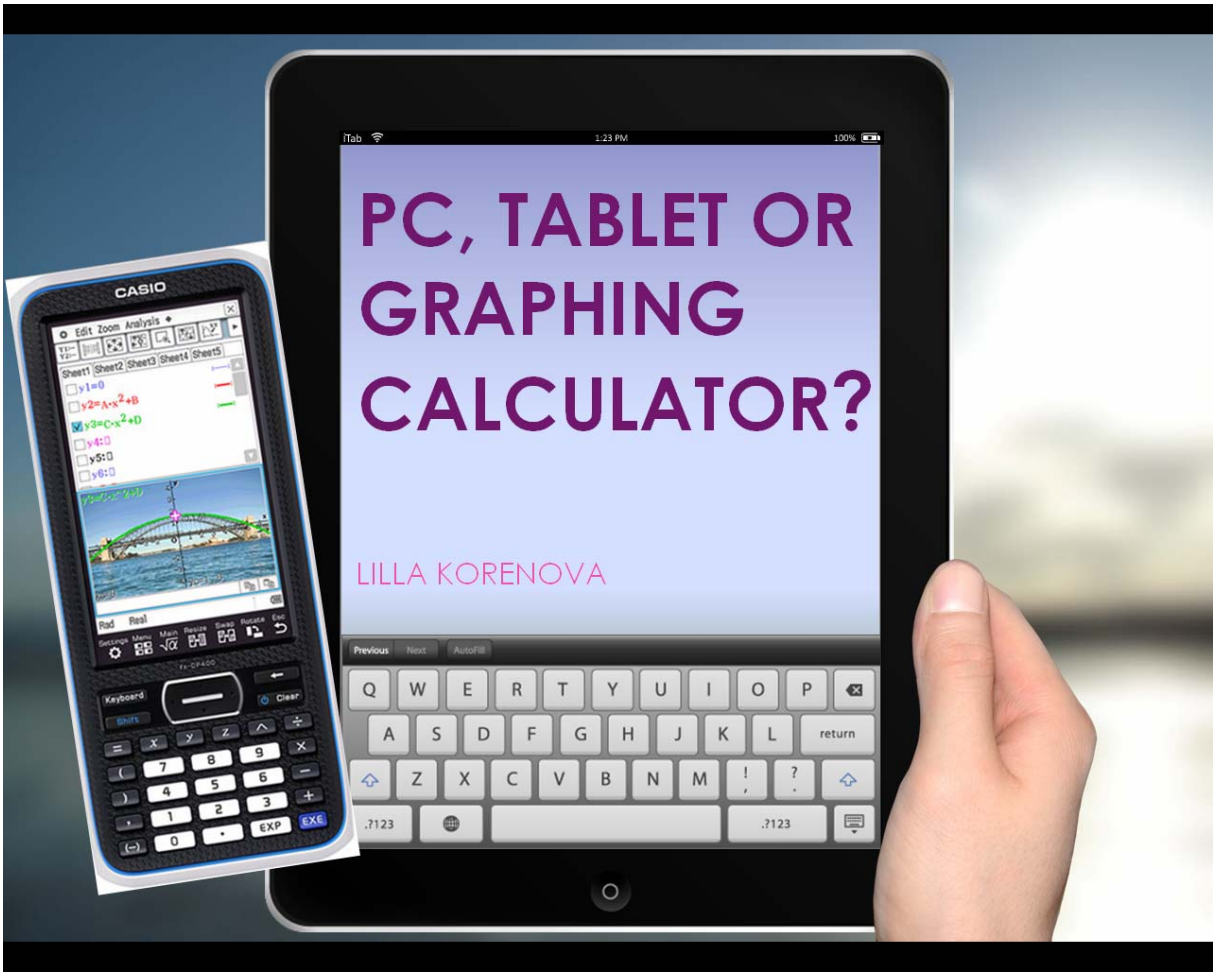
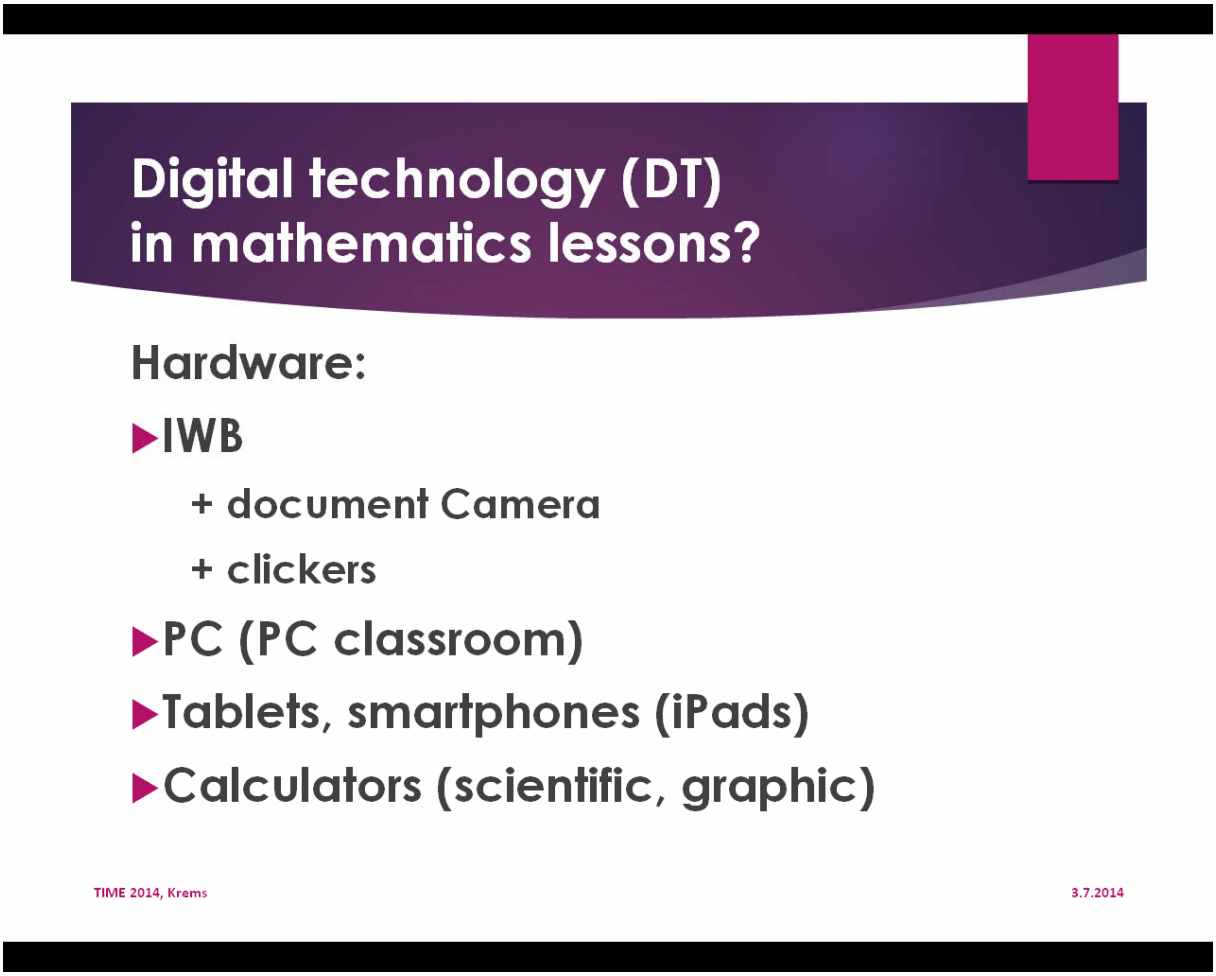

PC, TABLET OR GRAPHING CALCULATOR?
LILLA KORENOVA
CASIO

Today, according to the International Society for Technology in Education for youth are important following competences:

- Creativity and Innovation;
- Communication and Collaboration;
- Research and Information;
- Critical Thinking, Problem Solving and Decision;
- Digital Citizenship;
- Technology Operations and Concepts.

We are able to develop many of these competences also as part of maths teaching, the teaching performed in a digital environment.



At present in Slovakia, a maths teacher at primary and secondary schools can make use during a math lesson of:

Interactive whiteboard

most schools already have several classes equipped with IWB;

Classrooms equipped with PCs

most schools have minimally one classroom equipped with PCs, in such a number that mostly each pupil or a pair of pupils could work on one computer;

