CHANGING THE WAY WE TEACH FUNCTION TRANSFORMATIONS WITH GEOGEBRA

Cerenus Pfeiffer

Stellenbosch University Centre for Pedagogy (SUNCEP)

TARGET AUDIENCE: FET teachers (Grade 10 – 12).

DURATION: 2 hours

MAXIMUM NO. OF PARTICIPANTS: Number of participants will depend on number of computers in the computer lab. Each participant must have access to a computer for this session.

MOTIVATION FOR WORKSHOP (ABOUT 2 OR 3 LINES)

- Many learners asked teachers: "Why do we do the opposite when a change is made inside the parenthesis. Why does $f(x-2)$ move the graph of f two units to the right? Teachers have often tried to explain away this uneasiness by telling students to 'do the opposite operation when the change is inside the parenthesis.' This approach, of course, leaves much to be desired, especially when the goal of effective mathematics instruction is to help students develop reasoning about why things happen." (Faulkenberry & Faulkenberry, Transforming the way we teach function transformations, 2010.)
- Workshop will focus on approaches that will try to avoid giving learners only procedures to apply and memorization of the transformation rules. Workshop will also focus on visualizing the function transformations with *GeoGebra*.
- Teachers will be exposed to how to integrate *GeoGebra* (dynamic software) in the teaching of function transformations.
- To expose teachers to mathematics material that facilitates self-exploration and self-activity with *GeoGebra*.

CONTENT OF WORKSHOP (ABOUT 5-10 LINES TO ENTICE THE AUDIENCE TO YOUR WORKSHOP)

Participants will:

- Explore *GeoGebra* to familiarise themselves with the working of the software.
- Create activities to investigate the types of transformation when given $-f(x)$, $f(-x)$, $f(x)-2$, $f(x+3)$, $3f(x)$, $f^{-1}(x)$, etc.
- Draw explore the different transformations in the following functions:

- $y = a(x-p)^2 + q$
- $y = a(b)^{x+p} + q$
- $y = \frac{a}{x+p} + q$
- $y = a\sin(bx+p) + q$

PROPOSED TIME ALLOCATION FOR WORKSHOP ACTIVITIES

Short presentation on the need for learners to be active involve in the process of learning and the history of *Geogebra*.	**10 minutes**
Participants to familiarise themselves with the icons in *GeoGebra* that they will use during this session.	**15 minutes**
Creating of activities in *Geogebra* to investigate the types of transformation when given $-f(x)$, $f(-x)$, $f(x)-2$, $f(x+3)$, $3f(x)$, etc.	**1h15minutes**
Related discussions and installation of software.	**20 minutes**

Function transformations with *GeoGebra*

1. $f(x) = 3(x-1)^2 - 8$. Type in Geogebra in Input bar 3(x-1)^2 – 8 and then Enter.

Turning point coordinates :

x −intercepts: Type in Geogebra in Input bar: **root(f)** and then press enter on keyboard.

Type in the following into the input bar and complete the table.

	Equation of transformed graph	Type of transformation	Coordinates of TP	x-intercepts	y-intercept
(a) $g(x) = -f(x)$					
(b) $h(x) = f(-x)$					
(c) $p(x) = f^{-1}(x)$					
(d) $q(x) = f(x) - 2$					
(e) $r(x) = f(x+3)$					
(f) $s(x) = f(x-1)+3$					
(g) $t(x) = 3f(x)$					

2. $f(x) = x^2 - 2x - 8$

Type in the **Inputbar:** x^2 – 2x – 8 and press then enter on the keyboard.

For turning point: Type in inputbar : **extremum(f)** and then press enter on keyboard.

For x-intercepts: Type in Geogebra in Input bar: **root(f)** and then press enter on keyboard.

Type in the following into the input bar and complete the table.

	Equation of transformed graph	Type of transformation	Coordinates of TP	x-intercepts	y-intercept
(a) $g(x) = -f(x)$					
(b) $h(x) = f(-x)$					
(c) $p(x) = f^{-1}(x)$					
(d) $q(x) = f(x) - 2$					
(e) $r(x) = f(x + 3)$					
(f) $s(x) = f(x - 1) + 3$					
(g) $t(x) = 3f(x)$					

3. $f(x) = \frac{4}{x+2} - 3$.

Type in the input bar f(x) = 4/(x+2) – 3 and press then enter on the keyboard.

Equation of horizontal asymptote (HA):

Equation of vertical asymptote (VA):

Type in the following into the input bar and complete the table.

	Equation transformed graph	Type of transformation	Equation of HA	Equation of VA
(a) $g(x) = -f(x)$				
(b) $h(x) = f(-x)$				
(c) $p(x) = f^{-1}(x)$				
(d) $q(x) = f(x) - 2$				
(e) $r(x) = f(x + 3)$				
(f) $s(x) = f(x - 1) + 3$				
(g) $t(x) = 3f(x)$				

4. $f(x) = 2^{x+1} - 3$.

Type in the input bar f(x) = 2^(x+1) – 3 and press then enter on the keyboard.

Equation of horizontal asymptote:

Type in the following into the input bar and complete the table.

	Equation transformed graph	Type of transformation	Equation of HA
(a) $g(x) = -f(x)$			
(b) $h(x) = f(-x)$			
(c) $p(x) = f^{-1}(x)$			
(d) $q(x) = f(x) - 2$			
(e) $r(x) = f(x + 3)$			
(f) $s(x) = f(x - 1) + 3$			
(g) $t(x) = 3f(x)$			

5. $f(x) = sin(x + 30^o)$.

Type in the input bar g(x) = sin(x°+30°)

Maximum value :

Minimum value :

Period:

Amplitude:

Type in the following into the input bar and complete the table.

	Equation transformed graph	Amplitude	Period	Maximum value	Minimum value
(a) $-f(x)$					
(b) $f(-x)$					
(c) $f(x - 30°)$					
(e) $f(x + 60^{\circ}) - 3$					
(f) $f(2x)$					
(g) $f(\frac{x}{3})$					
a) $3f(x)$					