Computer assisted constructive tasks with infinite set of solutions for mathematical olympiads and contests

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Abstract. The report presents a usage experience of constructive educational tasks based on computer models. It is shown, that participants of competitions may construct many and various different solutions if they use software tools based on a computer model of a subject field to manipulate its objects. A solution representation in terms of some construction allows for assessing this solution by means of a set of formal criteria. Some criteria may be specified explicitly as objective functions to be optimized by participants, others may be stated a posteriori to test different methodological hypothesis about solutions features.

From the point of view of automatic assessment, this approach can be treated as a transition from multiple choice tests to tasks with an infinite set of solutions. To specify a way to automatically asses a constructive solution, a teacher does not need to describe a solution that he or she should know in advance. He or she should rather specify a set of criteria that must hold for a solution. Criteria used to analyze a solution also allow for assessing partial solutions and providing feedback for participants while they work with a task and thus adjust their work.

Authors also explore a usage of constructive tasks uas an intermediate step to generalize partial solutions and ideas to justify the full solution. The series of competitions in discrete mathematics have been designed and implemented. This competitions suppose a constructive activity with software tools to be followed by theoretical tasks. Such series of tasks were also tried out as a part of the discrete mathematics course in a technical university.

During the experiments held inside the „Construct, Test, Explore" competition and inside the Olympiad in discrete mathematics and computer science, the constructive tasks proved to be appropriate for participant of different level of preparation. But they also proved to have a drawback, that participants overfocused on the experimental activity to the expense of theoretical analysis of a task.

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