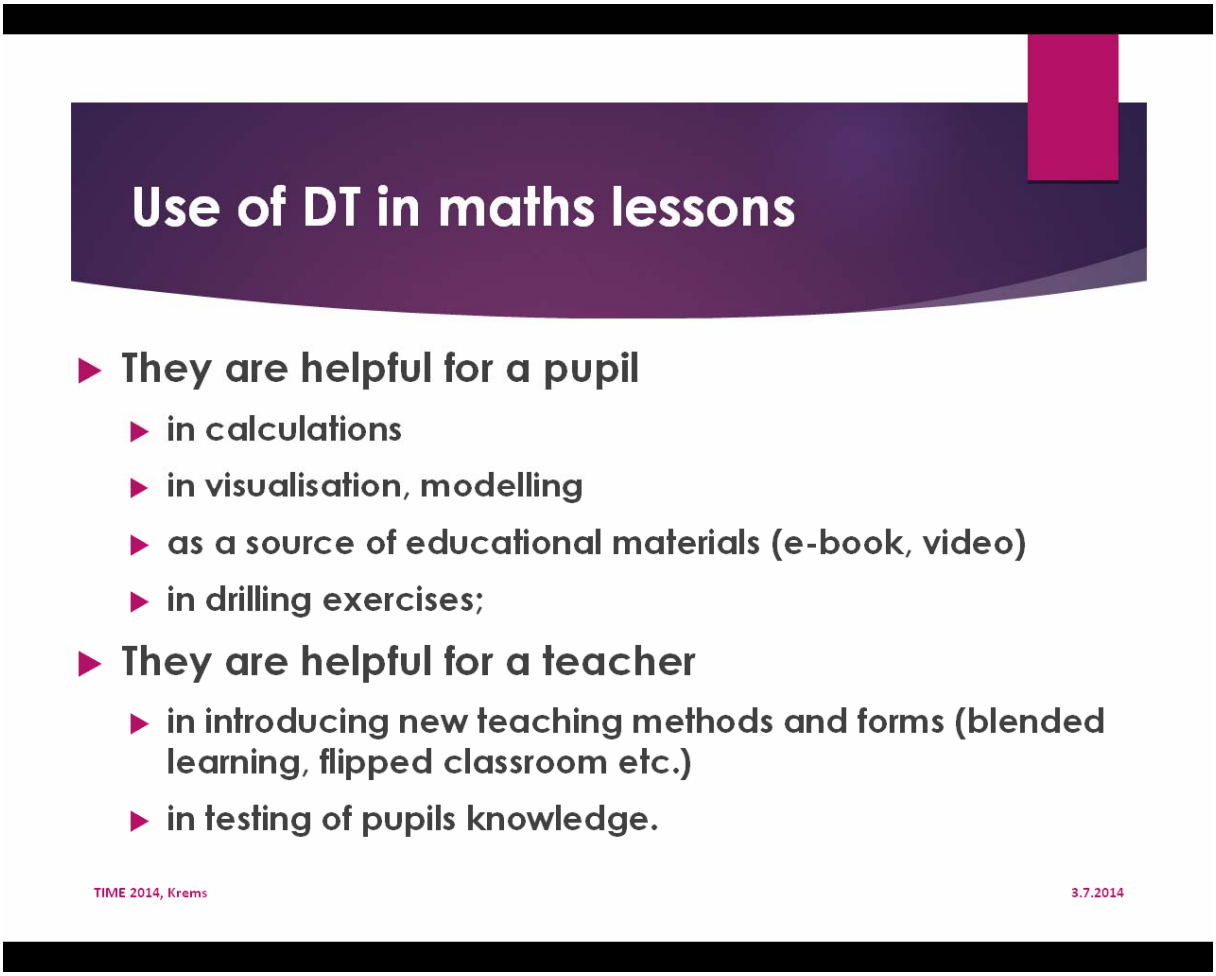
Tablets, smartphones, iPads;

Thanks to the sales policies of the mobile operators, the prices of smartphones and tablets sharply went down and that is why many pupils have their own smartphones or tablets (mostly with OS Android). Last year, the Ministry of Education launched a project in the framework of which about 5 000 IWB, 5 000 NB and 20 000 tablets were bought for schools.

Calculators

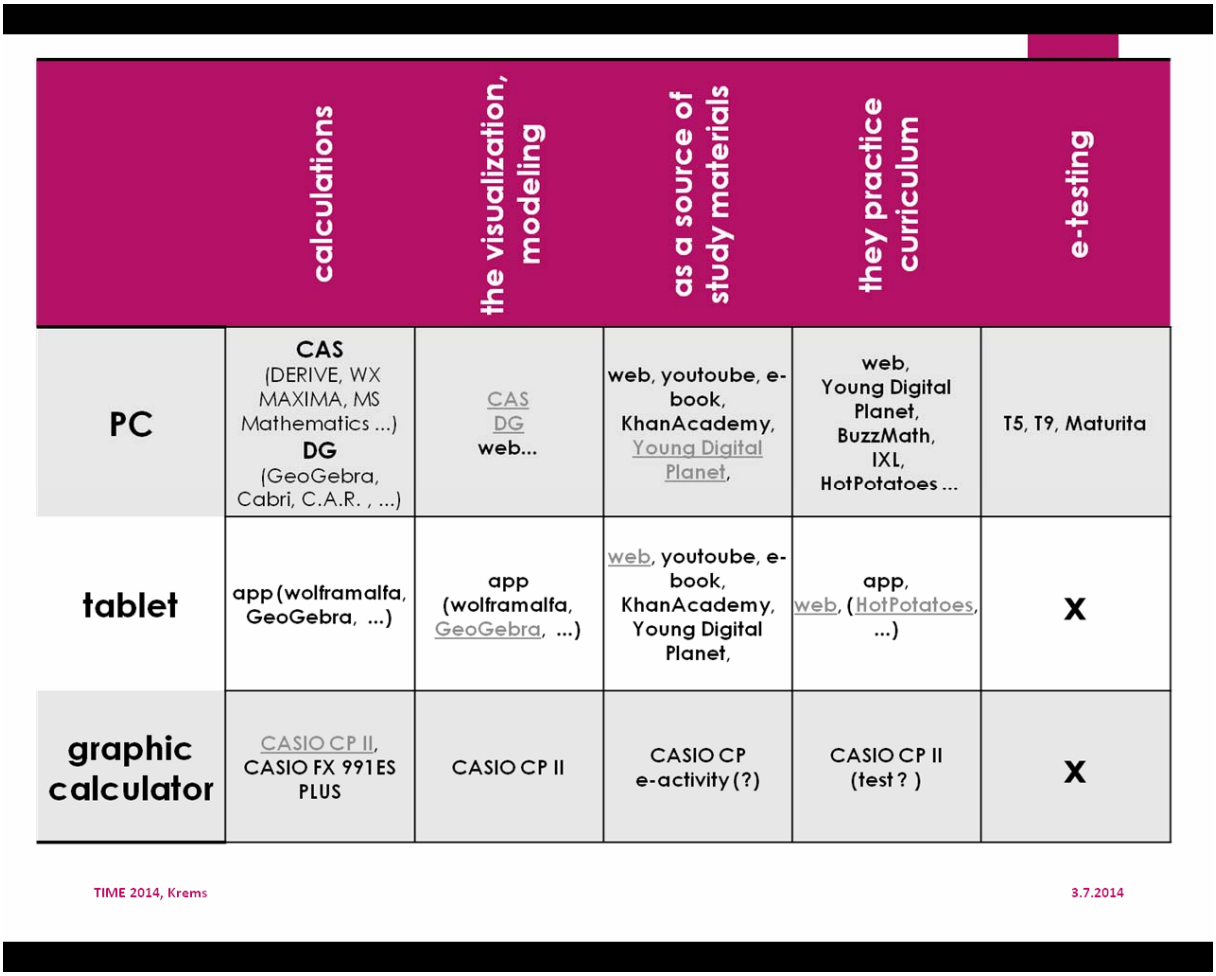
Scientific calculators are common at the maths lessons from the 7th class of primary school, graphic calculators are used in some classes. The reason is that graphic calculators must not be used in the nationwide tests (in the end of primary school or GCSE), set by the Ministry of Education.

We focused on a comparison of using PC, tablets and graphic calculators in maths lessons.



A pupil can make use of tablets and calculators:
at laborious numerical calculations so that he can concentrate on the solution of a problem itself;
at visualisation, modelling and simulation of problems and thus to obtain such a graphical representation of the problem, which push him towards a solution;
as a source of educational materials e. g. e-books or videos, interactive educational materials;
drilling exercises, a pupil can make use of electronic working sheets or e-tests to evaluate himself.

DT offer to teachers a possibility to make use of new educational methods, e. g. constructivist approach, controlled search, workshop method, peer instruction method. DT are very expedient for project teaching, too. Teachers can make use of blended learning, flipped classroom method etc.
Last but not least, the computers are used for electronic testing when knowledge of pupils is measured.



	calculations	the visualization, modeling	as a source of study materials	they practice curriculum	e-testing
PC	CAS (DERIVE, WX MAXIMA, MS Mathematics ...) DG (GeoGebra, Cabri, C.A.R. , ...)	CAS DG web...	web, youtoube, e-book, KhanAcademy, Young Digital Planet,	web, Young Digital Planet, BuzzMath, IXL, HotPotatoes ...	T5, T9, Maturita
tablet	app (wolframalfa, GeoGebra, ...)	app (wolframalfa, GeoGebra, ...)	web, youtoube, e-book, KhanAcademy, Young Digital Planet,	app, web, (HotPotatoes, ...)	X
graphic calculator	CASIO CP II, CASIO FX 991ES PLUS	CASIO CP II	CASIO CP e-activity (?)	CASIO CP II (test ?)	X

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If a teacher uses PC on maths lessons (mostly in a PC classroom, where 1 or 2 pupils are at one computer) he needs a special software or internet pages with an interactive material. At present, in Slovakia are used mostly software as DERIVE (the Ministry o Education bought it for all secondary schools), somewhere also MS mathematics, Graph, Graphmatica which are free. GeoGebra prevails from the softwares of dynamic geometry. Some students use also WolframAlfa (but it is used presumably in universities). These softwares are used mostly for making easier calculations, as well as visualisation and modelling.

The Ministry of Education bought for all schools licence for “planet of knowledge”, what is localized version of Young Digital Planet. In spite of the fact that there are many good materials for primary and secondary schools, there were long discussions about this topic. Materials are suitable for IWB and PC, they are not displayed on tablets.

The Ministry of Education decided to perform some nationwide testing in electronic form, as a pilot testing, e. g. testing of pupils of 9th class as well students passing GCSE exam in maths. A special software is developed for such a testing, ensuring that students cannot communicate with external world, therefore only PC classrooms in schools are suitable for this.

Tablets or bigger smartphones can be used for facilitating calculations. The most used applications are various applications – calculators. The most popular is MyScript Calculator. Secondary school leavers are using WolframAlfa application which can be also used for

modelling and visualisation. GeoGebra has also an application for tablets with an Android as well as for an iPad but it is more convenient from the user's point of view to start a ready GeoGebra drawing or aplet. It is better to use a version for PC if it is a case of more lengthy and complicate constructions.

