INVESTIGATING THE EFFECT OF CHANGING THE VALUES OF PARAMETERS ON THE GRAPHS OF FUNCTIONS USING *GEOGEBRA*

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The presenter will demonstrate, by using GeoGebra software, how to create sliders for parameters of functions. The effect of changing the values of parameters will be easily noticed on the transformed graphs of functions. The session will concentrate on trigonometric functions. The same actions could be applied to algebraic functions.

INTRODUCTION

GeoGebra is dynamic mathematics open source (free) software for learning and teaching mathematics in schools. It was developed by Markus Hohenwarter and an international team of programmers. *GeoGebra* combines geometry, algebra, statistics and calculus. One can download it for free from http://www.geogebra.org. In this talk I will attempt to show how to use *GeoGebra* to demonstrate certain concepts required in the CAPS document.

Even though transformations as a section on its own was removed from Grade 10 – 12 CAPS (2011, p 12), it is still important under the section 3.1.1. Overview of topics, 1. Functions states that:

> Work with relationships between variables in terms of numerical, graphical, verbal and symbolic representations of functions and convert flexibly between these representations (tables, graphs, words and formulae). Include linear and some quadratic polynomial functions, exponential functions, some rational functions and trigonometric functions.
>
> Generate as many graphs as necessary, initially by means of point-by-point plotting, supported by available technology, to make and test conjectures and hence generalise the effect of the parameter which result in a vertical shift and/or reflection about the x axis (Grade 10) and which results in a horizontal shift and/or reflection about the y axis (Grade 11).

Why is the effect of changing the values of parameters important?

- to help learners to sketch graphs using the properties of the functions rather than using a table;
- to show that the same change has the same effect on many functions.

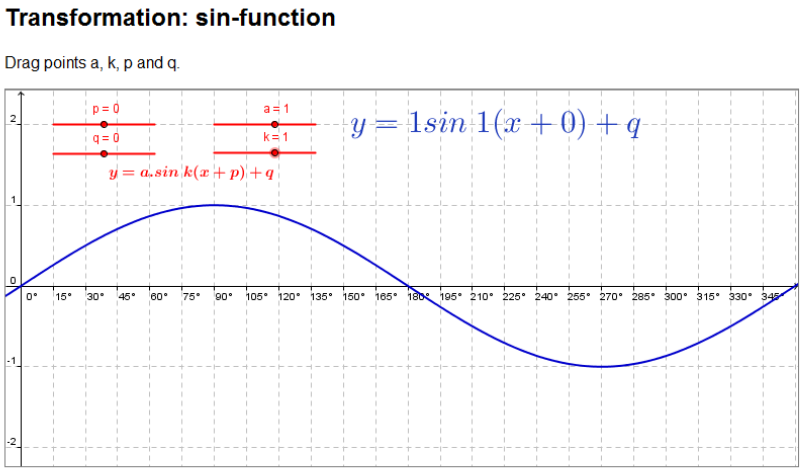
I am planning to do the following during the talk: By creating sliders for the parameters one can easily see the effect of changing the values of parameters on the transformed graphs of functions. I will concentrate on trigonometric functions. The same actions could be applied to algebraic functions.

Barnard, B. (2013). Investigating the effect of changing the values of parameters on the graphs of functions using *GeoGebra*. In Z. Davis & S. Jaffer (Eds.), *Proceedings of the 19th Annual Congress of the Association for Mathematics Education of South Africa*, Vol. 2. (pp. 80 – 82). Cape Town: AMESA.

CONTENT

The diagram below was taken from a website by Gerrit Stols: http://school-maths.com/interactive_maths/geogebra_files/transformation_trig/transformation_sin.html.

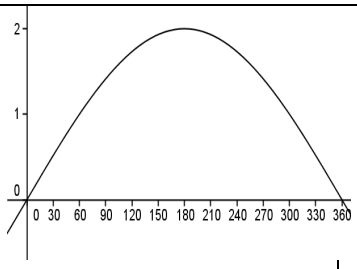
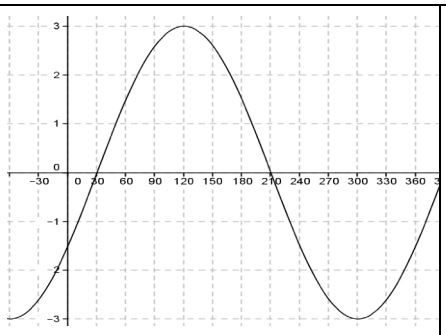
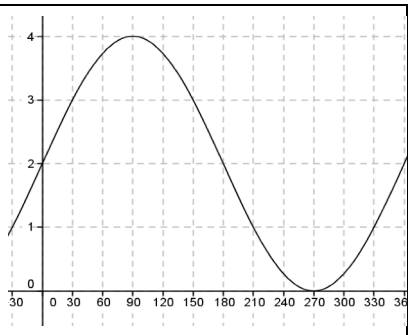
By dragging the points a, k, p and q on the sliders one can see the effect on the graphs. These are very dynamic demonstrations of the influence of each of the parameters a, k, p and q on the graph with equation $y = a * sin(k(x + p)°) + q$. It can be seen separately or combined. One can do the same for $y = a * cos(k(x + p)°) + q$ or $y = a * tan(k(x + p)°) + q$.



The following questions could be attempted during the session:

QUESTION 1

Determine the equations of the following sin graphs: (3 x 2 = 6)

		
1.1	1.2	1.3

QUESTION 2

Draw sketch graphs of the following functions for the intervals given on separate systems of axes. Indicate the intercepts with the axes and the turning points: (2 x 3 = 6)

2.1 $y = -cosx - 2$ for $0° \leq x \leq 360°$	2.2 $y = \frac{1}{2}\cos(x + 60°)$ for $-60° \leq x \leq 300°$

QUESTION 3

Describe in your own words the effect of each of the parameters *a, k, p* and *q* on the equation $y = \text{acos}(k(x - p)°) + q$ (4 x 2 = 8)

Effect of *k*	Effect of *p*
Effect of *a*	Effect of *q*

CONCLUSION

Teachers who participated in the training indicated that the software is easy to use once it was demonstrated to them and proved to be effective in the classroom with the support of a training manual by Barrie Barnard and Gerrit Stols (2012).

It does not matter if you do not have access to a computer laboratory as you can demonstrate the activities by making use of an off-line version of *GeoGebra* and demonstrating it with a data projector and screen. If you have access to the internet you could show all the interactive mathematics from the website: http://school-maths.com/ and other sites in your class.

REFERENCES

Barnard, B. and Stols, G. (2012). Investigating the effect of changing the values of parameters on the graphs of functions using *GeoGebra*, a training manual, AIMSSEC.

Department of Basic Education. (2011). Curriculum and Assessment Policy Statements (CAPS) Grade 10 – 12 Mathematics.

http://school-maths.com/interactive_maths/geogebra_files/transformation_trig/transformation_sin.html accessed on 23 February 2013.