Series of GeoGebra Workshops

Presenter Overview

Table of Contents

August 28th, 2008

Judith@geogebra.org
Markus@geogebra.org

Comments

Every session of this workshop series was created to cover about **three hours** of workshop time. While workshops 1 to 5 are considered to be introductory workshops, workshops 6 to 8 are more advanced and might not be suitable for all groups of workshop participants whose members are GeoGebra novices.

Guided activities are supposed to be lead by the presenter while the participants work along. We encourage you to explain the mathematical content as well as use of GeoGebra and address participant's questions or occurring difficulties as they work on the examples.

Practice activities are supposed to be solved without direct instruction by the presenter. Nevertheless, you might want to walk around and assist participants if they ask for help.
Note, that it is more beneficial for participants to solve their own problems by following instructions than by watching you doing this for them!

Every workshop contains a **Challenge of the day** activity. It is meant to be an extension activity for more advanced participants or if some time is left at the end of a workshop.

Some workshops contain a **presentation** and **discussions**. They are supposed to be given / lead by the workshop presenter and should help participants to better understand the use, functionality and/or possible applications of GeoGebra for their everyday teaching.

The suggested **time frame** is meant only for planning purposes. Experience shows that the different activities can take more/less time depending on the skills of the participants.
Note: If time is limited, it is usually more beneficial for participants to skip one or more practice activities during the workshop (and to encourage them to try them out at home) than to hurry through all activities.

Thank you for spreading the word about GeoGebra!

Good luck for your workshop,
Judith & Markus

WS 1: Introduction, Installation & Drawings vs. Geometric Constructions

1. Introduction and Installation • General information about GeoGebra (PowerPoint presentation) • Examples for visualization, representation, experiments • Information about support possibilities (GeoGebra Wiki, UserForum, online help,…) • Installation: Use WebStart if possible • Note: bring USB drives with installers for Windows / MacOS • GeoGebra-ws-files distribution: copy folder to computers – unzipped from USB drives	**40 min** presentation guided activity
2. Basic use of GeoGebra • Explain / present the use of geometry tools • New tools: New point, Move, Line through two points, Segment between two points, Delete object, Undo / Redo buttons, Move drawing pad, Zoom in / Zoom out • Saving and opening GeoGebra files	**20 min** presentation
3. Creating drawings with GeoGebra • Participants explore the "easy" GeoGebra tools presented before • Participants practice how to save files, create points on objects, select objects, use undo / redo	**20 min** practice activity

4. Drawings, constructions, and drag test
• Participants explore dynamic worksheet "Squares, squares, squares…" and experience a potential way of using GeoGebra with their students
01_Drawing_Construction_Squares.html
• Discussion: Drawing vs. constructions
  ○ What is the difference between a drawing and a construction?
  ○ What is the "drag test" and why is it important?
  ○ Why is it important to construct figures instead of just drawing them in interactive geometry software?
  ○ What do we have to know about the geometric figure before we are able to construct it using dynamic mathematics software?
	20 min
	practice activity
	
	discussion

5. Rectangle construction • New tools: Perpendicular line, Parallel line, Intersect two objects, Polygon • New features: Labeling setting to *New points only*	**30 min** guided activity

6. Navigation bar and Construction protocol
• Explain the use of the Navigation bar
• Explain the use of the Construction protocol
  ○ Change order of construction steps (Why is this not always possible?)
  ○ Grouping of construction steps by setting breakpoints
	20 min
	presentation

7. Equilateral triangle construction • New tools: Circle with center through point, Show / hide object, Angle • Explain: clockwise and counter clockwise orientation of a polygon / angle	**20 min** guided activity
8. Properties dialog • Enhance the equilateral triangle construction • How to access the Properties dialog • How to select different objects, all objects of one type • Different label styles • Which tabs are available for which types of objects?	**10 min** guided activity
9. Challenge of the day: Isosceles triangle • ONLY if there is some time left, otherwise suggest as home exercise • No detailed instructions for participants • Participants need to figure out the use of a new tool	challenge activity