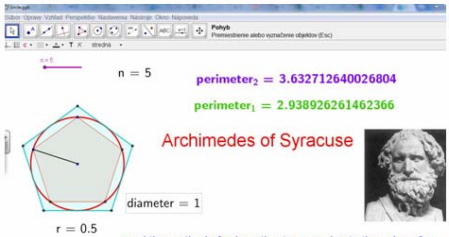
In the last years, many maths teachers developed electronic materials for primary and secondary schools pupils. Many of these materials are tests in HotPotatoes and they are in most cases freely accessible on internet, on school sites or on personal sites of teachers. These HotPotatoes tests are often used on maths lessons, namely on tablets and bigger smartphones. In this way, pupils can drill exercises, they get immediate feedback and each pupil can progress at his own rate. Graphic calculators, unfortunately, are not commonly used in Slovakia. The main reason for this is a fact that the Ministry of Education is not allowing their use for GCSE exam. In some pilot schools graphic calculators CASIO CP and TI 89 were tested. Teachers as well as students confirmed that graphic calculators are very suitable for testing, because except for very good software they do not have internet, chat or SMS, so that students cannot "contact" outside world during the test. Teachers were very happy that during the work with a graphic calculator they were not tempted by internet, facebook etc., on the other hand in PC or tablet they would have been tempted.

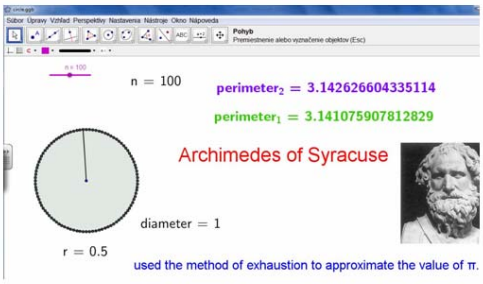
The latest calculator CASIO CP II has an option for developing minor tests for self-evaluation of students; we will bring illustrations later.

At the end of my presentation I will show some examples

Example Method of controlled exploring and exploration method (GeoGebra, PC)

- How to calculate the circumference and the area of a circle? What is the number π?





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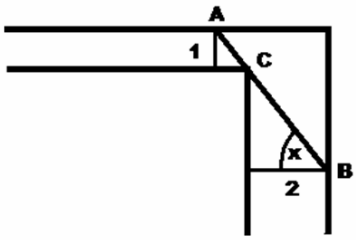
In GeoGebra, students create a drawing:
a circle of radius equal to 1 and inscribe and circumscribe a polygon
Using the Slider they increase the number of the polygon's edges.
Students interactively study the perimeter of both polygons.
The students deduce, that the circle's circumference is a value between them. As we can see on the image, when n is more than 100, the perimeter of both polygons is accurate to 2 decimal places
Next task for the students is to choose circles with various radii and study the ratio of the perimeter of the polygons to the circumference of the circle.
A consequence of correct observation is the discovery of the number π
In the last phase, it is advisable to point out the historic background. Students can, for example, search for information about the work of Archimedes and Euclid in this area.
Such exploring of the number π on secondary schools can be extended on high schools exactly the way Archimedes did it.
In GeoGebra, we create a polygon inscribed and circumscribed to a circle. We express their area (as the sum of their triangles). The students will now study the ratio of these areas to the radius squared.

Example – calculations, the visualization, modeling GC

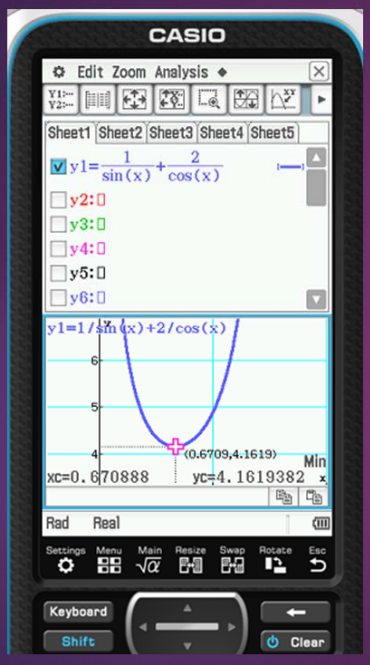
- Carrying a ladder of 4meters and holding it in a horizontal position in a corridor shown in Figure is it possible to turn round the corner? Is there enough room for the ladder?



- A ladder of maximum length which "goes in" that corridor turn at that particular rotation (the angle of the rotation can be given by x) is l(x)

$$l(x) = \frac{1}{\sin(x)} + \frac{2}{\cos(x)}, x \in (0, \frac{\pi}{2})$$

- Using ClassPad plot the graph of the function and find the minimum

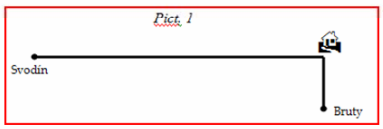


c) It is seen that the minimum of the function is 4.1619381 what means that the ladder of 4 meters can be turned round in the corridor turn.

d) The task can be solved geometrically, too.

Example

c) Field road between two villages consists of two perpendicular straight stages. The longer stage measures 19,3 km and the shorter one 3,9 km. In the point of right angle of this two stages, there is a forlorn house (see pict.)



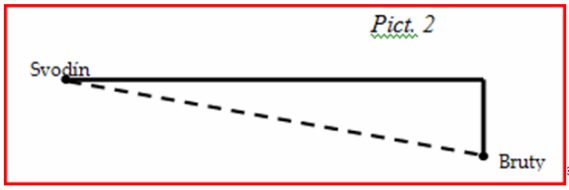
d) A committee decided to substitute this field road with a tarmac road. Deputies of committee have a problem where the new road should lead. Experts estimated that

e) 1km of the new road built on the original field road would probably cost about 182 500€,

f) 1km of the new road built out of the original field road would probably cost about 219 000€.

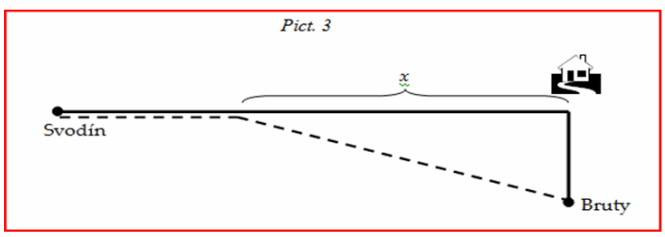
c) The deputy Fajnor proposed that the tarmac road should be built on original field road. He claimed that this would be the cheapest way how to built the new road. How much would this solution cost?

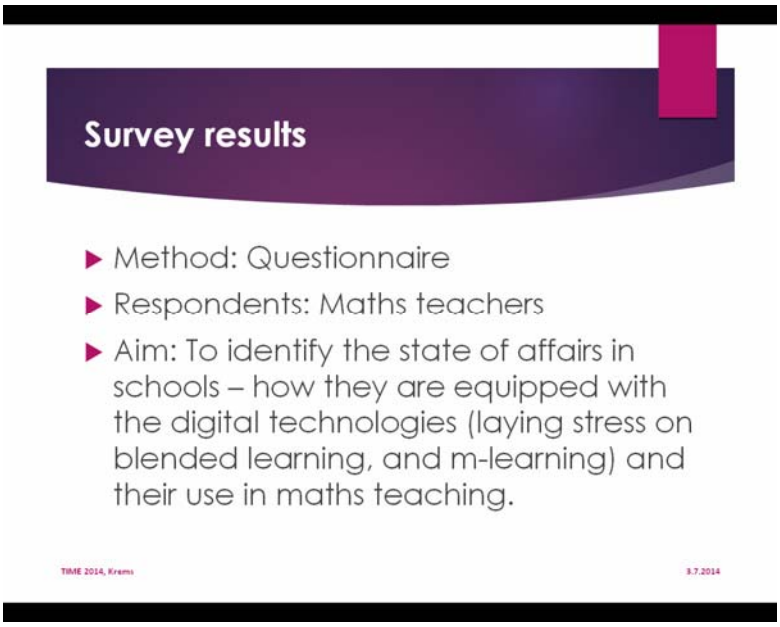
d) The deputy Bucko supposed that the cheapest solution would be to built straight road from Svodin to Bruty. See pict.2. Dashed line display suggested road. Calculate the price of building of this road.



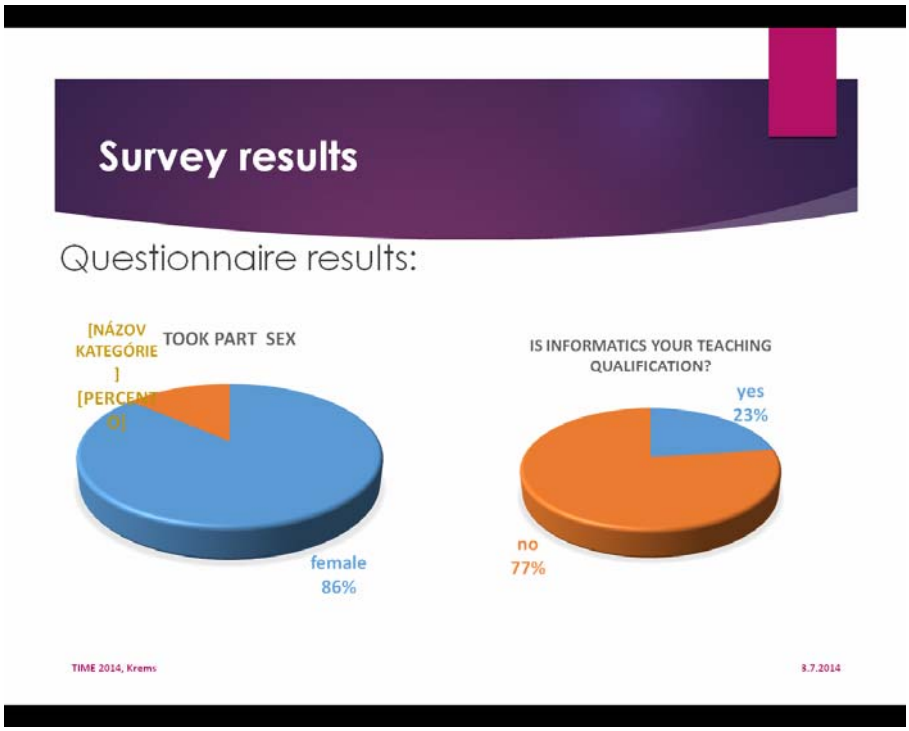
c) The deputy Ferkova proposed a different route: a new road would lead at first on original field road from Svodin and from the specific point would gain a new direction and would lead straight to Bruty. In relativity, where is the specific point, formulate the price of this road. The distance from the point of diversion to the forlorn house mark with letter x (pict.).

