RESEARCHER STUDENTS

J.Benito Búa

Ies Ramon Cabanillas (Spain)

Notebooks of Mathematics aims the students carry out small researches where they use their knowledge about Mathematics and, if it is necessary, they obtain new knowledge. http://centros.edu.xunta.es/iesramoncabanillas/cuadmat/index.htm

The works were always done by volunteers and most of the students carried out the work in their free time.

In "Drawing a Crop Circle" the students have to design and take on the land a geometric drawing. Besides being a tool to carry out a geometric construction, GeoGebra was useful to measure lengths and distances, which were later converted to adapt them to the dimensions of the field where the drawing was carried out.

The "Vitruvian Man" is centered in the proportions of the human body mentioned by Vitruvius and Leonardo da Vinci. GeoGebra was used to check these proportions on a scanned image of Vitruvian Man, something a little more difficult to carry out without a computer. The students reach some interesting conclusions: the length of the elbow mentioned by Leonardo isn't the same as the one that appears in the drawing, the golden mean is not present in the relationship between circumference radio and length on the side of the square and the loss of height when opening the legs is not of 1/14.

In the pyramid of Kheops, GeoGebra has been used to make graphics related to the activities developped.

In the problem of Trigonometry it has the same function, besides allowing to calculate areas. In the logarithmic equation it allows to solve an equation graphically, a method that the students should know.

The problem of the demographic growth was outlined to be solved by using GeoGebra as a that allows to work easily with functions depending on parameters, although the students preferred to use a worksheet.

In the activity of the golden rectangles, GeoGebra is an useful tool to carry out a geometric construction on a scanned image and to take lengths of segments on the image.

This way, in all the problems and projects, GeoGebra is as a tool and not as a goal. In fact , in the web, other problems where GeoGebra is not important can be consulted.

Actually the question is, should we think about how to teach Mathematics using the computer or think about how to use the computer to teach Mathematics?. To focus too much in the computer as an innovative way of teaching Mathematics can give place to excesses. I will give an example:

When studying Trigonometry, we can outline a problem, giving the necessary data to solve it, expecting students to use their knowledge to solve the problem. Or we can outline the problem and let the students obtain the necessary data to solve it and then solve it. With a GeoGebra applet we can solve that same problem and all the problems of the same kind only by introducing the data. GeoGebra provides the solution but it isn´t the student who solves the problem but rather the author of the applet the one who has made it previously.

I will give another example. The utility of Mathematics to obtain models is undeniable. The present year I have carried out an experience about the deduction of a mathematical model. The study object is the behaviour of a stain of oil on water, which is justified for the students as a case of environmental pollution. I could give them the data with an obtained chart of some source and let the students build the model from these data but I think it is more interesting that the students are the main characters of the whole process from the obtaining of data until the construction of the model. The students obtained the data experimentally in the laboratory of the school, dropping oil on water, measuring the quantity of dropped oil and the diameter of the circular stain that appears on the water. Next, they introduced the obtained data in GeoGebra and they tried to deduce what function it approaches the points, function which turns out to be the square root multiplied by a constant that is different for each chart of data. It represents, therefore, a case of study with GeoGebra of functions dependent on parameters. In the first phase, the students should decide in a combined debate: what instrument to use to drop the oil and what instrument to use to measure the diameter of the stains. In the laboratory the students were distributed in 3-4 students' groups and each group had to decide what quantity of data to take and what values of volume of oil to use. Each work group introduced their data in a computer and they should deduce what function is the appropriate. Then a debate was carried out so that each group communicates its results to the rest of the groups. In a new whole debate the students discussed how it the function would be modified if, instead of representing diameter in the y-axis, we represent the radius or the area. How it would change if we represent the area in the x-axis and the volume of oil in the y-axis. Everything looking for the relationship between the results and the operations among functions. In

that way, among other operations, the composition of functions and the calculation of the inverse function appear. To end, the debate about why the square root is precisely the appropriate function was proposed.

It is an activity where the students are the main characters of the whole research, the teacher working only as a coordinator. In the experience, GeoGebra plays a very important role but its main utility is to make easy a work that, if GeoGebra weren't used, could be carried out but with much more work and efforts.

The question is evident: which should the role of GeoGebra be when teaching Mathematics?. Should it be a support or help or should it be the centre of the teaching?. Should we reduce its use to the use of available applets in the Internet, ready to be used, or to applets made by each teacher for his or her lessons or does its use go further on?.