Training Teachers after Bridges

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Abstract

After attending to the last two editions of Bridges – Pécs and Coimbra – we introduced in our classes for future math teachers some ideas inspired in Bridges sessions. In this paper we give a brief account of this experience and of our students work with their students after our classes.

Introduction

In the last 20 years we have been involved in training math teachers for basic and secondary school. One of the problems teachers face very often is how to motivate students and keep them interested in classes. It is necessary to give students the right answer to the old question "what is that for?" Our experience showed us that, actually, students don't want to know the use of math topics in real life. They just want to be able to use them by themselves. For instance, the approach using functions described in [3], where students were assigned to use mathematical functions to describe curves in cartoons they designed, helped to answer this question when functions were concerned. Students usually study functions without seeing any application of this study. With the approach described there, students can handle function graphs for a purpose that they understand and, so, they stop asking about the use of studying so many things about functions because they actually apply those things. Bridges Conferences were a source of other interesting ideas that can be applied in other chapters of Portuguese math curricula, both as motivational ideas or as applications of the studied topics. We decided to include some of these ideas in our classes for future math teachers and to encourage them to really apply them in their teaching practice. The idea is providing the teachers with tools that help motivating and applying mathematics but that, as far as we know, were not used in Portuguese basic and high schools. In what follows we describe how our students converted some of these ideas in a reality during their training period on schools.

Balloons

In Bridges Pécs, we attended Vi Hart workshop *Mathematical Balloon Twisting for Education* [2] and we thought this approach could be very motivating both for teachers and students, as balloons are very popular in Portugal. At that moment we couldn't imagine how our future teachers will become enthusiastic with the idea. After one class teaching them a few basic things about twisting balloons and some of the possible relationships between that and mathematics, our students began to figure out how they could use it in the classroom with their students and, afterwards, they really did it!

In Portuguese high school there is a course called Mathematics for Social Sciences, which is attended mostly by students that don't like math at all. One of the chapters of this course is about graph models. Together with our students – teachers to be – we prepared a practical activity with balloons

named “When graphs take shape” on graph theory topics such as circuits and paths. The question was not teaching the concepts, as they already knew them; the aim was to make them really understand the ideas behind the concepts and see a different application of mathematics. The activity was a success and the students that attended it were very happy at the end because, through balloons, they suddenly understood things that they couldn’t understand before, such as the characterization of Euler paths and Euler circuits. And, of course, they had a great time (and their teachers too!).

Figure 1 - *The first twisting balloons class*

As the training period for future teachers takes place both in basic schools and high schools, our students also prepared activities for younger children, age 10-12, and they had the opportunity to present it at the beginning of the academic year in the School Day. Although at this level they don’t study graphs, the activity started with a few definitions on graph theory, with the aim of making the connection between graphs and balloons and, then, applying this to something they already knew: polyhedra. Young students really took this activity seriously: twisting balloons with the form of different polyhedral is quite a challenging activity.

Figure 2 – *Tetrahedron sculpture*

With the help of teachers, they started mastering the art of balloon twisting, just doing dogs, but soon they were concentrated in doing tetrahedrons, following the directions on the screen, as it can be seen on figure 2. Children were very interested in the question of the number of balloons required to do each polyhedron and it was also an opportunity for presenting them the five platonic solids which is a topic of the curriculum, but later in the academic year. They students commented many times that they never imagined that mathematics could be connected to balloons and that math activity was the best of the whole day. They also commented that they should pay more attention to math classes because math could be full of surprises. Most of them left the classroom very happy wearing tetrahedrons like helmets.

Figure 3- *Lots of fun in the classroom*

Pull-up polyhedra

At Portuguese schools, students are taught about polyhedral models, starting with regular shapes and, finishing, by the age of 15-16, studying polyhedra like the cuboctahedron. Nets for polyhedra are very popular and students are encouraged to use the unfolding of polyhedra to solve geometric problems. However, pull-up polyhedra is something unknown in Portuguese schools. It was also unknown for us until the Family Day, in Bridges Pécs, where we did some with Escher-type tessellations. Following the ideas in [4] and [5], again we challenged our students to apply this on their own teaching. As platonic solids are studied in different grades, they prepared a colorful kit with the possible nets for pull-up polyhedra, prepared for different activities according to students age.