MS EXCEL





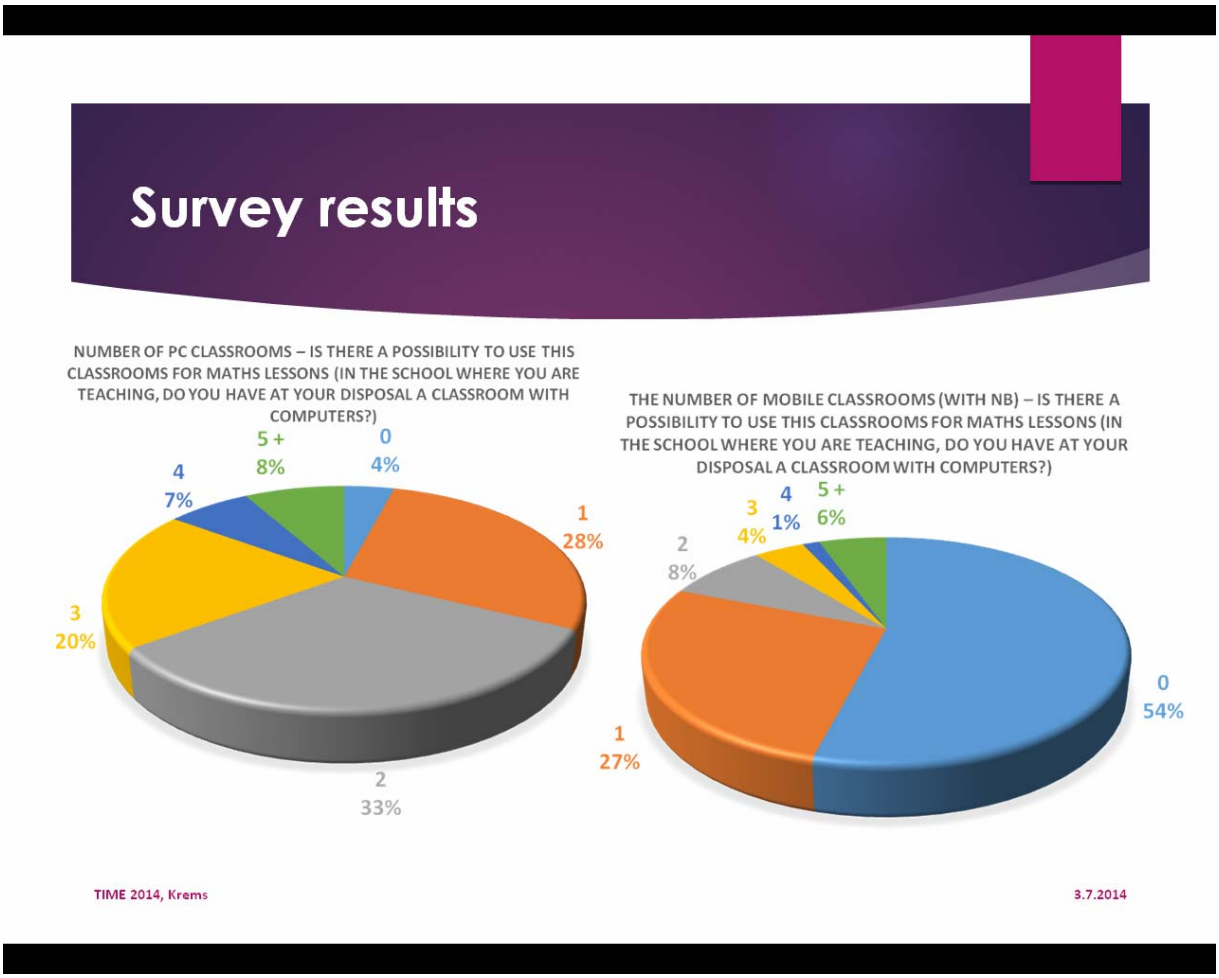
In May and June this year, a survey, using an electronic questionnaire, was carried out. The aim of the survey was to identify the state of affairs in schools – how they are equipped with the digital technologies (laying stress on blended learning, and m-learning) and their use in maths teaching. At the same time, we wanted to find out the influence of schoolings and courses on methods and forms of maths teaching in a digital environment.



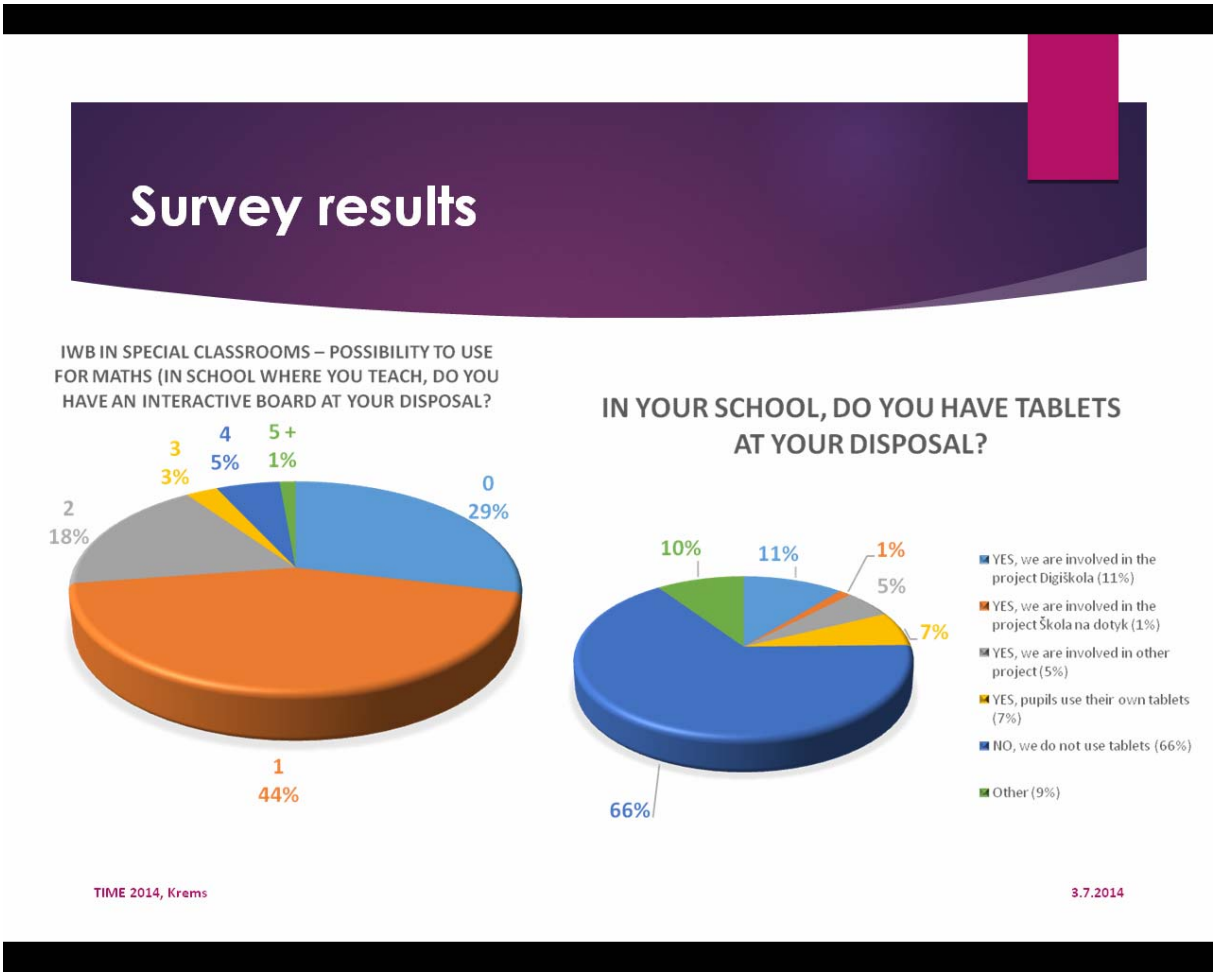
The questionnaire was completed by 74 maths teachers from the whole Slovakia namely 64 women and 10men. 17 teachers had informatics as their teaching qualification, what is less than one third.

Let us suppose that this fact did not skew the results.

One half of the teachers is teaching at secondary schools the other half on primary schools.



28 % of teachers have 1 PC classroom at their disposal, 33 % of teachers have 2 PC classroom at their disposal and 35 % of teachers have even 3 PC classroom at their disposal.
27 % of teachers have 1 mobile classroom at their disposal which means NB for one class.



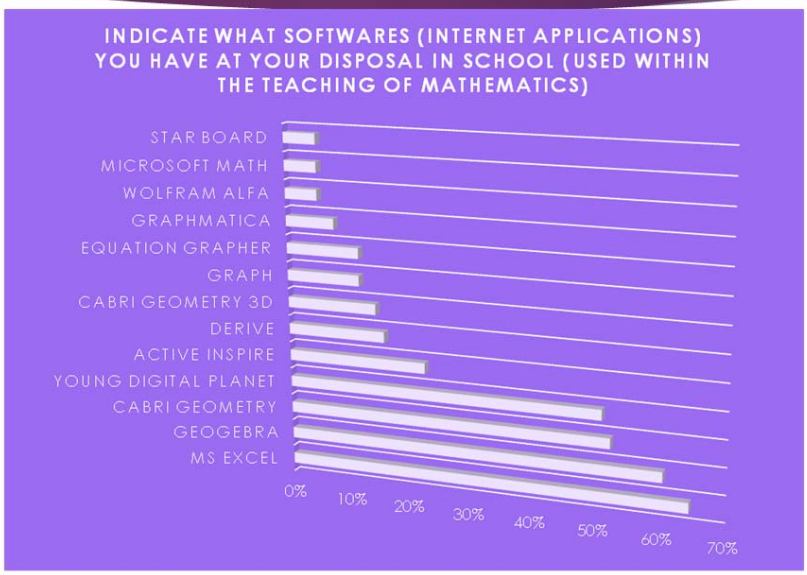
43 % of teachers can use 1 IWB in a maths lesson;

In each school, there are several data projectors in 7 schools they had even document cameras.