WS 2: Geometric Constructions & Use of Commands

1. Square construction AND / OR Regular hexagon construction • Participants practice skills obtained in the first workshop • Participants can pick the activity and work with partners or on their own • Participants can practice ONE OR BOTH of these activities	**30 min** practice activity
2. Discussion time • Questions, comments,… about the use of GeoGebra so far • Why do some people get the exterior angles of the polygon? • Different ways of constructing a square? • Explain why the hexagon construction works like this.	**10 min** discussion
3. Circumscribed circle of a triangle • New tool: Line bisector • Back to school tasks and discussion	**20 min** guided activity
4. Visualization of the theorem of Thales • Participants explore the dynamic worksheet to learn about the construction process *02_Theorem_Thales.html* • New tool: Semicircle through two points • Discussion: What did Thales find out? How can we word his theorem? • Presentation of dynamic worksheet showing the proof *02b_Theorem_Thales_Proof.html*	**30 min** guided activity discussion presentation

5. Constructing tangents to a circle (part I)

20 min
practice activity

discussion

- Participants explore the dynamic worksheet to learn about the construction process
  03_Tangents_Circle.html
- Discussion
  - Which tools did you use in order to recreate the construction?
  - Were there any new tools involved in the suggested construction process? If yes, how did you find out how to operate the new tool?
  - Did you notice anything about the toolbar displayed in the right applet?
  - Do you think your students could work with such a dynamic worksheet and find out about construction processes on their own?

---

6. Constructing tangents to a circle (part II)

30 min
guided activity

discussion

- Introduce the use of commands (examples, explain syntax with brackets)
- Redo construction using commands instead of tools
- Explain naming a tool vs. automatic naming in alphabetical order
- Explain difference between free and dependant objects
- Discussion
  - Did any problems or difficulties occur during the construction process?
  - Which version of the construction (mouse or keyboard) do you prefer and why?
  - Why should we use keyboard input if we could also do it using tools?
    Hint: There are commands available that have no equivalent geometric tool.
  - Does it matter in which way an object was created? Can it be changed in the algebra window (using the keyboard) as well as in the graphics window (using the mouse)?

7. Exploring parameters of a quadratic polynomial
• Participants follow instructions on a paper worksheet (see handout)
• Discussion
  ○ Did any problems or difficulties concerning the use of GeoGebra occur?
  ○ How can a setting like this (GeoGebra in combination with instructions on paper) be integrated into a 'traditional' teaching environment?
  ○ Do you think it is possible, to give such an activity as a homework problem to your students?
  ○ In which way could the dynamic exploration of parameters of a polynomial possibly affect your students' learning?
  ○ Do you have ideas for other mathematical topics that could be taught in similar learning environment (paper worksheets in combination with computers)?
	20 min
	practice activity
	discussion

8. Using sliders to modify parameters • More dynamic way of exploring the impact of parameters • Algebraic input and common mistakes (multiplication, upper case x, variables don't exist yet,…) • Hint: Participants need to read the error message – it could be useful! • Have participants check out the Tips and Tricks section at the end of the workshop handout	**20 min** guided activity
9. Challenge of the day: Parameters of polynomials Exploring the impact of parameters on a quadratic polynomial by using and extending the construction of the last activity.	challenge

