

TEACHING TRIGONOMETRY WITH DYNAMIC GEOMETRY

Marie Pierard and Valérie Henry

University of Namur - Belgium

Trigonometry has an important place in mathematical Belgian education. At grade 10, students have to go from trigonometric numbers, with degrees and in triangles, to trigonometric functions, with radians and in the unit circle. This passage could be quite uneasy. To lighten this field, we analyzed the history of trigonometry and the Belgian programs and manuals. We are now questioning teachers and students. Afterwards, we plan to build a lesson using dynamic geometry to illustrate this passage.

TRIGONOMETRY AT GRADE 10

At grade 9, students discover trigonometric numbers in right-angled triangles (step 1). Sine, cosine and tangent are numbers: a quotient between the lengths of two sides of a triangle. At grade 10, they first extend the trigonometric numbers' definition in any triangle, measuring the angles in degrees and working only with positive angles (step 2). Then, they discover the unit circle, measure the angles with radians and work with any angle. Sine, cosine and tangent become functions (step 3). At grade 11 and 12, trigonometry appears in analysis with graphical manipulations, derivatives and integrals. We noticed that in France, our French-speaker neighbor, the curriculum is pretty different.

A LESSON USING DYNAMIC GEOMETRY

We plan to build a lesson using technologies to bring students from step 2 to step 3. To do that, we follow the didactic engineering process of Artigue, in four phases. The first one consists on preliminary analysis. Firstly, we studied the history of trigonometry and the Belgian programs and manuals. Now, we are questioning teachers to know how they do teach trigonometry in their classrooms (we distributed a survey on early December 2015 so we would be able to present results at ICME-13). We are also questioning 11th grade students to detect their difficulties and compare them with those noticed by Canadian and French colleagues (Bloch, Proulx, Tanguay, Vadcard).

Afterwards, we will study the pertinence of using dynamic geometry in this discipline, on computer or tablets, leaning especially on the artifact/instrument theory of Rabardel. Today, we hope that geometric manipulations would make students *see* mathematical objects like sine or cosine. Moreover, we want to use dynamic geometry to avoid drawing similar figures again and again. For example, we will draw a unit circle only once, and then adapt it to illustrate any trigonometric situation.

References

- Artigue, M. (1998). Ingénierie didactique, *Recherches en didactique des mathématiques*, 9 (3), 281-308
- Bloch, I. (2009). Activité... la mesure des angles en radians au lycée. *Petit x*, 80, 47-53.
- Proulx, J. (2003). L'histoire de la trigonométrie comme outil de réflexion didactique. *Bulletin de l'Association Mathématique du Québec*, XLVIII (3), 13-27.
- Rabardel, P. (1995). Les hommes et les technologies – Une approche cognitive des instruments contemporains, Ed. Armand Colin.
- Tanguay, D. (2010). Degrés, radians, arcs et sinusoides, *Petit x*, 82, 59-71.
- Vadcard, L. (2002). Conception de l'angle chez les élèves de seconde, *Recherches en didactique des mathématiques*, 22 (1), 77-117.