

## Students' Understanding of the Parameters of Function using GRAPES - The Case of Sine Function -

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## Brief Introduction of Myself

- I am a math teacher at Universidad Pedagógica Nacional "Francisco Morazán" (UPNFM), Honduras.
- I have a Bachelor Science in Mathematics from Indiana University of Pennsylvania, U.S.A.
- I have a Master degree in Math Education from UPNFM.
- Title of thesis: "Studying the linear function using technology".

## Why to use GRAPES?

- To know how technology support students' understanding of the effects of parameters in function.
- GRAPES is easier for students to use than other software (ex. Derive).
- GRAPES shows not only result but also processes which students tried.

## Experiment Design

- There were 15 students from a normal high school.
- The lessons and activities were planed with my colleague.
- Experiment was implemented in the math computer laboratory of the University.
- Main activity is to change the parameters of the sine function  $y = a \sin(bx + c)$ , and to identify the effects of each parameter.
- See worksheets.

## Some points of Evaluation of Students' understanding

- Check if students can find the values of parameters from a given graph.
- Ask the students for arguments to find the values of parameters.
- Check their worksheets and videotapes to know their thinking.

## The result of the First Experiment

- There are some general results about the planning
- There are some findings about students' understanding of parameters
  - From 15 students
  - 4 students identify the effects of parameter  $a$ .
  - 7 students identify  $a$  and  $b$ .
  - 4 students identify  $a$ ,  $b$ , and  $c$ .

## General Results

- The attitude of students for the lesson with GRAPES was favorable. They think it is easy to use and liked its framework.
- The experiment took a longer time than we expected. We needed to change the lesson hours from three to five (to be done in 1 ½ hours each worksheet).
- It is important to include tasks for the students as to write arguments, conclusions and reflections.

## Findings about parameter " $a$ "

- It seems that this parameter is easy for students to visualize the effects on graph.
- Students who failed to identify the effects of parameter  $a$  as the amplitude. They think  $a$  is always a positive number.

## Findings about parameter " $b$ "

Students who failed to identify the effects of parameter  $b$  think as followings:

- $b$  correspond to the number of intersections in a distance of  $2\pi$ .
- $b$  correspond to the length of two intersections.

## Findings about parameter " $c$ "

- Most of students failed to identify the effects of parameter  $c$ .
- It seems this is the most difficult parameter to visualize. Students who associated the value of  $c$  with translation of graph, did not take care of parameter  $b$ .
- They wanted to associate a point in a graph with a parameter, like they did with the other parameters.

## For the next step

- It is needed to analyze more deeply that the differences of difficulty between the parameters
- Some students understood the effect of parameters as just "cause and effect", other students understood the mechanism of the effect of parameters. We should be careful about that and distinguish.
- It is needed to have ideas of what research would be efficient to analyze students' understanding.

Thank you