' basic school e-test with examples will be presented.

Tim Brzezinski

In this online workshop, we will explore many of the tools in GeoGebra 3D Graphing Calculator app and will use these tools to create various constructions. Through this exploratory process, participants will discover how they, in turn, can have their students build within this powerful app so as to naturally lead to many "aha!" moments throughout various curricula (middle-school geometry through multivariable calculus). In addition, we will explore means through which we can have our middle, secondary, and undergraduate students regularly work within a 3D-context to mathematically build models of every-day, real-world objects. We will then use Augmented Reality (AR) to take a few of these constructions and then (virtually) project them in our environment. Through this, participants will be able to virtually explore these constructions (from the inside and out) and test their accuracy.

GeoGebra 3D with AR: Quick Setup Instructions

<https://www.geogebra.org/m/bcdafv8s>

Melanie Tomaschko

GeoGebra offers a set of powerful math tools that are used by millions of students and teachers worldwide to teach mathematics and science. In this talk, I will present and discuss current updates of the GeoGebra applications and demo some of the exciting new possibilities they bring for learning and teaching mathematics. Furthermore, the GeoGebra website and its latest developments will be presented. Finally, an outlook on future developments of the GeoGebra Apps and website will be given.

Thomas Lingefjärd

This talk is about problem solving and programming in GeoGebra, Python and WolframAlpha as programming is becoming a part on mathematics education in the Nordic countries. In my new book I have described about 200 mathematical problems or situations and I have compared how the three different programming environments handle these problems/situations. I am looking forward to sharing some of the programming experiences with you.

Talks (30 minutes)

1. Jonas Hall

Modeling the Zombie Apocalypse (and other things)

GeoGebra is very good at modeling all sorts of situations. With its combination of graphical, algebraic, numeric and probabilistic views and tools it can handle most modeling situations arising in school. Using these tools to solve systems of differential equations allows the student to concentrate on 21st century skills, such as problem formulation, advanced use of ICT and analysis rather than mechanical equation solving techniques. A number of different scenarios are presented together with underlying reasoning of how to formulate the equations, then how to solve them using GeoGebra and some thought on analysis of parameters and presentation of projects.

The project has been presented before.

2. Mikko Rahikka

Galilei's beautiful inclined plane theorem

I have been studying a long time Galilei's Dialogues books in English. Still most of the geometric proofs are very hard to understand because my intelligence on Euclidian geometry is not very good. In his "Discorsi e Dimostrazioni Matematiche, intorno a due nuoue scienze" (Discourses and Mathematical Demonstrations Relating to Two New Sciences) he states in Third Day Theorem VI, Proposition VI "If from the highest or lowest point in a vertical circle there be drawn any inclined planes meeting the circumference the times of descent along these chords are each equal to the other."

We actually have two theorems.

1. Start from the the top of the circle with particles sliding without friction with different angles. At the same time they should be on the same circle.
2. Start from the circumference of the circle so that the planes meet at the lowest point, they should meet at the same time.

What happens after that.

Let's study this with GeoGebra.

<https://mikonfysiikka.wordpress.com/2018/06/13/galileis-beautiful-inclined-plane-theorem/>

3. Digital matriculation exam in Finland - what have we learned?

Lauri Hellsten

The Finnish matriculation exam for the upper secondary school has been fully digital from the spring of 2019 meaning that also the math, physics, and chemistry exams are done with laptops in a closed network using the Abitti-operating system. The students in the upper secondary schools practice using different programs (incl. GeoGebra) to model, solve and approximate different problems at hand in STEM-subjects according to the Finnish curriculum. The curriculum has set goals for the student's ICT-skills that are tested in the matriculation exam.

This presentation will give an overview of the first digital exams, example problems from the exams and solution proposals that include the use of GeoGebra.

4. GeoGebra in the physics classroom - analyzing, modeling and simulations

Lauri Hellsten

My students have been using GeoGebra in the upper secondary school physics courses for analyzing data, modeling different situations, drawing free-body diagrams and solving equations. Personally, I have been creating different simulations and activities that develop the student's understandings about the situations and physics laws at hand.

In this presentation, I will give examples of how GeoGebra has been used by the students in my courses and what kind of different simulations I have created for the students to work on.

