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DEVELOPMENT OF SPATIAL ABILITIES WITH DIDACTIC COMPUTER GAMES.

Students of engineering are expected to have a good spatial imagination, which is essential for their work. Most people have to deal with some kind of 3D environment as well. But how can they get familiar with an abstract 3D space? A spatial imagination is not easy to gain, students have a lot of troubles with it and the situation seems to be getting worse. It seems clear that we need more methods how to improve and develop the abilities. The sooner we start the better. Opportunities for the improvement missed at the age of 10–12 years are difficult to substitute later. Apart from essential manual manipulation, one way how to reach better understanding of 3D tasks (even seemingly without hard work) is using a computer, especially using computer (didactic) games. Students may enjoy the activity and teachers do not have to spend long hours preparing didactic materials. The aim of this paper is to show four didactic games and aids for teachers. Each of them offers a program, the background for solving problems and a set of tasks for children or students from 10 to 20 years. Games are freeware and require only web-browser with VRML plug-in (it is free, too).

Game 1 – BUILDING SET – was originally designed to support the understanding of a coordinate system id 3D space. It was planned to be a game for young children, but it showed a lot of help for 18 years students. This game requires pupils' building designed shapes in a text background. They choose basic shapes and set their position and size in orthogonal coordinate system. The game supports using a correct terminology. Pupils can create their own imaginary scenes or build given shapes. Viewing and manipulation with resulting scene is realized – as well as in the other games – in a virtual space using VRML background.

Game 2 – "GAME" – seems similar, but it is more like a kind of brain-teaser. The goal is to develop student's shape and position imagination, to guess hidden parts, and to combine shapes. The solution is evaluated. GAME can be used by young children and by 20-

year-old students as well. We have created a set of approximately 30 tasks and didactic materials for this game. The demands of tasks increase from very simple ones to the brain-teasers that train technical imagination. It can be used at school training or for homework. Teacher can receive a tool for testing student's ability. The record of student's solution is written into a text file.

Game 3 – "UNFOLDING CUBE" – is a "live" version of well-known quiz: "solve how an unfolded net of a given cube looks like". Students (or a teacher) can generate a cube (they can choose textures and texture orientation of the sides of the cube), then examine (rotate) it in VRML 3D scene and then unfold it with hidden textures (for the demonstration of a correct solution it is also possible to see the textures during the process of unfolding). Finally, they draw the position and orientation of figures on the sides of the net, while the textures on the original (folded) cube can be seen or hidden. The application also offers a tool that allows teachers to create easily a set of different printed tests and quizzes: filling up missing figures on sides of a cube, sorting nets etc. Hand-making of such a test is terribly time consuming and it is always difficult to explain to students the mistakes if you don't have the solid cube in real. The program can stand without it.

Game 4 – 3D DOMINOES is a dynamic, "strategic" game. It is more complicated version of a well-known desk game and it requires player's manipulation with cubes in 3D scene (via keyboard or manipulators) and connecting the sides of cubes. By connecting sides equally "rated" (labelled), the player scores. We have different variants of this game – game for one or two players and with or without timing, scenes pre-arranged or generated at random. It is also possible to compete who scores more in one particular game. The game for two players allows to prevent a rival from annexing one's valuable positions and to plane the best tactics. It is based on the need of imagination of position in 3D space.

Using computers in classroom activities brings – besides its undeniable advantage – a lot of troubles and risks. Pupils and students tend to play and simply enjoy the game without gaining any knowledge. The ways how to avoid this include a precise and detailed teacher's lesson plan and individually formulated tasks. There is also another way: using the programs that essentially require such training abilities that when missed do not allow gaining the solution of the problem. The training of spatial abilities is a difficult task. But it is definitely worth trying and using computers is a suitable way.