GeoGebra in a School Development Project – Mathematics Education as a Learning System

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GeoGebra Instituut Vlaanderen, Brussel

Background

Computers in the classroom
Mid 1980's

A computer lab in every secondary school
20 lessons of computer science in grade 7–9

Late 1990's–early 2000

Development project: IT in School (ITiS)
60 million €
Every teacher involved got a PC of their own

Some years later ...

Almost no traces left behind

School development

Top down-approach
- an (external) agent initiate an innovation
- (unrealistic) expectations that ICT will revolutionize teaching practice
- the project lies outside the regular teaching
- when the project is over most teachers return to their usual habits of teaching

Aim

Develop mathematics teaching into a learning system
- through a dynamic math software (GeoGebra)
- design a sequence of learning situations (activities)
- the teachers are the owners of the project
- university team members act as coaches and tutors

School development

Crucial when implementing an ICT-project
- time to learn the software
- peer support
- regular teaching
- supervision
Before we started ...

Visiting an upper secondary school using ICT in all subjects

Visiting G I of Norway

Two workshops
Introducing the teachers to GeoGebra

The Project

Workshop 1
2-3 hours every third week
Design an activity with GeoGebra
Outcome – Worksheet (students) and Teacher's sheet
The Project

Teaching in regular classes

Workshop 2
Evaluate the lesson/activity
Make changes in the worksheet and in the teacher’s sheet
Design a new activity

The Project Spiral

6. Evaluate
5. Teach
4. Re-design
3. Evaluate
2. Teach
1. Design

The Activities

GeoGebraTube

An investigative approach
Guided discovery
Instruction for the construction
Investigate ...
Write in your own words
Change the ...
Result?
### Quadratic functions

**PART 1**

Quadratic functions can always be written in the form \( f(x) = ax^2 + bx + c \) where \( a, b \) and \( c \) are real numbers and \( a \neq 0 \). In part 1 we shall study quadratic functions written in this form using GeoGebra.

- Start by creating the sliders \( a \) and \( c \) using the tool.
- Change the option "increment" to 0.5 for all sliders.

Tip: Paint on the slider and at the same time press down the right mouse-button. By doing this you can move the slider over the screen.

- Move the entire Cartesian plane, so that the origin is in the center of the screen.
- You do this using the tool.

### The Project

**Worksheet**

- Write the function, \( ax^2 + bx + c \), in the "Input"-window at the bottom of the screen.
- Put the formula (the rule) that you found in the algebra window (to the left on the screen) in the Drawing Area. You do this by highlighting the formula and *drag* it into the Drawing Area.

### Teacher's information sheet

<table>
<thead>
<tr>
<th>Title</th>
<th>Content</th>
<th>Course</th>
<th>Syllabus</th>
<th>Abilities</th>
<th>Working</th>
<th>Time</th>
<th>Comments</th>
</tr>
</thead>
</table>

1. Your first task is to investigate in what way different values for the coefficients changes the graph of the quadratic function.

   a) Investigate in what way the graph changes with different values for the constant \( c \). Set slider \( a = 1 \) and slider \( b = 0 \) and \( c \) to find out in what way the graph changes when the value of slider \( c \) is changed.

   Write in your own words in what way the value of \( c \) alters the graph.

   

\[
\text{Result:}
\]

Change the value of the sliders \( a \) and \( b \) and find out if your result from above still is valid.

\[
\text{Result:}
\]
Informationsblad till Vektorer med GeoGebra

Rubrik: Vektorer

ämnesinnehåll:
- Konstruktion av en vektor mellan två punkter
- Addition och subtraktion med vektorer och konstruktion av vektorer
- Multiplikation av en vektor
- Uppdelning i komposanter

ämnesplan:
- Begreppet vektor och dess representationer såsom riktad sträcka och punkt i ett koordinatsystem
- Addition och subtraktion med vektorer och produkt av en skalär och en vektor
- Parallellogrammet
- Polygonmetoden
- Multiplikation av en vektor med ett tal
- Uppdelning i komposanter

förmågor att utveckla:
- använd och beskriva begreppet vektor
- hantera procedurer och lösa uppgifter av standardkaraktär utan och med verktyg
- analysera och lösa matematiska problem
- följa och föra matematiska resonemang
- kommunicera matematiska tankegångar muntligt, skriftligt och i handling

arbetstyper:
- Klassrumsaktivitet – parvis
- Tidsåtgång
- 2 lektioner

didaktiska kommentarer:
- Aktiviteten fungerar som introduktion till momentet vektorer (efter kort genomgång)

GeoGebra

Strengehts
- Alter and transform your teaching practice
- Natural differentiation
- Promote an explorative way of learning
- Focuse the mathematical content
- Strong effects on students' learning
  - feedback
  - formative assessment

GeoGebra

Different activities with GeoGebra

Whole class instruction
- Introducing a new content
- Promote whole class discussion/group discussion
- Repetition

Homework
- ... follow up on an activity
- ... prepare for an introduction
- ... challenges for gifted students

Core concepts

Math education as a design science

Substantial Learning Environment
(Lernumgebungen; situation didactiques)

Learning systems

Collegial learning

Thank you for listening!

Arne Engström

GeoGebra Institute of Karlstad