In 6 schools, they have class set of graphic calculator CASIO CP.

In 18 schools (of 74) pupils use tablet during maths lessons. Somewhere they are tablet owned by the school (bought through a project), somewhere pupils have their own tablets.

Survey results



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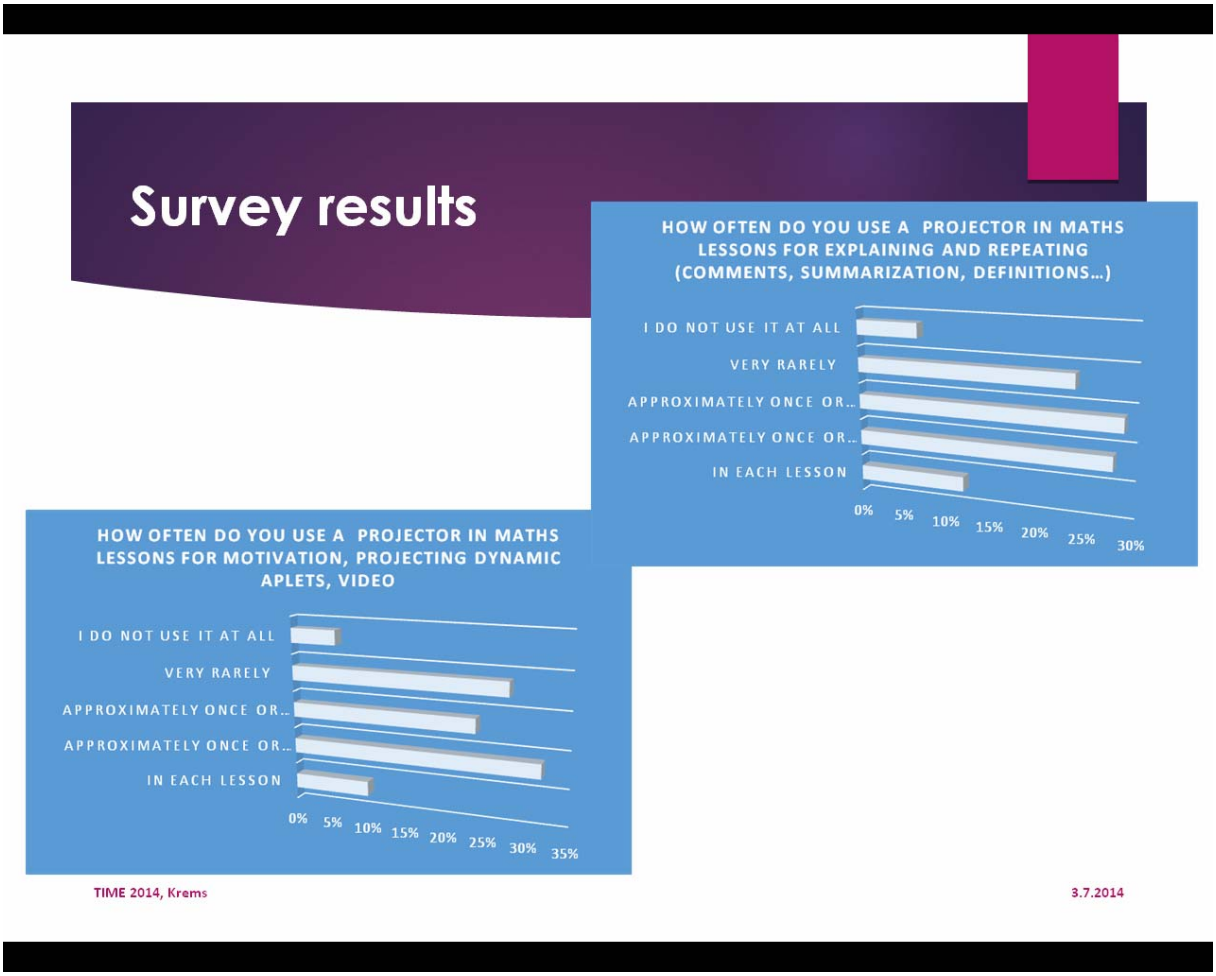
We asked teachers what soft wares they use most often.

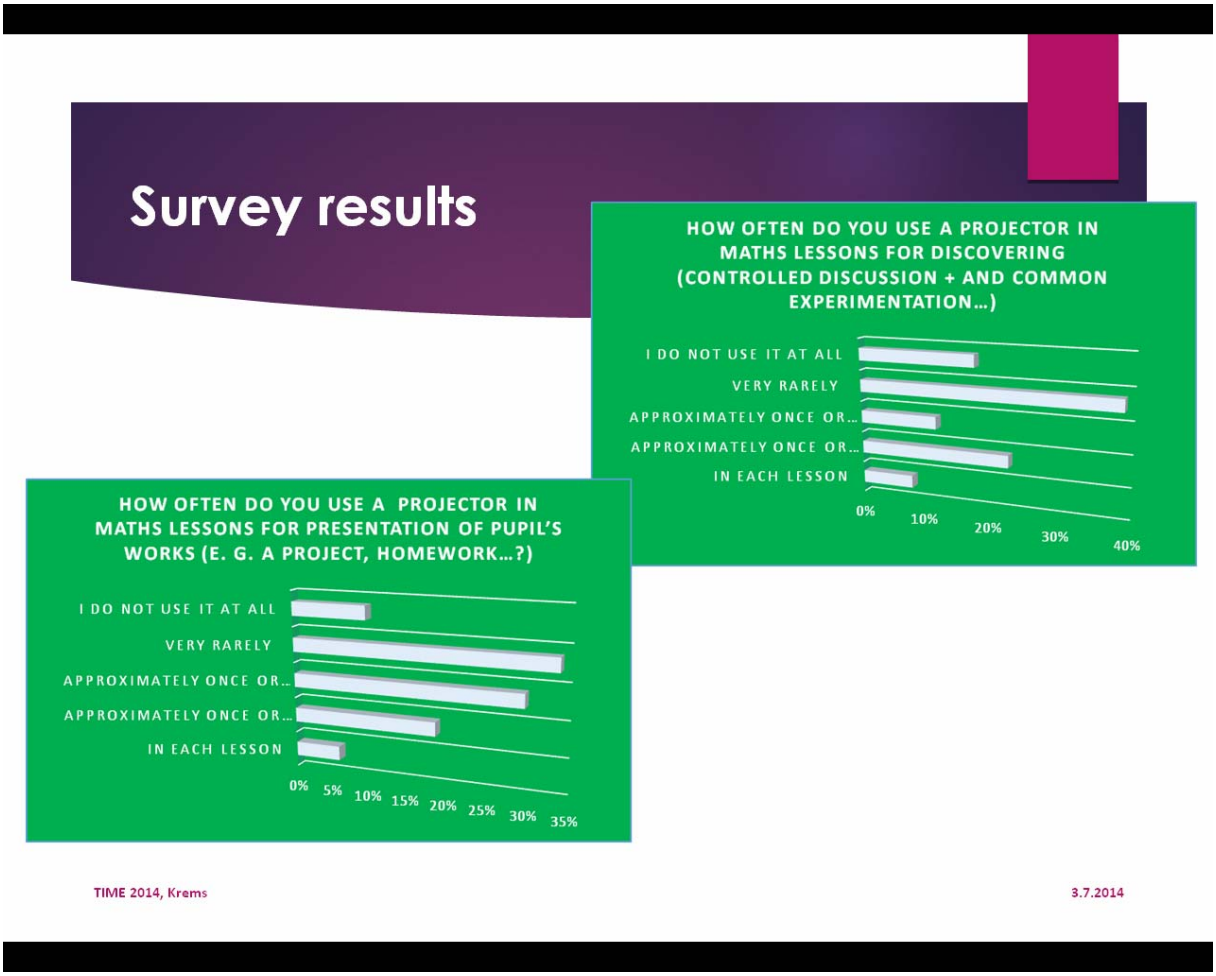
Most of them, 65 % use MS EXCEL, 61 % use GeoGebra, 53 % use Cabri Geometria, 51 % use Young Digital Planet, 16 % DERIVE.

Then soft wares for IWB as 23 % Active Inspire and 5 % Star Board follow.



