

The maximum number of rectangular islands - Experiments in the classroom

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We consider the combinatorial problem of rectangular islands by elementary means. The topic of islands and the methods for its investigation is suitable also for high school students, although some of the corresponding results are quite new. We believe that it is worth to show the topic of islands to teachers and young students because not only new research questions, but also many easy and novel exercises can be created in this topic. Moreover, the motivated students can be involved in the process of constructing definitions for a suitable mathematical model, which is not typical in the standard math curriculum. Because most of the problems are of finitary type, experimental mathematics with computer support proves to be useful for the formulation of general conjectures related to the bounds of the number of islands in particular configurations. The use of calculators and computer algebra systems is gaining greater and greater importance in education today. Their functionality is twofold here: we construct several graphical representations and interactive games which facilitate detecting finite patterns which might lead to general conjectures. To make interactive computer games and demonstrations we used the computer algebra system Mathematica 6. The aim of the first game is to create as many islands as we can on a rectangular board. In addition, by increasing or decreasing a cell height, the new configuration is replotted and the sum of the number of islands will be immediately recomputed by the computer. Moreover, the user gets a checkmark if the maximum number is reached. In the second game the user starts with a 3D cuboid representation of a given island system. By a slider, he can increase or decrease the water level. The tool brings the idea of a particular enumeration of the islands closer to the learner. The use of interactive games can support the shift from frontal teaching to project based, self-paced or active small group learning. The learning process is an active one and it can only be successful and effective if students actively participate. Therefore, the joint interpretation of the observations and results gained by using the interactive computer games will probably encourage and motivate students to formulate conjectures or simply ask reasonable questions. The role of the teacher here is to organize, facilitate, control and to guide the empirical activities of the students. For the integration of computers into math education, we refer to Buchberger's White Box/Black Box principle.

References

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