Knowledge construction in the Bebras problem solving contest

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Abstract

In this workshop we will try to discuss the question: how can a computer science contest contribute to knowledge construction? Usually a contest tests already learned knowledge and skills. In the case of the Bebras contest no pre-knowledge and no specific skills are required by the students (age 10-19). While participating in the contest they can learn about different aspects of computer science concepts, like information representation, structures, algorithmic aspects, automation aspects, etc. While trying to solve given tasks the students may construct their knowledge that is related to the presented problem sets. The quality of the problem set is most important for giving the right stimuli for learning. That is why we will discuss, based on some given Bebras tasks, the attributes of tasks that allow a maximum effect on the learner's knowledge construction.

Keywords

Computer Science Concepts, learning Informatics, learning by contest, knowledge construction

Seymour Papert wrote how children learn in a particular context using their own and from others created objects (Papert, 1993). A main point of constructionism is not to accumulate more and more knowledge, but to learn different methods and ways of targeting information and to select and absorb the abundance of knowledge and using them effectively to create new knowledge. The constructionistic learning can be conducted in different ways. We will concentrate here on the way via solving tasks while participating in contest.

„Bebras" (Lithuanian for beaver) is an international initiative to promote Computer Science (CS) among teachers and students aged 10 to 19 (http://bebras.org). The Bebras method is to organize easily accessible and highly motivational online contests in many countries (Dagiene, 2008; Futschek, 2009). Each country-wide contest asks small and interesting questions that can be answered without prior knowledge about CS, but are clearly related to CS concepts and require computational thinking skills in information representation, discrete structures, computation, data processing, as well as algorithmic concepts. That is, any Bebras question can both demonstrate an aspect of CS and test the participant's CS-related talent. Since 2004, Bebras has quickly spread across Europe and in 2011 there were 370,000 students participating; thus, it is the non-school activity in CS education with the largest audience.

Each country provides a set of task proposals, and the whole pool of proposals is then discussed at an international workshop. The national contest organizers make up their national task set from

this pool. A subset of the task pool is determined to be mandatory and must be used in all national Bebras contests.

The International Bebras Contest is a very ambitious contest. It does not test pre-knowledge or specific skills learned at school. In contrary there are only problem solving activities, no pre-knowledge is necessary. The students may learn aspects of informatics concepts by solving Bebras tasks. The better the problem-solving skills the better are the results. The more tasks the students have worked on the more they have learned. A very important aspect of the Bebras tasks is the construction of knowledge in CS. The tasks should have the character of a game and not the characteristic of an examination. This workshop will enable participants to explore, understand and evaluate the Bebras tasks and to find out how they involve concepts of informatics.

The contest is for all lower and upper secondary school pupils, divided into four age groups. Students have to solve 18 to 27 tasks on different levels within 40-60 minutes, entering answers via computer. They do not require a specific topic knowledge, but they require to be able to reason with common structures in the CS/informatics canon.

The tasks involve concepts such as algorithms (sequential and concurrent); data structures (heaps, stacks and queues, trees, and graphs); modelling of states, control flow and data flow; human-computer interaction; and graphics. Students do not formally study these topics, instead, the topics are introduced implicitly by letting the students thinking about interesting problems. A "narrative cover story" is used to relate the tasks to an underlying topic.

List of Content:

Contest tasks that inspire thinking
Aspects of Knowledge Construction
Outline of "Bebras International Contest on Informatics and Computer Fluency"
Learning through a contest
Example tasks that support knowledge construction
The challenge to design such tasks
The experience of some participating countries

Duration of workshop: 2 hours

Expected audience:

IT teacher, teacher educators, educational scientists.

If there are secondary school pupils of local schools available we can even perform a 40 min contest with them during the workshop.

Example of a Bebras task

Graph of a map

Maps can be easily pictured as graphs. In such a graph every node is a country and the lines between the nodes mean that they border each other. The picture shows a graph of a map with seven countries. Jim has to find a map that fits the given graph. He has four options. Can you help him find a map that matches the graph?

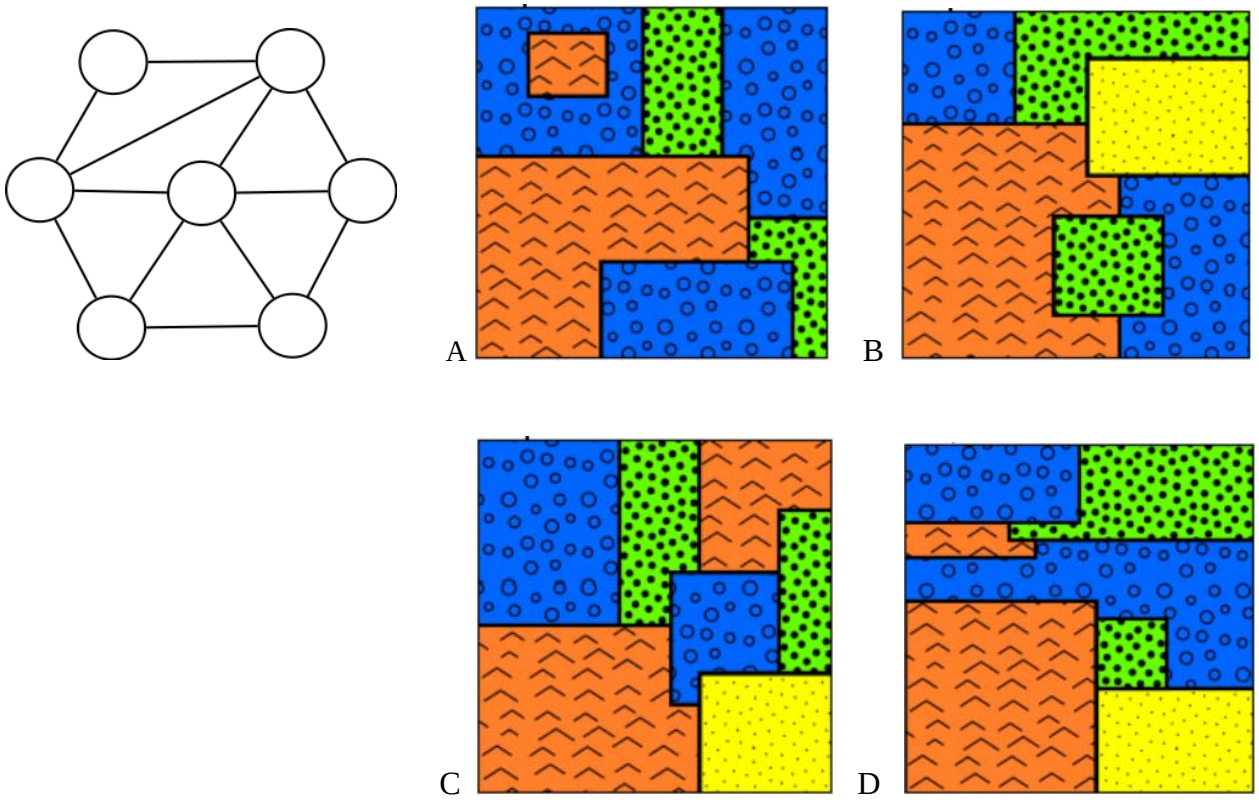

Figure 1.The graph and multiple-choice answers

While solving this task the students learn that a graph may represent the neighbourhood relation of a map of countries. They also develop strategies to find out which map relates to a given graph. In this way the Bebras task helps constructing knowledge and thinking skills that are closely related to Computer Science.

References

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