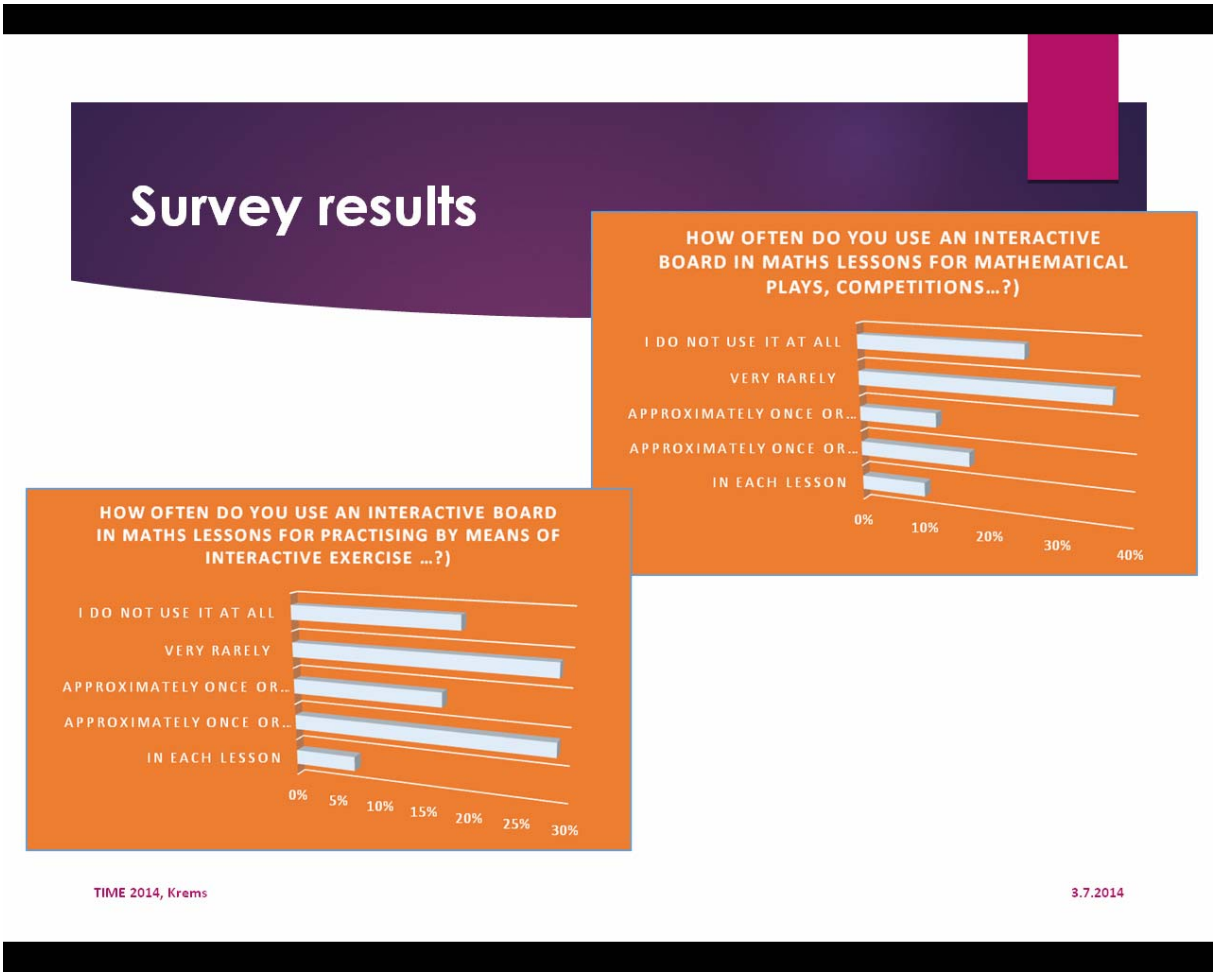
We wanted to know how teachers use digital technologies.
For explaining and repeating, 12 % of teachers in each lesson, 67 % weekly or monthly, 24% rarely and only 7 % do not use DT at all.

10 % teachers use DT for motivation, projecting dynamic applets, video in each lesson, 56 % weekly or monthly, 28 % rarely and only 6% do not use DT at all.

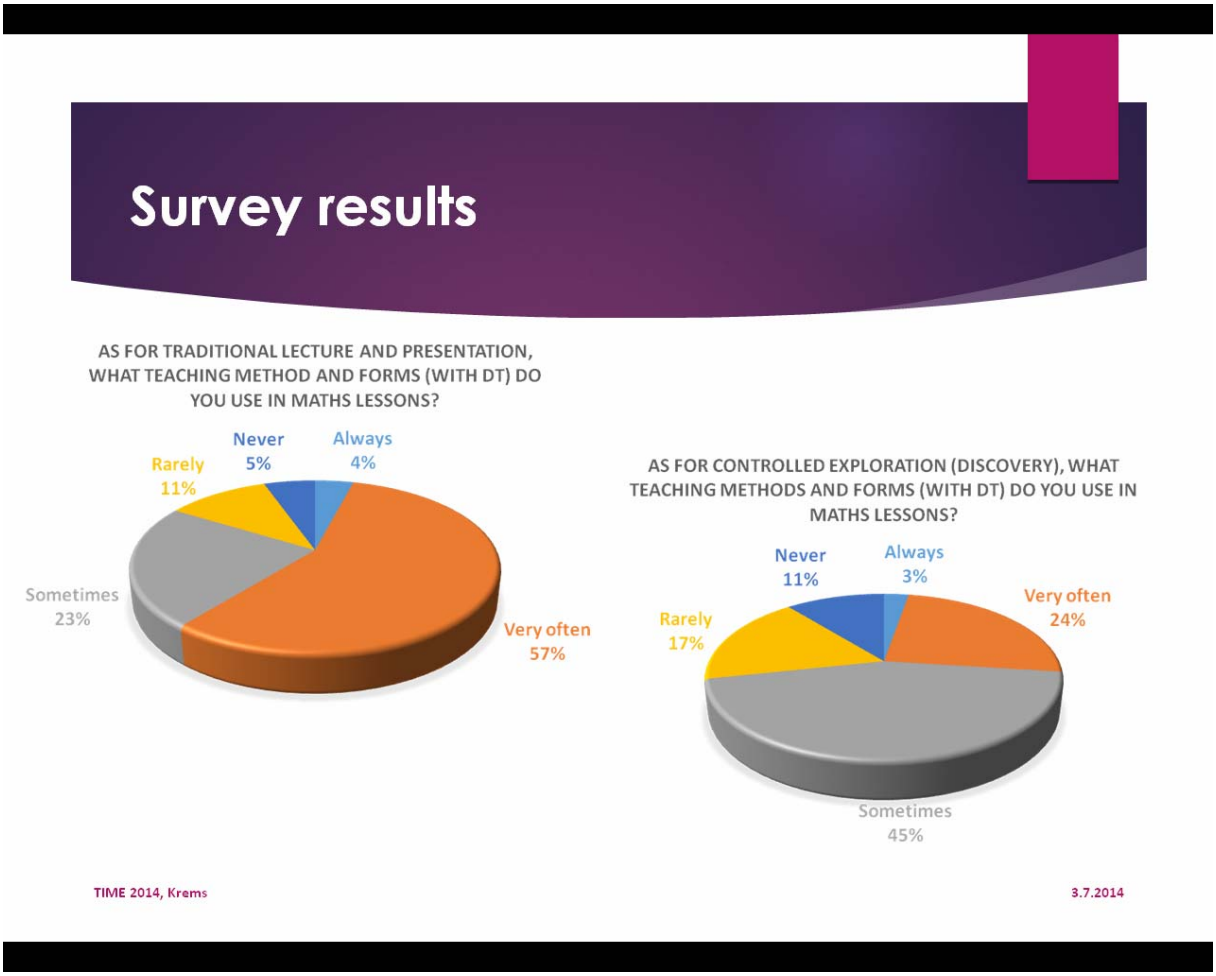


Only 8 % of teachers use DT for discovering, experimenting of pupils, controlled discussion in each lesson, 35 % weekly or monthly, 39 % rarely and only 18 % do not use it at all.

Only 6 % of teachers use DT for project teaching and presentation of pupil's works in each lesson, 49 % weekly or monthly, 34 % rarely and only 10 % do not use it at all.

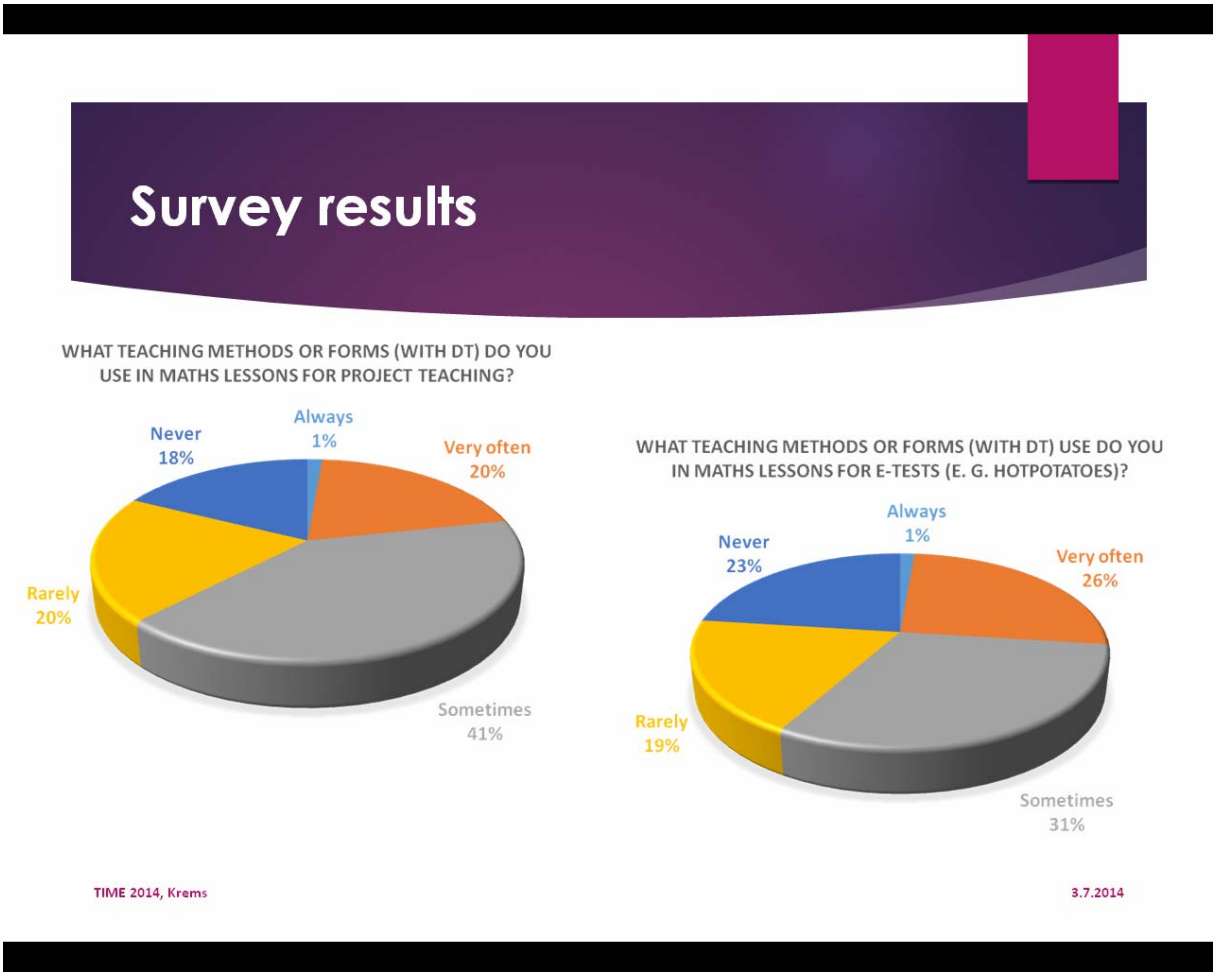


10 % of teachers use IWB for plays and competitions in each lesson, 29 % use it weekly or monthly, 37 % rarely and 25% do not use IWB at all.
7 % of teachers use IWB for practising by means of interactive exercise in each lesson, 46 % weekly or monthly, 29 % rarely and only 19 % do not use it at all.
One school only indicated that it has voting equipment and they use it approximately once a month in maths lessons.
As for tablets, teachers use them for individual work of pupils.