WS 3: Algebraic Input, Functions & Export of Pictures to Clipboard

1. Parameters of a linear equation • Practice skills obtained in the last workshop • New tool: Slope • Task: Participants write down instructions for their students. • Discussion of task	**30 min** practice activity
2. Library of functions – Absolute values • Enter and intersect functions • Back to school: Possible application for teaching • Discussion: Solutions for back to school tasks	**20 min** guided activity
3. Library of functions – Superposition of sine waves • Excursion into physics: explain amplitude, frequency, phase, superposition, meaning in music • Introduce indices for object names and Greek letters • Back to school: Possible application for teaching • Discussion: Solutions for back to school tasks	**30 min** guided activity
4. Introducing derivatives – the slope function • New tool: Tangents • New feature: Trace on / off, characteristics of trace • New command: Slope • Back to school: Work on tasks • Discussion: Solution for tasks What about introducing concepts of calculus to students in an intuitive way – maybe in lower grade levels?	**30 min** guided activity
5. Exploring polynomials • Review entering polynomials and commands • New commands: Root, Extremum, InflectionPoint	**20 min** practice activity
6. Exporting pictures to the clipboard • Guide participants through exporting the drawing pad to the clipboard • Note: No picture file is saved on the computer! • Reduce the size of the GeoGebra window before the export – the whole drawing pad will be exported	**20 min** guided activity

7. Inserting pictures into a text processing document (e.g. MS Word) • Insert picture from the clipboard • Reduce size of a picture • Note: Scale of the picture could be modified by MS Word.	**30 min** guided activity
8. Challenge of the day: Creating instructional materials • Create a worksheet / notes / quiz for your students • Create a sketch in GeoGebra and export to clipboard • Insert sketch into Word • Come up with explanations / tasks / problems for students • Format nicely	challenge

WS 4: Inserting Pictures into the Graphics Window

1. Creating a 'Function Domino Game' AND / OR 'Geometry Memory' • Participants practice exporting pictures from GeoGebra to the clipboard and inserting them into MS Word • Participants learn how to create and format a table (determine number of rows / columns, set row height / column width to a certain size, set vertical alignment of table cells) • Participants can practice ONE OR BOTH of these activities	**30 min** practice activities

2. Exploring Symmetry with GeoGebra I
• Back to school: explore the dynamic worksheet "Axes of Symmetry" (*04_exploring_symmetry.html*)
• Discussion
  ○ How could your students benefit from this prepared construction?
  ○ Which tools were used to create the dynamic figure?
	15 min
	practice activity
	
	discussion

3. Exploring Symmetry with GeoGebra II • Make sure everybody has the picture file saved before you start the construction • New tools: Show / hide label, Mirror object at line • New features: Trace, set a background image • Discuss characteristics of trace feature	**20 min** guided activity discussion
4. Resizing, reflecting, and distorting pictures • Make sure everybody has the picture file saved before you start the construction • Set FIRST and SECOND corner point of the picture • Set picture to a certain size • New feature: Reduce the filling of a picture, set corner points • Back to school tasks • Set the third corner point to distort the picture • Back to school tasks	**30 min** guided activity

5. Exploring properties of reflection • Participants continue with the previous GeoGebra file • Constructing the FOURTH corner point of the picture • Reflecting the corner points and connecting corresponding points and their images with segments • Creating angles between the line of reflection and the connecting segments • Back to school tasks and discussion of solutions	**30 min** practice activity
6. Translating pictures • New tools: Vector between two points, Translate object by vector • New features: Grid, Point capturing on (Grid)	**25 min** guided activity
7. Rotating polygons • Change axes scaling (Properties dialog of drawing pad) • New features: Rename objects, Auxiliary objects • New tool: Rotate object around point by angle, Slider for angle • Discussion: How could you use this file to introduce the concept of rotating an object around the origin of a coordinate system to your students?	**30 min** practice activity discussion
8. Challenge of the day: Tilings with regular polygons • Learning environment (10 dynamic worksheets, 1 paper worksheet) • Participants explore tilings with regular polygons • Participants learn how to determine the interior angles of regular polygons • Participants find a rule to determine if tiling is possible with a certain regular polygon	challenge

