Ten Years of Creative Robotics Contests

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Abstract. Educational Robotics is a new field that did not win the position it deserves in the educational systems yet. We look at its role from a natural view, provide some didactic arguments and concentrate at robotics contests. We focus on one type of robotics contest that is not very common – creative robotics contest. We have been organizing it in Slovakia for ten years and wish to share our views and opinions with a wider community.
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1 Introduction

Learning to be creative, self-motivated, goal-minded, and capable of effective and efficient gathering, organization and application of information should be among the highest-priority goals of the contemporary schools. Regardless of how natural these capabilities might be for a human being, they can easily be left undeveloped when youngsters are growing up in a non-stimulating environment, an environment lacking challenges, interactions, opportunities, and stimuli. A highly hierarchical, structural and very advanced organization of the society we live in can easily become demotivating, boring, or even frustrating for young people. Creating smaller or larger isolated worlds on its own with rules and facts that are comprehendible and contain goals and challenges to be achieved by systematic efforts can be among the best possible scenarios to stimulate creativity, self-motivation, goal-mindedness, and information processing. Let us call these "worlds" virtual games. Participants of virtual games can be individuals or cooperating groups, teams. Finding ways of effective inclusion of virtual games into educational process is a key to its success.

In the context of information processing skills, and other contexts as well, let us underline that it must be recognized how centrally placed virtual games are to the informatics education even when they do not relate to informatics, computers, or algorithms directly. They typically require planning, role assignment, scheduling, task distribution, progress reporting, logging, evaluation and presentation of information and results. Many of these are important elements of thinking about and dealing with information. Having them established in one's mind before attempting to understand and acquire specific concepts and skills corresponds to building a bridge instead of trying to jump over a wide river. The second approach often results in sinking and drowning. And we have witnessed this fate in various attempts. For instance, when trying to integrate computer programming into standard curriculum. In those cases, the mental substrate – the foundations to be built on were simply not there. Every attempt resulted in a collapsed structure, falling down to the river, passing away and leaving no traces. How harmful this has been to our field!

Starting with virtual games that do not directly relate to "computer science" might also be a very suitable way of connecting the children's interest and buying them into the course framework. Once they feel comfortable, further informatics concepts may slowly be integrated into the scenarios they experience. In this way, we may achieve popularity and passion of informatics courses among the children from the very beginning and further on. In fact, we believe this is the only way that works and it is also what we are trying to do. Provide entertaining activities that ignite the interest and generate self-motivation. We live in a society, where education-by-force does not work any more. That era has passed! We live in a society that should be labeled education-by-motivation. And even though the idea has always been there, it has only recently become possible and it is now flowing into the main stream.

Setting up virtual games demands immense amount of work to be performed when realized by every teacher separately. Sharing and common organization seem to be an implicit requirement. Shared scenarios imply or at least provide for a social aspect among the participating groups or classes. These common activities may involve meetings, shared presentations, and awards. They can take form of independent or interconnected challenges – a virtual game for one class or a team, or *a competition* of multiple individuals, teams or classes. We believe, competitions are an excellent example of virtual games. They are a very potent bridge building activity. Bridges between different parts of knowledge, reasons, arguments, beliefs, facts, constraints, positions, activities, dependencies, sequences, etc. are inevitable for learning. We think that the real contribution of competitions to the educational progress of an individual is more substantial than it is generally believed. We think that they deserve more attention. However, we have to be careful here, and not to organize a competition just for the sake of it. There are various kinds of competitions, and we will elaborate on this idea further below.

In the remaining sections, we will discuss the role of the competitions, the role of robotics in informatics education, and provide a short overview of robotics contests. We describe our creative robotics contests, which are the main focus of the article. In the later sections, we describe how we support the teachers in the educational robotics activities, evaluate the outcomes of our efforts, and finally conclude with a few remarks on the future.

2 Competitions

In this and our previous work [1], we have learned about the key characteristics of the competitions:

Competitions have a fixed deadline that cannot be moved in any circumstances. This provides a learning experience of a hard constraint. In order to succeed, pupils must learn to work well with time, set their priorities, and weigh their decisions based on the finite resource they are dealing with. The deadline also works as a strong motivating factor and helps pupils to learn to perform time-efficient work, and to deal with stress.

Successful competitions are prepared by experienced individuals who are able to asses the difficulty of the task specification and select tasks that are neither too hard nor too simple. Pupils that participate in the competition can usually support their thinking by the assumption that the task is solvable. The task is defined in very clear and graspable language. The task specification defines a small world of its own as we described above. The competition organizers also make sure their task is novel, and the solution cannot be tricked by searching for it on the Internet.

