WRITING TEACHING MATERIALS FOR PROJECTS IN MATHEMATICS EDUCATION FROM THE DESIGN OF EVERYDAY THINGS

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ABSTRACT

In this paper we try to show the richness in the geometry of everyday things for developing projects in high school and in Mathematics teacher preparation. We examine some experience reported in the literature (Balbuena, 2000; Alsina, 2005; Zverkova, 2006) and then we present two cases: the building of a prismatic shaped house for wild birds and the geometry present in the heart of palm allocation in a can. Both cases reveal a wide range of possible mathematical and historical explorations for high school students and prospective Mathematics teachers. Our aim is to write materials for helping teachers to build engaging, fostering and relevant learning environments.

Key Words: Mathematical exploration, Project Approach, Teacher Training.

INTRODUCTION

One of the Mathematics Education aims is to provide opportunities to students for "doing" Mathematics, that is to explore, experiment, conjecture, solve and pose problems (NCTM, 2000).

The geometry of everyday things, through the Project approach, gives to the students the opportunity for exploring and modeling while working with real life problems.

MATHEMATICS AND REAL LIFE PROBLEMS

This paper is framed in the Realistic Mathematics Education through guided invention and the so called emergent modeling (Gravemeijer, 2005). It is well known that modeling reinforces the interdisciplinary approach, fosters creativity and shows the links between Mathematics and real life problems.

In the literature there are interesting works reporting teaching experiences using real life problems. Balbuena (2000). With his high school students has explored the geometrical resources present in La Laguna historic downtown at Spain. Many goods and product packages have interesting geometrical properties, and Alsina (2005) has compiled and analyzed many examples which can inspire research projects from the geometrical design of many everyday things. Shaham et al (2008) have developed a trip around the school neighborhood in order to expose the students to facts about Geography, History and Mathematics. The experience has been highly motivating and a good source of research subjects for the students. Zverkova (2006), teaching how to study environmental problems with the help of mathematical models in such a way that the students could adapt the model to their own geographical context, found – besides the mathematical advantages – that this personal and emotional approach can lead students to pay more attention to the environment.

DEVELOPING TEACHING MATERIALS FROM REAL LIFE PROBLEMS

In order to develop learning mathematical processes in a meaningful context making connections between Mathematics and real world problems, teachers need suitable written materials. Movshovitz-Hadar (2008) says that for developing creativity in Mathematics it is very important to compile, test and analyze sets of valid tasks.

One of our experiences began in Manresa Center gardens – at Dobogoko, near Budapest – in that place there were several models for building bird houses. One of the designs apparently had more information than necessary to build a prismatic shaped house. Analyzing the situation, we found that the problem could be solved at different levels – from high school to teacher training – with different tools (Romero and Castro, 2008): for instance:

- The problem can be solved using Euclidean Geometry by applying either Thales or Pythagoras theorems.
- The building can also be considered an optimization problem and could be solved through one or two variable Calculus.

Another of our experiences arose just opening a can containing hearts of palm – a vegetable product produced by the palm *Bactris gasipaes*. Sometimes the can contains exactly three cylindrical pieces of palm mutually tangents and also

tangents to the can; in this case we have a rigid configuration. This fact can be the starting point of several exploration paths in subjects, such as:

- Geometry
- Discrete Mathematics
- Fractals
- History of Mathematics
- Foundations of Mathematics.

In what follows we present some specific tasks:

- The problem of finding the radius of each cylinder can be approached via locus of points, and this path will carry us to conics.
- If we add a fourth heart of palm – tangent to the other three – we will have an example of the so called Steiner's Chain. The study of that interesting configuration can lead us to a very rich kind of Mathematical problem–proposition: the *porism*. This can be a first step in revisiting History and Foundations of Mathematics.
- There is also a nice formula – discovered by Descartes – which gives a relationship between the four mutually tangent disc curvatures. The original situation is also related with one of the ten Apollonius' problems.

We think that these starting points can have a multiplicative effect in the teaching practice, fostering the creativity between the students.

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