WS 5: Inserting Static and Dynamic Text

1. Coordinates of reflected points • Practice reflection about a line, Properties dialog • New feature: Point capturing on grid	**10 min** practice activities
2. Inserting static and dynamic text • New tool: Insert text • New features: Set distance of grid lines, fix text • Task and discussion: Come up with instructions for students	**40 min** guided activity
3. Visualizing a system of linear equations • Entering linear equations • Practice creating indices	**20 min** guided activity
4. Visualizing the angle sum in a triangle • New tools: Midpoint or center • Fix text and sliders • New features: Calculate values to display them as dynamic text (e.g. sum of angles)	**30 min** practice activity
5. Constructing a slope triangle • New feature: Labeling option to All new objects, Calculate rise, run, and slope • Practice inserting static and dynamic text, fix text	**25 min** practice activity
6. Inserting dynamic fractions • Explain what LaTeX is • New features: Insert a fraction (using LaTeX), attach text to objects • Demonstrate use of other LaTeX items (e.g. sqrt)	**10 min** guided activity
7. Attaching text to objects • Version 1: Create midpoint, attach existing text manually (Properties dialog) • Version 2: Create midpoint, activate text tool and click on the midpoint to attach new text right away	**15 min** guided activity

8. The mod 3 Clock • Advanced example! • <u>New functions</u>: random(), floor() • Thoroughly explain these functions as well as how the random integer is created and why we link it to slider *a* (update the random number using the slider) using + a – a • Fix text and sliders so they can't be moved accidentally	**30 min** guided activity
9. Challenge of the day: Visualize a binomial formula • Participants explore a dynamic worksheet and try to recreate the construction • Give participants hints about the construction steps if necessary	challenge

WS 6: Creating Dynamic Worksheets

1. User Forum and GeoGebraWiki • Introduce the User Forum (demonstrate the search feature, show them FAQs) • Have participants look up certain keywords • Introduce the *English GeoGebra Wiki* (show some examples, demonstrate how to download files,…) • Have participants find worksheets to certain topics	**20 min** presentation practice activity
2. Lower and upper sums • Explain syntax of the commands used (why enter function name, interval, number of rectangles) • Task: Check out the construction and answer questions • Discuss relation between lower and upper sums and the integral	**20 min** practice activity discussion
3. Creating dynamic worksheets • Use the construction with the lower and upper sum • Demonstrate how to reduce the window size and explain why we do this • Demonstrate how to export the dynamic worksheet and fill in the *Basic tab* of the export dialog • Create a *new folder* when exporting the file and explain to the participants why this is important (keep all files together) • Explain the “useful information” mentioned in the handout	**30 min** guided activity
4. Enhancing dynamic worksheets • Explain the *Advanced tab* of export dialog • Export the same dynamic worksheet with different functionalities and user interface options (e.g. reset icon, toolbar, input field,…) • Have participants try out some of these options	**20 min** guided activity practice activity

5. Providing dynamic worksheets to students
• Explain why all created files need to stay together
  ○ html contains text
  ○ ggb contains information about the applet
  ○ jar contain GeoGebra and maintain the functionality
• Important: Tell them to NEVER RENAME the ggb file or the jar files!
	10 min
	presentation

6. The GeoGebra Upload Manager • Explain how to create a user account for the GeoGebra Upload Manager • Explain how to create a personal upload folder WITHIN the folder “english” – NOT in top level folder! • Homework: Participants create own user account, personal upload folder following the instructions in the handout	**10 min** guided activity
7. Visualizing triangle inequalities • Participants practice creating a dynamic worksheet using the SSS construction of a triangle • New tools: Segment with given length, Circle with center and radius • Construction protocol: Set breakpoints of construction • Applet features: Show the Navigation bar in the applet • Participants need to come up with tasks for your students and export the construction to a dynamic worksheet	**20 min** practice activity
8. Quality criteria for dynamic worksheets • Use prepared presentation • Presentation: e-learning principles, good and bad examples of dynamic worksheets. How to avoid common mistakes.	**20 min** presentation
9. Creating a ‘Tangram’ puzzle • Participants explore the dynamic worksheet Tangram • Participants need to figure out the side lengths of each Tangram part • Participants construct the seven Tangram parts and try it out (they get just hints, no detailed instructions.	**30 min** practice activity
10. Challenge of the day: Enhancing the ‘Tangram’ puzzle • Participants export their Tangram to a dynamic worksheet • Participants search the Internet for Tangram pictures and import it to their Tangram construction in order to encourage the creation of different figures using the Tangram shapes	challenge