5. Silent video tasks and their use as formative assessment

Bjarnheiður Kristinsdóttir

Silent video tasks came up as an idea within the Nordic-and-Baltic-Geogebra-Network in 2014. Since 2016 the tasks have been further developed in collaboration with four mathematics teachers in different upper-secondary schools in Iceland. In silent video tasks, teachers invite students to watch a short silent mathematics film and ask them to work in pairs to prepare and record their voice-over to the video. Next, teachers listen to students' solutions and plan a follow-up lesson in which they initiate a whole-group discussion. The data collection in the first phase of this design research study focused on the teachers' expectations and experiences with the silent video task. Thus, the teachers were interviewed before and after assigning the task, and after the follow-up lesson to better understand their experiences. In this talk I will discuss the potentials of silent video tasks as means of formative assessment.

6. What is an effective way to teach the use of GeoGebra and other ICT in Teacher Education?

Freyja Hreinsdóttir

Since 2010 a course on the use of GeoGebra in compulsory school and upper secondary school has been given at the University of Iceland for every pre-service mathematics teacher and many in-service teachers.

The course is 5 ECTS and focuses on the use of GeoGebra and other software. The goal is that students/teachers will continue to use GeoGebra after the course has finished. In the course every student first learns a few basic features GeoGebra and then makes/adapts his/her own material to be used to teach some specific mathematics. Everyone gives a talk and writes a report explaining the use of their material. During the talk the structure of the course and its efficiency will be discussed.

7. First steps with GeoGebra in IT class

Justé Valdoné Lediené, Jonas Jonikaitis

We will share our experience of GeoGebra integration with information technology lessons. In our school, we decided to make a short introduction course to GeoGebra program tools as a part of the information technology lesson course. Together with math teachers, we made plans for five lessons and put them into action. In our short talk, we will speak about positive results and what can we improve for the next season.

8. Instant feedback in an interactive platform - some illustrative examples

Lene Grøterud Leer, Harald Sande

The Norwegian Centre for Mathematics Education collaborates with Kikora on making interactive learning resources. The Kikora platform provides the students with instant feedback on their work in GeoGebra. In this talk we will present the project and give some examples.

9. Formative assessment with IT

Emīls Veide

Participants will answer questions and think about math problems by using different applications and tools that can also be used for formative assessment: Plickers, Socrative, Kahoot, Photomath, Desmos, GeoGebra, Mathigon.

10. Implementing computational thinking and programming in the new Norwegian math curriculum - Why and how?

Sigbjørn Hals

In this 30 min. plenary talk, I will give an overview of why and how the terms computational thinking, programming and in-depth learning have become central elements in the new Norwegian math curriculum, which will be applicable from August 2020. I will also present the authorities' arguments for emphasizing these concepts and some of the arguments from those who are reluctant to the emphasis of programming in the new curriculum. Finally, I will give some examples of how we, as teachers, can make programming and computational thinking increase motivation and stimulate mathematical endurance in problem solving.

11. The use of GeoGebra and other digital tool in the project Skola2030 (School2030)

Sandra Krauze

The system of education of Latvia is going to change. This year the new curriculum will be introduced in the preschool, next year it will be done in the 1st, 3rd, 7th and 10th grade, and by the school year of 2022/2023 this curriculum will reach every student from preschool to 12th grade included. What changes will it bring? Among other things - digitalisation in mathematics, students will be required to perform several skills not only by hand, but digitally as well. Which digital tools to use and to what extent will be discussed at the conference.

12. Math education in Greenland

Karla Petrussen

I will present math education in general in primary school in my country. We have our own curriculum. The school is divided into three levels. National tests are taken in 3rd and 7th grade. The students finish their schooling with final exams in 10th grade. We have our own teaching material in mathematics, which is in two languages.

I will also talk about written exams in math, where we are in developing process. The project includes IT tools in written exams and it will be a huge challenge. Math teachers are not used to using IT in their mathematics education/lessons.

There are five municipalities in Greenland, and 2-3 of them have decided to give iPads to pupils and teachers, every each students and teachers have it. We don't know how much the teachers includes iPad into their math education.

13. Constructing Quadratic Surface with Nine Points in GeoGebra

Tõnu Tõnso, Rando Tõnso

In this paper we will construct the equation of quadratic surface passing through nine points, using the tenth order determinant. We simplify the equation with GeoGebra CAS and show different resulting surfaces in 3D graphics view. The surfaces can be dynamically altered by dragging the control points.

Workshop (45 minutes)

1. Question time

Jonas Hall

During this session I will attempt to answer any question (preferably about GeoGebra). These can be either technical (e.g. "How do I...") or didactic. If no questions arise naturally I will present medium advanced features of GeoGebra, such as using the probability calculator, using CAS, working with the Fit() command to fit ANY function to a data set, working with the Sequence() command to generate sequences of objects such as sequences of graphs and custom grid lines etc.