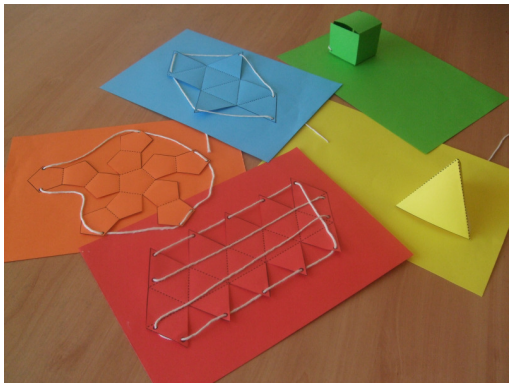

Figure 4 - *The pull-up polyhedra kit*

They first applied it to young students and the reaction, again, was very positive. Although they had studied it before, at the beginning of the class none of the students knew exactly the names of the five platonic solids. After preparing their own kits they knew, not only the names, but a lot about them. After they started thinking about other possible nets for pull-up polyhedra and, above all, they understood that nets for polyhedra could be of immediate use. All of them wanted to keep the whole collection, so they could surprise friends and family pulling-up the solids.

Sonobe modules

In Bridges Coimbra we attended Nick Fout and Jenn Marker's workshop *Folding Your Way to Understanding* [1]. The construction of a Sonobe module is a good departing point to apply Pythagorian theorem or some trigonometry to study the angles and measures of the Sonobe module. After that comes the 3-D part.

Again our students were strongly willing to apply this knowledge on their classes. When the moment arrived to use it in the classroom students were enthusiastic, not only with the paper work done, but trying

to solve some related geometry problems. Some students noticed that, as each Sonobe module has two pockets and two points, it was possible to assemble any number of Sonobe modules. A group decided to do it and the "winged polyhedra" appeared. They discovered a pattern: Each time they add a Sonobe module they could not always build a new polyhedron but they could add a "wing" to the last polyhedron. They did it from 2 to 12 Sonobe modules and the result is shown on figure 5.

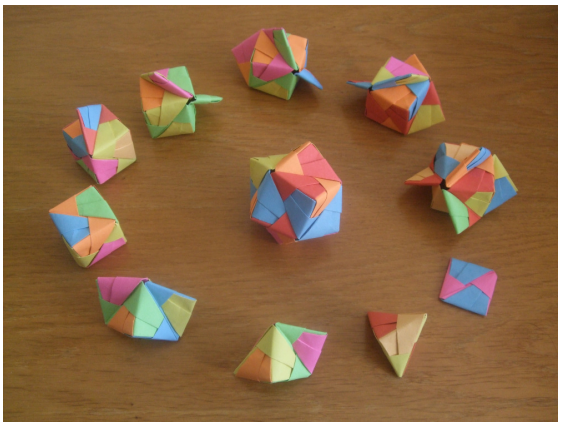

Figure 5 - *The winged polyhedra*

Using this kind of modular origami proved to be a very motivating tool for dealing with geometry problems, including the use of trigonometry, a topic that students usually don't like. While trying to solve some of the questions they were asked to answer, the trigonometric tools appeared naturally and even the students seemed surprised that trigonometry could be so useful.

Conclusion

Besides the topics described in this paper, we taught our students other items, some based in Bridges talks or workshops, other not, but all created with the inspiration we got from Bridges Conferences. The classes we gave our students opened them new horizons. Now they are convinced that finding stimulating motivations and applications for math topics is a right way to help students to really learn mathematics. In the schools where the activities took place many other teachers were very interested in that kind of approach, unknown to them, and we are preparing now a course for them on the same topics.

References

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