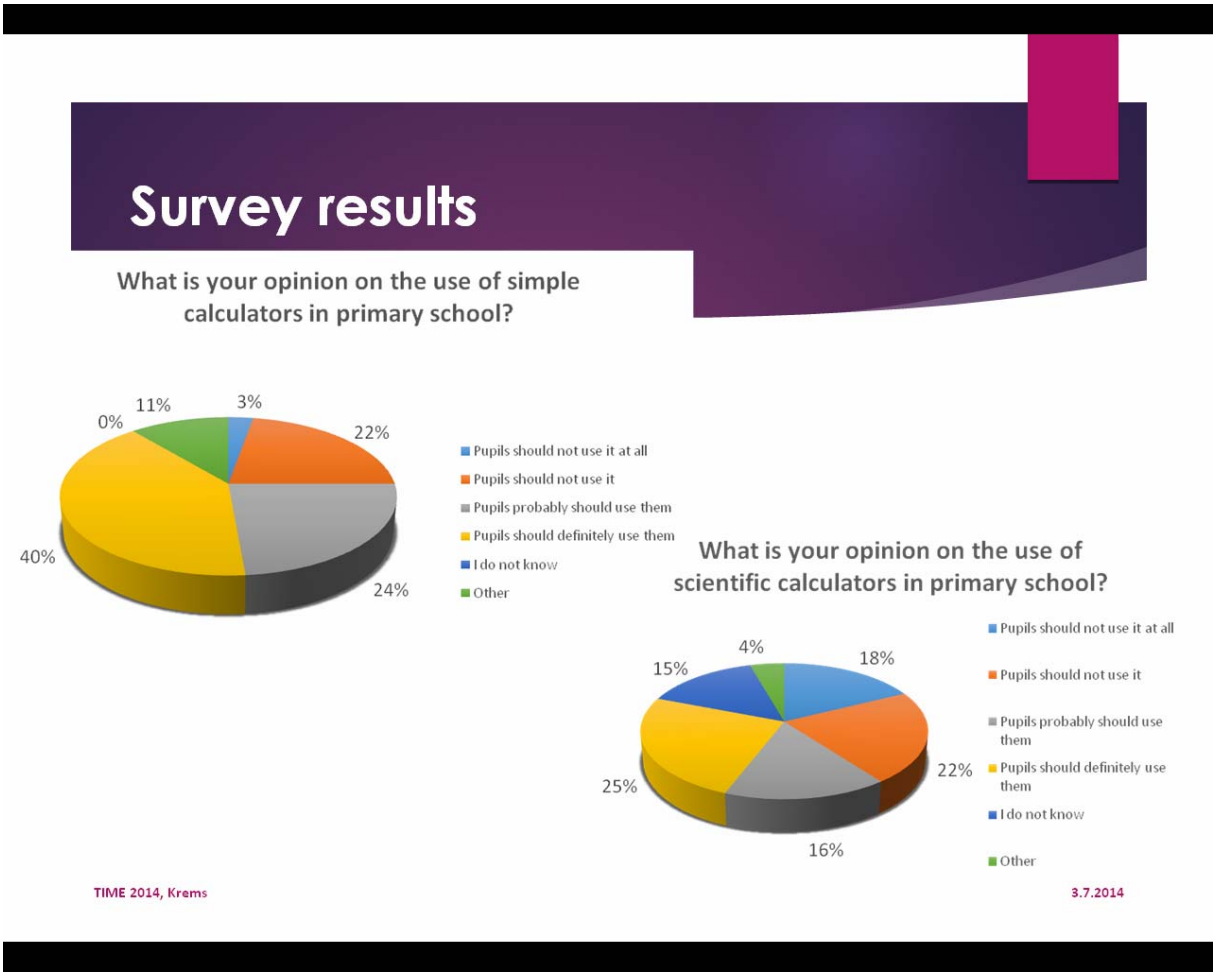


In the last part of the questionnaire, we asked what teaching methods and forms do teachers use in maths lessons (when they use DT).

So many as 84 % teachers use DT during presentations, it means during traditional lecture. 53 % of teachers indicated that they sometimes use DT for the method of controlled exploration (what is a constructivist approach).



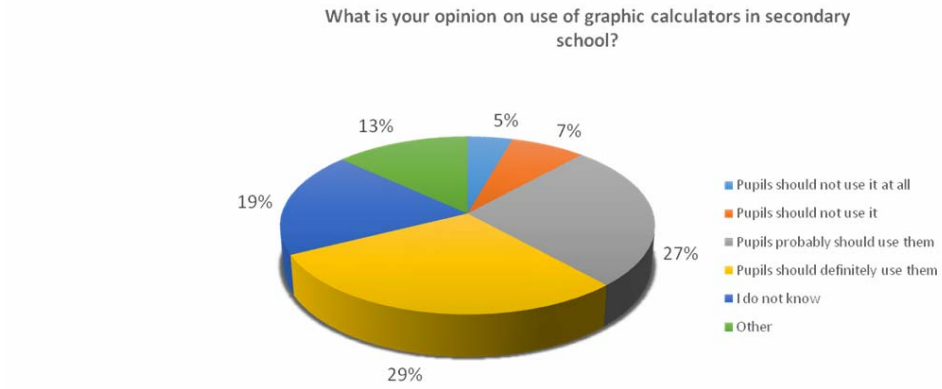
62 % of teachers often or sometimes use a project method with DT.
27 % of teachers use e-tests (e. g. HotPotatoes) for practising very often, 23 % sometimes 14 % rarely and 17 % never.
Teachers practically do not use a workshop method or flipped classroom.
Questions: “Do you think that an appropriate use of DT can stimulate interest for maths among pupils?” and “Do you think that an appropriate use of DT can improve knowledge of maths among pupils?” most of teachers answered positively.



We asked teachers also about their opinion on the use of simple calculators in primary school. This topic is rather controversial among teachers.

As for pupils of primary schools, 25 % think that they should not definitely or probably use. 64 % think that they should use them in maths lessons.
As for scientific calculators calculating fractions, teachers´ opinion was mostly negative. 38 % think that they should not definitely or probably use. 53 % think that they should use them in maths lessons.