WS 7: Custom Tools & Customizing the Toolbar

1. Visualizing the theorem of Pythagoras • New tool: Copy visual style • Participants practice to insert static and dynamic text, attach text to objects, and match the color of objects and corresponding text • Participants export the construction as a dynamic worksheet and come up with and explanation for their students	**40 min** practice activity
2. Creating custom tools – Altitude tool • Prepare the construction of an altitude (minimal distance between a point and a line) • Create a custom tool (output objects, input objects, name, toolbar help) • Let participants try out their new tool • Demonstrate how to save (file name extension ggt!) and import a custom tool into the GeoGebra toolbar	**20 min** guided activity
3. Square tool • Participants create a Square tool • Construction process different to the one used in workshop 2 (parallel lines instead of all perpendicular lines) • Participants save their new custom tool	**25 min** practice activity
4. Fibonacci spiral • Participants open a new GeoGebra window (so that custom tool is NOT part of the toolbar) • Participants import the custom tool into the toolbar • Create Archimedes' spiral (golden rectangle, squares in one direction)	**30 min** practice activity

5. Constructing the center of a circle
• Paper worksheet: circles without center
• Back to school: Participants try to find the center of the circles using paper folding, pencil and ruler
  ○ Version 1: fold two circle diameters which intersect in the circle's center
  ○ Version 2a: perpendicular bisectors of two chords intersect in the center of the circle
  ○ Version 2b: repeat construction 2a with pencil and ruler
• Recreate version 2 with GeoGebra
• Which tools do you really need in order to create this construction?
• Export the construction (with Navigation bar, without toolbar) and save as center-circle-solution.html
	40 min
	practice activity

6. Customizing the toolbar • Customize toolbar so it just contains the tools needed to construct the center of a circle • Clear the graphics window from all objects apart from the circle and export as a dynamic worksheet again with customized toolbar and toolbar help	**25 min** guided activity
7. Challenge of the day: Euler's discovery • Participants construct the three 'remarkable' points of a triangle (circumcenter, orthocenter, and centroid) • Participants create a custom tool for each of these points • Participants apply their custom tools to an arbitrary triangle and explore the Euler line • Participants customize the toolbar and export a dynamic worksheet for their students	challenge

WS 8: Conditional Visibility & Sequences

1. Visualizing integer addition on the number line • New feature: Hide the y-axis, set interval of x-Axis • Calculate the result of the addition problem • Insert dynamic text and match the color of text and corresponding sliders / vectors • Export figure as a dynamic worksheet	**45 min** practice activity
2. Checkbox to show / hide objects • Use the visualization of integer addition file • New tool: Insert checkbox to show / hide objects • Checkbox allows participants to show / hide the result of the addition problem. • Boolean variables: How to add another object to the influence of the checkbox	**30 min** guided activity
3. The Sierpinski Triangle • Create a custom tool for stage 1 of the Sierpinski triangle • Apply the custom tool to create stages 2 and 3 • Insert 3 checkboxes that control the visibility of 3 stages	**40 min** practice activity
4. Introducing Sequences • New command: Sequence[ ] • Explain command Sequence[ ] and its syntax • Participants try out 3 examples for sequences	**20 min** guided activity
5. Visualizing Multiplication of Natural Numbers • Create polygon whose width and height are controlled by sliders named *Columns* and *Rows* • Use sequences to subdivide the polygon into unit squares • Insert dynamic text that states the multiplication problem	**45 min** guided activity
6. Challenge of the day: 'String Art' based on Bezier Curves • Explain about Bezier curves • New command: Element[list, number] • Create two connected segments • Create lists of points along these segments whose number can be changed using a slider • Create segments between the first and last, second and last but one,…, last and first element of the point lists	challenge