Witold Kranas
Teacher trainer in the center for in-service teachers training in ICT. Co-author of schoolbook "Lessons with computer" for lower secondary school students, now preparing schoolbook on ICT for primary school (published in 2004). Involved in popularization of LOGO language in Polish schools.

Centre for Informatics and Technology in Education
02-026 Warsaw, Poland
Raszynska 8/10

Email: witek@oeiizk.waw.pl
Tel.: +48 605 883 881
Fax: +48 22 626 92 50

Short paper
Let Children Play to Develop Mathematical Ideas – Imagine Microworlds Examples

Abstract
Many primary school mathematics teachers in Poland are interested in using ICT during lessons. My institute is involved in international project MatComp – Applications of Information and Communication Technology in Learning and Teaching Mathematics, aiming to help teachers of mathematics in Poland and across Europe to become confident and competent users of ICT in everyday professional practice.
We are also taking part in international project CoLabs proposed by Márta Turcsányi-Szabó. Polish part of the project is to define and develop collaborative microworlds for mathematical and scientific modeling for secondary school children aged 12-18. Presented microworlds are either product of Polish team working on CoLabs project or side product concerned with this work. All microworlds are prepared in Logomocja – Polish version of Imagine. There are 4 microworlds: one second grade example – counting the rests, one forth grade example – factorization and two six grade examples: bare code and vectors. Microworlds are defined on the base of constructivist approach. There are possibilities of different kinds of pupils activity, gathering the experience, answering questions: what will happen when we change...

Keywords
microwolds, vectors, factorization, bar code, Imagine

There is a pressure in primary schools in Poland to use computers across curriculum. The process starts at a level of elementary education, where the pupils are mainly drawing and playing simple games. Many primary school mathematics teachers are interested in using ICT during lessons. My colleagues were involved in international project MatComp –

Applications of Information and Communication Technology in Learning and Teaching Mathematics, aiming to help teachers of mathematics in Poland and across Europe to become confident and competent users of ICT in everyday professional practice. The key element of the activities was the modeling of mathematical systems in the form of open and accessible computer programs.

Now we are taking part in international project CoLabs proposed by Márta Turcsányi-Szabó. Major challenge of CoLabs is to find ways to support children in building and testing models collaboratively across European cultures and beyond. Polish part of the project is to define and develop collaborative microworlds for mathematical and scientific modeling for secondary school children aged 12-18.

Presented microworlds are either product of Polish team working on CoLabs project or side product concerned with this work. Two of this microworlds are included in primary school informatics course. All microworlds are prepared in Logomocja – Polish version of Imagine. Imagine Logo is a strong authoring tool for development of sophisticated microworlds. I'll present 4 microworlds: one second grade example, one forth grade example and two six grade examples.

Second grade example (8 years old pupils): counting and rests (remainder).
The theme of microworld is counting money – what will be the change. It is based on Imagine authors project (A. Blaho, I. Kalas, P. Tomcsanyi and L. Salanci) presented on Imagine workshop in Warsaw.

The activity is to calculate and "pay" the rest. You can se the sum to pay and given amount of money. Button **To pay** – causes picking up a new sum to pay and the amount of money which is given (and also clearing the pane). Button **Check** – calculates the rest and checks paid rest.
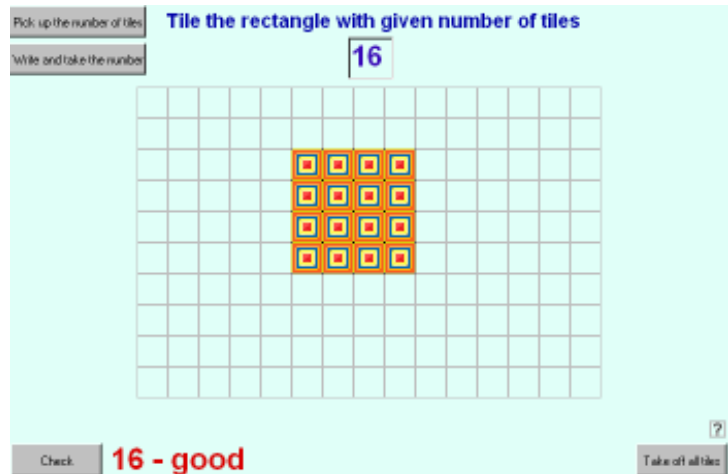
Paying the rest - is dragging coins to the blue pane. When a coin is dragged to the white pane it returns on its stack.

Forth grade example (10 years old pupils): factorization.

Building rectangles out of tiles pupils can exercise factorization of numbers. It may also help in understanding concept of prime numbers. The activity is to tile a rectangle on a mesh out of a given number of tiles.

A tile is placed by clicking on a mesh. Clicking on a tile clears the tile. Button **Pick up the number of tiles** – causes picking up at random new number of tiles and drawing a mesh. Button **Write and take the number** – allows to take written number of tiles and draw a mesh. Button **Check** – causes checking whether rectangle is properly constructed. Button **Take off all tiles** – clears the mesh. If number of tiles is a prime number it is not possible to tile a rectangle.

Sixth grade example 1 (12 years old pupils): bar code.

The code is simplified to white and black bars replacing 0 and 1. Counting the value of the bars is changing from binary to decimal representation, while building a bar code is changing in reverse direction.