Survey results



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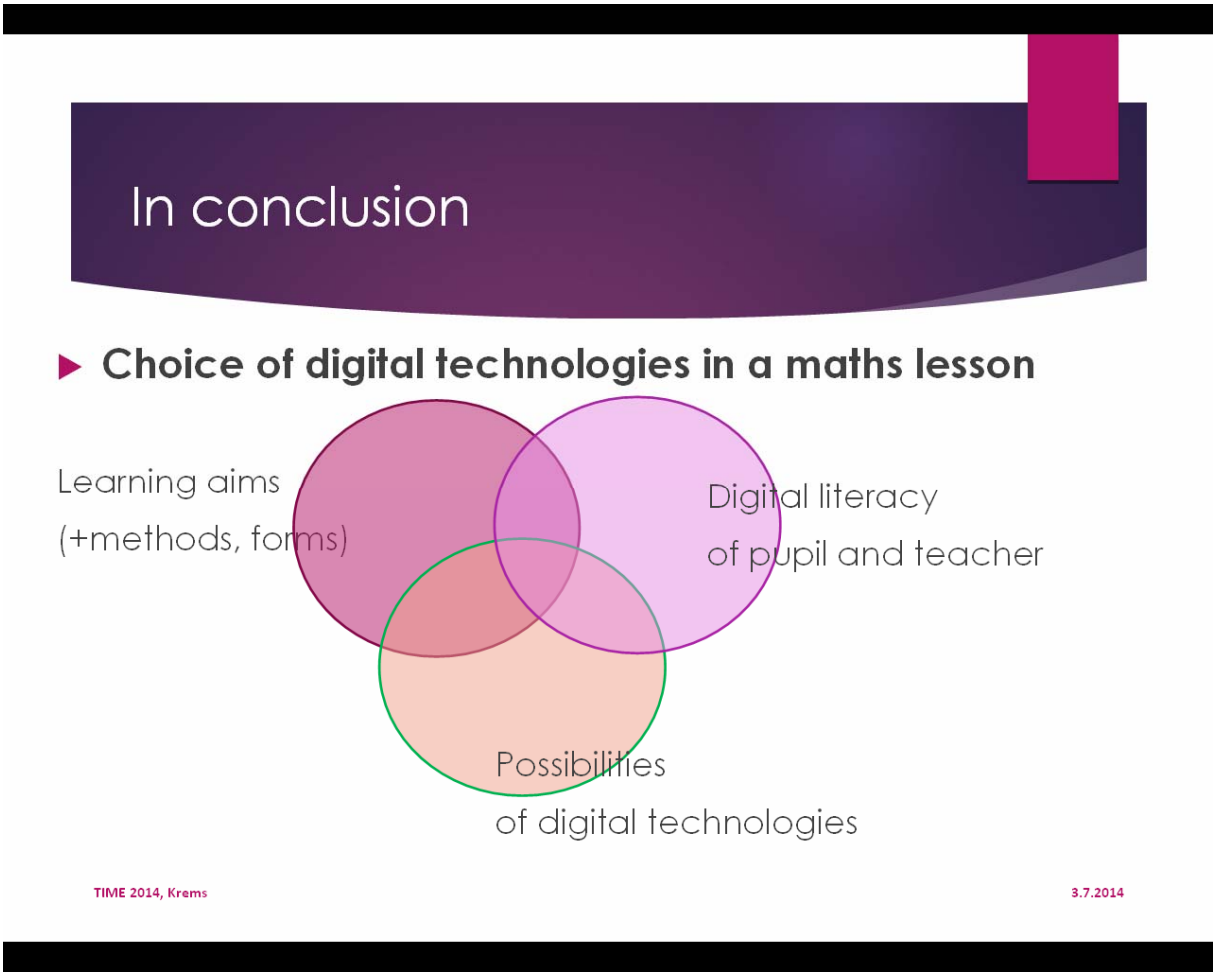
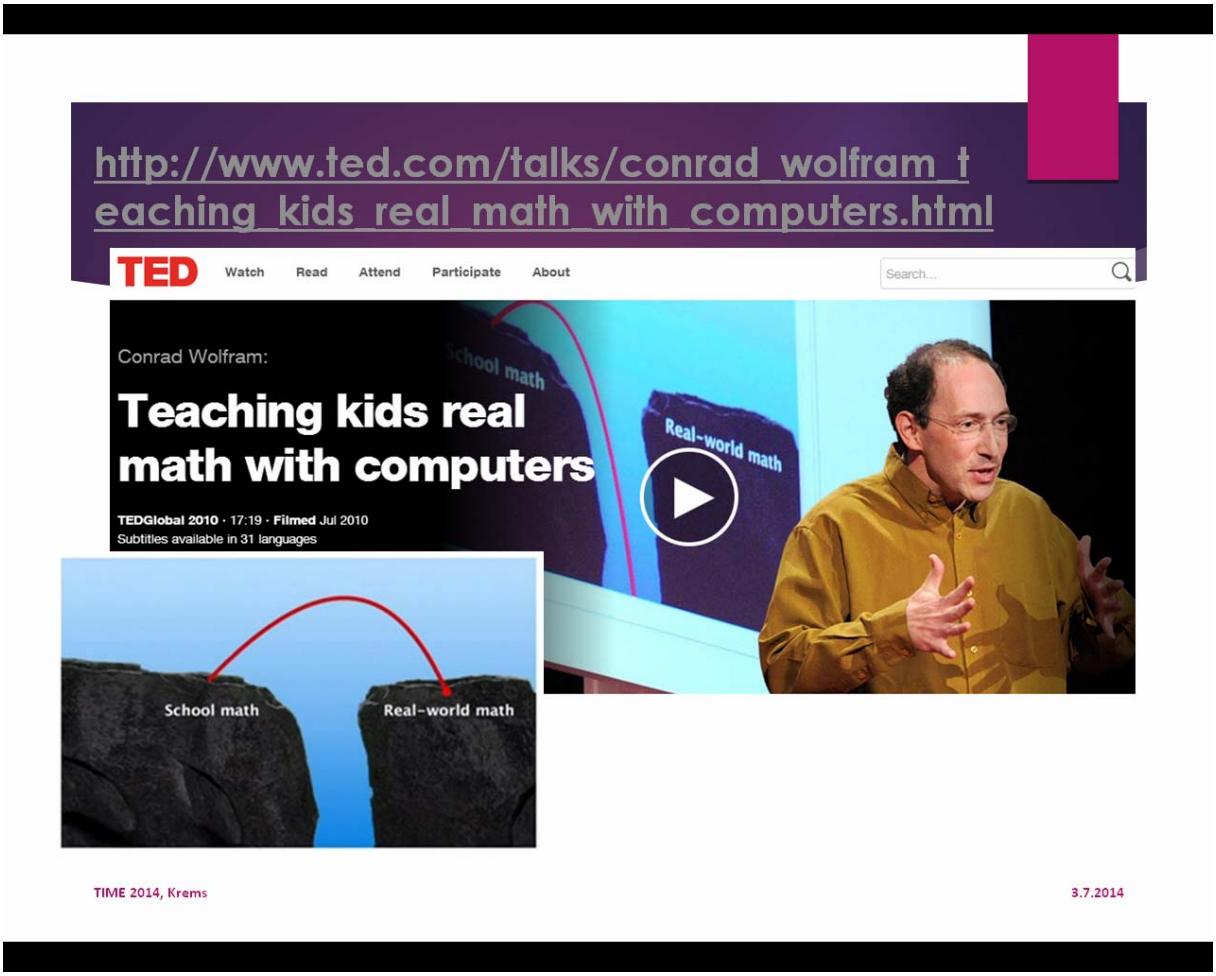
I was surprised by the opinion of teachers on using of graphic calculators in secondary school. 51 % of teachers are for the use the calculators. 11 % of teachers even think that students should use it obligatorily.



In conclusion" DT are a part of today generation of pupils and that is why they necessarily belong to schools. PC, tablet as well as graphic calculator have their place in maths lessons. Which technology teacher choose, it depends on learning aims which he wants to achieve, learning methods and forms which he wants to use, an the level of digital literacy of pupils as well as of teacher himself, and of course on availability of these technologies.

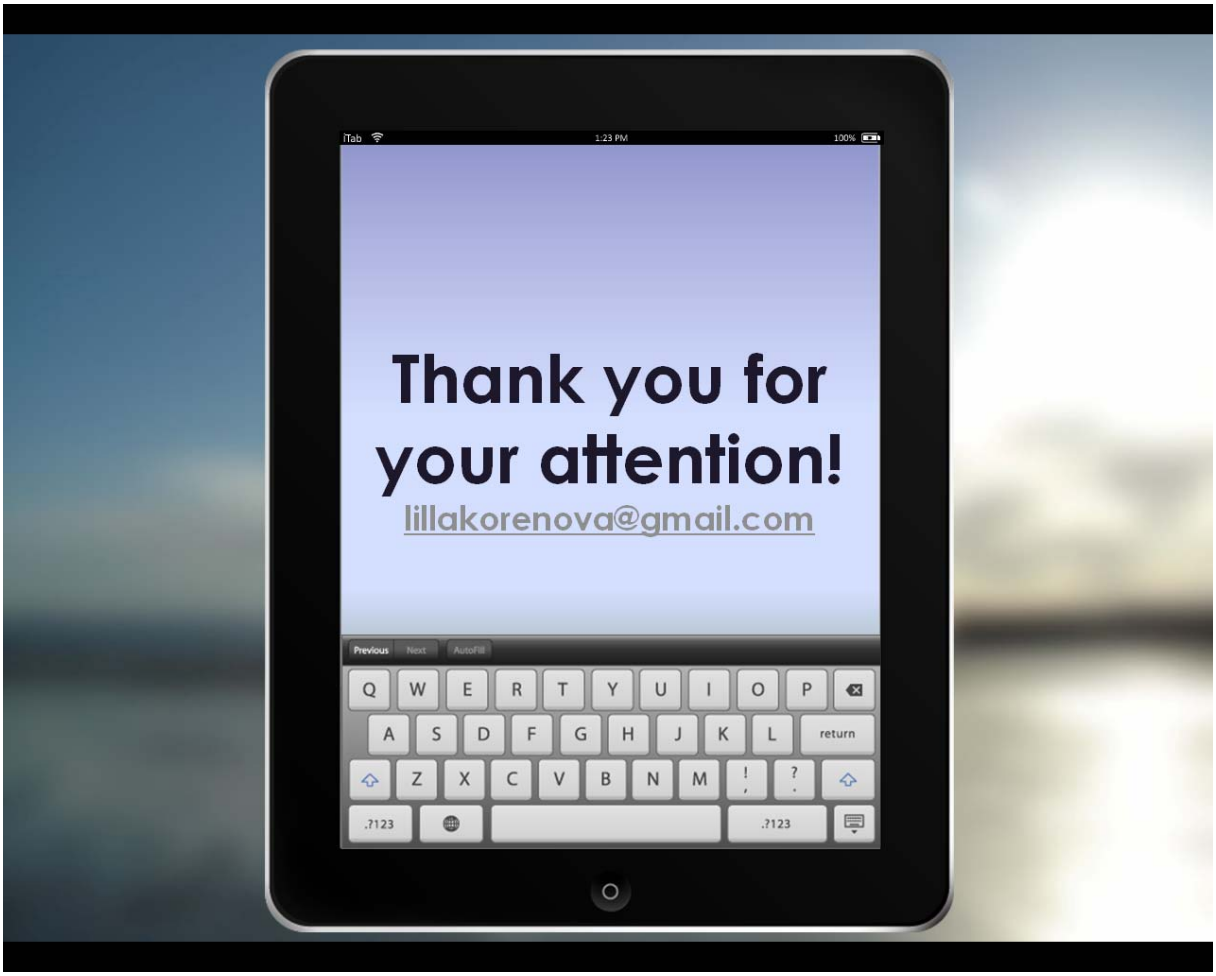


Conrad Wolfram:

„We've got a real problem with math education right now. Basically, no one's very happy. Those learning it think it's disconnected, uninteresting and hard. Those trying to employ them think they don't know enough. Governments realize that it's a big deal for our economies, but don't know how to fix it. And teachers are also frustrated. Yet math is more important to the world than at any point in human history. So at one end we've got falling interest in education in math, and at the other end we've got a more mathematical world, a more quantitative world than we ever have had.

So what's the problem, why has this chasm opened up, and what can we do to fix it? Well actually, I think the answer is staring us right in the face: Use computers

I think we should be assuming computers for doing the calculating and only doing hand calculations where it really makes sense to teach people that. And I think there are some cases. For example: mental arithmetic.“


Thank you for your attention!
lillakorenova@gmail.com