Workshop (90 minutes)

1. Probability with Geogebra

Hannu Mäkiö

With probability calculator in Geogebra, some traditional problems which involve for example binomial or normal distributions are easily solved. In workshop we look first these easy ways, then we consider problem types which may need CAS commands. At the end we look hypothesis testing and if there is time enough, how to make some simulations.

2. Building Thinking Classrooms

Anders Sanne

This workshop is based on ideas from Peter Liljedahl (2014, 2018) on visibly random groups working on vertical non-permanent boards. My colleagues and I have tried these ideas with a group of experienced teachers. Now it's your turn!

We will emulate a thinking classroom where you are the students and I am the teacher. I will give you some problems on rational functions to work on in small groups. In the last part of the workshop, we will discuss this experience and how you can take these ideas back home to your classrooms.

How is this related to GeoGebra? It's not, but the given problems on rational functions are well suited for further investigation in GeoGebra. In the workshop we may discuss how this kind of group work can go together with GeoGebra.

Liljedahl, P. (2014). The Affordances of Using Visibly Random Groups in a Mathematics Classroom BT - Transforming Mathematics Instruction: Multiple Approaches and Practices. In Y. Li, E. A. Silver, & S. Li (Eds.) (pp. 127–144). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-04993-9_8

Liljedahl, P. (2018). Building Thinking Classrooms BT - Teaching and Learning Secondary School Mathematics: Canadian Perspectives in an International Context. In A. Kajander, J. Holm, & E. J. Chernoff (Eds.) (pp. 307–316). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-92390-1_29

3. Statistics and Probability in Elementary School

Hannes Jukk, Rita Postov

We will introduce the geogebra book "Statistics and Probability in Elementary School". Various worksheets have been created where the data or questions in the tasks vary. And that's the plan to show how such worksheets have been done.

The Geogebra book contains a work guide for each worksheet (in Estonian), but we attempt to introduce one in more detail in English.

4. How and why graphs of polynomials look as they do and don't look as they don't, with a twist

Anders Karlsson

By integrating step by step, starting with the zero polynomial, we will explore the possible shapes of polynomial curves in one variable up to degree n , where n will be at least 4. We will also encounter a couple of eerie facts about degrees three and four, the proof of which are left as challenges.

5. The two faces of GeoGebra: Teacher prepared self-correcting activities vs students' investigation process

Svetlana Yushmanova

GeoGebra can be used for creating randomised exercises aimed to work on specific aspects of the curriculum. You know your students and want to give them exactly what they need and the ready made tasks in books and on the web are often not exactly what you want. Why not learn to create whatever you need in GeoGebra? Nothing fancy, just some randomly generated dynamic texts. It takes some time, but it is so much worth it.

On the other hand, students can open a clean GeoGebra sheet and investigate. Investigate what? These activities need to be as thoroughly prepared by the teacher as the ones named above. What mathematics is suitable to be examined in the "laboratory" called GeoGebra? How do we give instructions?

6. How to make quality applets for GeoGebra.org

Rikke Teglskov, Bo Kristensen

Are you tired of making applets which looks and feels like something made by a drop-out programmer from the 90'ies?

In this workshop we will present ideas on how to pimp you applets using simple tricks and systematics in choices of colors and building of interfaces.

Among other things, we will be looking at how to

- use RGB color schemes and correct sizing
- make borders and areas
- make empty inputfields in the applet
- use pictures as buttons and illustrations
- making objects untouchable

We will be adjusting existing applets or making new ones from scratch, depending on the needs of the participants. So if you want to, you can bring your own applets and maybe get some new ideas on how to pimp them.

7. How to pose problems when students have access to powerful tools like GeoGebra

Rikke Teglskov, Bo Kristensen

In the Danish schools all the students have powerful math tools available all the time. Knowing this, we need to transform the way we need to teach, since many of the tasks previously performed by the human brain is now being outsourced to the digital tools. If we hand the students an automatic electrical hammer, the task of hitting nails becomes meaningless. Instead we should focus on using the enforced capacity of the student giving to them by the tool, to make something out of the hammer and nails.

This workshop will show a variety of examples of how to use the potential of the dynamic software GeoGebra to help the students understand math concepts even better. This is done by linking the symbolic and the visual representations while exploring math concepts in real-time.

The examples are aimed at children from the age of 6 to 15.