The activity is to calculate bar code. **New bars** button – allows to take by lot new bar code. Calculated code number should be written in white field. After pressing **Check** button triangle turtle will check the code. Configuration of 0 and 1 suiting the code and the code number will be seen. **Fill bars** button allows to draw bars (using a pencil).
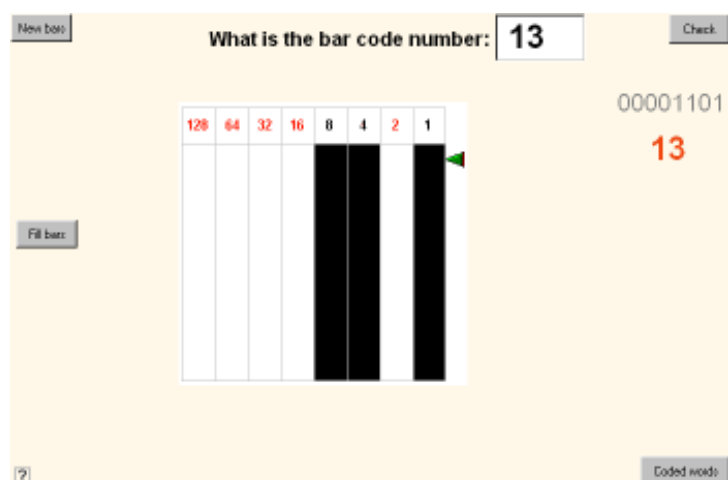
Coded words button causes jumping to the page with words to decode (letter numbers are ASCII numbers of big letters).

Sixth grade example 2: vectors and coordinates system.

The aim of this microworld is to introduce different ways of presenting vectors: graphic representation, analytic representation in Cartesian coordinates system, analytic by length and direction (circular coordinates system) and by means of colors (model of space of colors). The exercises show the connections between different vector representations and help to understand what is vector and how it can be represented.

The first page of microworld shows two representations of a vector – graphic and analytic. The vector placed on the light blue pane may be changed by dragging an arrow. Changing vector arrow causes change in analytic representation shown in the field below a pane.
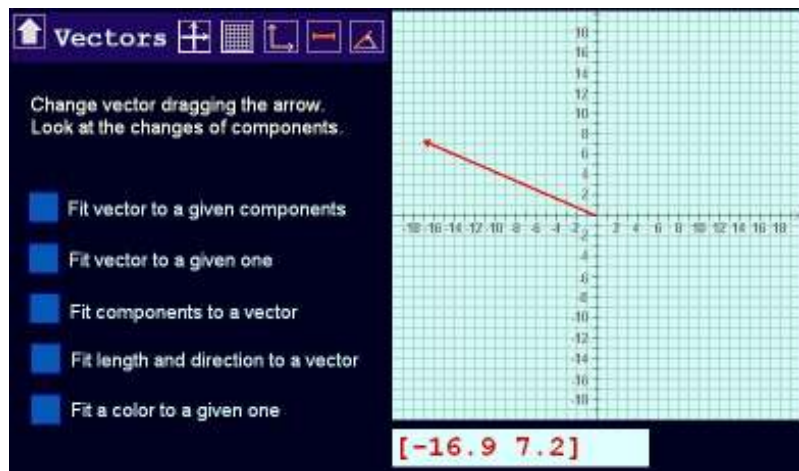
Activities examples

1.1. Drag vector arrow to different places of blue pane. Look at the changes of components in analytic representation. Write down your remarks.

1.2. Check how big is a blue pane. Drag vector arrow to the borders of a pane. Write down results.

1.3. Switch on the grid on coordinates system. Using it try to set up vectors:
    [1 1], [10 10],
    [5 -8], [-5 8],
    [7 7], [-7 -7],
    [-9 15], [15 -9]
    Describe how are vectors in pairs interconnected.

1.4. Switch on the components presentation on the plot. Find and write down 4 different vectors with the same values (lengths) of components.

The last page of microworld shows another vector model

Any color is a mixture of three fundamental colors: red, green and blue (RGB model).

Let assume that each fundamental color may have 256 saturation levels from 0 (no saturation) to 255 (full saturation). So color may be represented by vector with 3 components showing
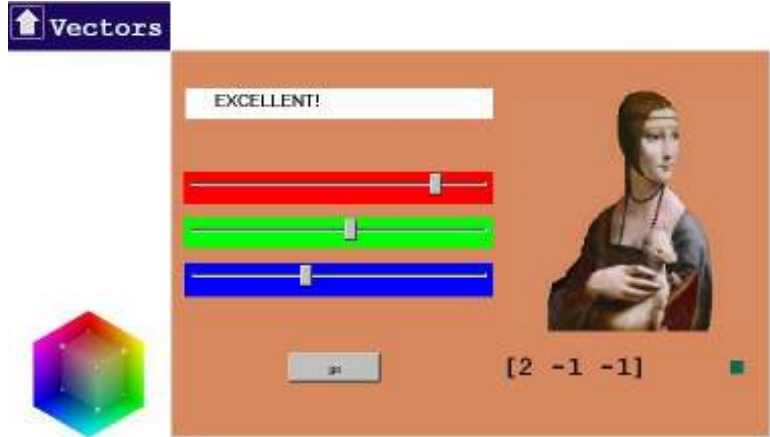
saturation of red, green and blue respectively. For example vector [0 255 0] will represent green.

Activities

2.1. Using sliders change the color of the square placed on the right and compare the color and color vector form.

2.2. Using sliders set given color vectors. Write down the colors.
[255 0 0]
[0 255 0]
[0 0 255]
[255 255 0]
[255 0 255]
[0 255 255]
[255 255 255]
[0 0 0]

2.3. Press **go** button. New pane color will be picked at random. Using sliders change the color of a square to fit pane color. Check how it fits pressing **ready** button.