Problems to put students in a role close to a mathematical researcher

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Abstract

In this workshop, we present a model of problem that we call Research Situation for the Classroom (RSC). The aim of a RSC is to put students in a role close to a mathematical researcher in order to make them work on mathematical thinking/skills. A RSC has some characteristics : the problem is close to a research one, the statement is an easy understandable question, school knowledge are elementary , there is no end, a solved question postponed to new questions... The most important characteristic of a RSC is that students can manage their research by fixing themselves some variable of the problem. So, a RSC is completely different from a problem that students usually do in France. For short : there is no final answer, students can try to resolve their own questions : a RSC is a large open field where many sub-problems exist; the goal for the students is not to apply a technique: the goal is, as for a researcher, to search.

These type of situations are particularly interesting to develop problem solving skills and mathematical thinking. They can also let students discover that mathematics are “alive” and “realistic”.

This workshop will be split into two parts. First, we propose to put people in the situation of solving a RSC to make them discover practically what is it. After, we present the model of a RSC and some results of our experimentations.

Introduction

In 1969, at the first International Congress on Mathematical Education, Hans Freudenthal said in an address:

> *Mathematics is more than a technique. Learning mathematics is acquiring an attitude of mathematical behavior.*

In this workshop, we present a model of situation the goals of which are not to learn a specific mathematical notion but to learn mathematical behavior and especially mathematical thinking/skills related to problem solving. By mathematical thinking/skills related to problem solving, we mean : formulating conjectures, carring out experimentations, posing new problems, proving, defining new objects, modelling... So, here we propose a model of situations that can let students work on that.

As our goal is to let as many students as possible work on mathematical thinking, we also build our situations with the aim that mathematical notions are not an obstacle to understand the problem and to start the research.

The sequence of the workshop

First, we propose to the participant to try to solve a mathematical problem which satisfies the characteristics of our model. In the second step, we make a didactical and epistemological analysis of the problem which enable us to identify some characteristics of our model. Finally, the model will be given and we will present the results of our experimentations. At the end, if we have enough time, we will also present others situations.

An example of problem :

Consider a garden which is a “piece” of grid. There are flying bugs which land in our garden and it is riling us!

So, we decide to put traps (one trap takes one case) in our garden to stop them. But, unfortunately, a trap costs a lot of money. So, we want to use the shortest number of trap.

We give some examples where we use the garden of figure 1 and the bug of figure 2.

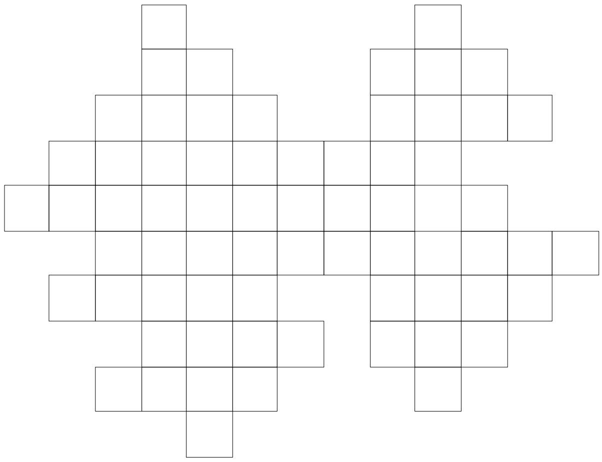

Fig. 1: An example of garden

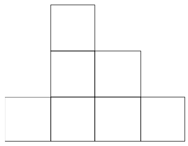

Fig. 2: An example of bug

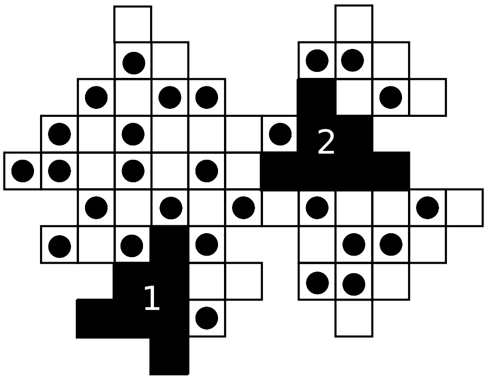

Fig. 3: A location of traps where a bug can land.

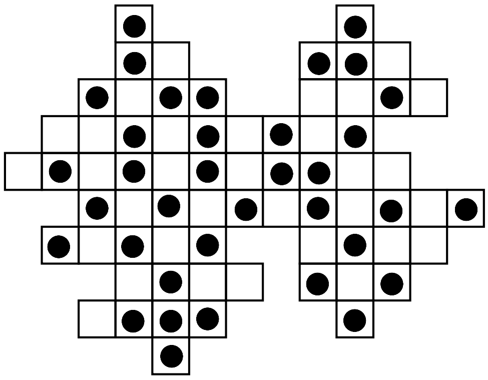

Fig. 4: A location where any of the bug can land

In Figure 4, the location of traps enables any of the bugs to land, but can we do better ?
This problem is linked to a research problem. Indeed, it was inspired by Pentomino Exclusion problem due to Gollomb (1994) and partially solved by Bosh (1998) and; Gravier and Payan (2001) and Moncel (2007).

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