Competitions are organized around standardized platforms. Participants know in advance what they can expect, what tools and skills will be required to take part in the contest. Large user communities form around standardized platforms, online forums, manuals, tutorials, and example projects help the participants to get started, and keep a steady progress without running into a wall and being blocked on an issue that could not be resolved for weeks.

Competitions allow the schools and teams to attract the media and sponsors' attention. They are also a good opportunity to persuade the school administration to provide the best practice space, time, and human resource conditions to the team in order to maximize the chances the participants win an award, helping the school image. It is also a useful opportunity for the teacher to let other students in the school know about the activities and inspire them to join in.

A very important aspect is the one of relating the children's performance against their peers. Young people are permanently and intensively trying to determine and learn about their role in the society. Talented students need to learn about their endowments and build upon them. At the same time, this aspect also poses a high risk of disappointment, and it can result in loss of interest, unpleasant attitudes, loss of performance and other complications. Team leaders must be prepared to deal with the situation in advance, and balance the motivation of the team for the contest with the interest for the subject and activity itself, find different ways to reward the team members for their performance unrelated to the position in the contest.

Competitions are social events. Schools are social institutions, but nothing is more mind-numbing than a daily stereotype in a master-slave configuration of a classroom education. Pupils meet and interact with wider population and its ideas. They exchange experience, learn from each other, and learn to act on their own in a novel situation when asked for a certain type of performance, different from a daily routine.

Competitions emphasize friendly and fair-play atmosphere, they carry the good spirit and create an island of time when everything and everybody is subordinated to a good outcome, result, and feeling of every single individual. Experiencing this atmosphere helps vitally later in the life when a participant faces difficult team or individual challenges.

3 Educational Robotics

The idea of using robots in the educational process is not new, but it may still appear surprising, disturbing or useless at the first sight to many of us. Let us explain why the contrary is true and why it is so natural and inevitable process.

One of the distinguishing features of a human being is the capability to use instruments and tools. Humans were getting involved in a social transfer of knowledge from the earliest time. Young people can handle a much steeper learning curve and thus an establishment of a school as a form of a social gathering of youngsters with the purpose to learn from the more experienced is among the most natural acts of our species. And from the earliest times, tools were used in this process – chalk, stone or a blackboard, abacus, rulers, pencils, books. These all are tools. In every age period, the learning tasks would always be supported by the technology that is available, accessible, and can automate or in any other way support the learning and teaching process: mechanical drawing boards, erasers, calculators, computers with word processors, spreadsheets, mathematical programs, and educational software. In the very same manner, it is just natural to use robots, for instance, to deliver items from place to place in the school; clean the floor, or other surfaces; provide guidance to school visitors; monitor and patrol the environment; help in the kitchen and dining room; perform simple office tasks – copying, stapling, stamping, etc.; operate, control, or measure experiments on chemistry, physics, or biology; throw or collect balls in various sport activities for the purpose of training, or make measurements, or otherwise assist in the physical education activities; explain or demonstrate a particular material to the students by letting them or the teacher operate it or even program it; be part of a student project assignment, allowing the students to extend their range of experimental scenarios.

All of the above are reasonable uses of robots in the school, even though some of them are less frequent yet. There is no separation between the "traditional" teachers who should not be involved with the robots and "weird modern folks" who should be dealing with them. Robots are here and they are entering the school in the same way as the stylus did thousands of years ago in the ancient Egypt or Greece. Robots are greeting every teacher or employee of the school alike, they are for them all.

The last four items in our list describe roles when robots actively participate in the educational process. A common term *Educational Robotics* is sometimes used to identify them. To this end, various systems have been put at the market or constructed in the research laboratories. Among others,

- small wheeled mobile robots, programmable to certain degree, can be used to teach basic elements of control theory, mechanics, electronics, and some programming, these robots typically have a well-defined and limited range of possible applications;
- robot arms and manipulators, can be used to setup various kinds of experiments that involve manipulation, they are typically single-purpose devices;
- dedicated automated or robotic systems that are assembled for a particular purpose, can demonstrate or assist a single type or a limited set of experiments;

- users can chose to build their own robot systems from raw parts and materials, if only they are equipped with the required skills, background, and resources;
- versatile construction sets with programmable control units that can be used for various purposes, in most cases to learn about control and programming, and to provide a platform for exploratory student projects.

All of the listed approaches work well for their purpose, although the most popular certainly is the last item of the list. Among the reasons are: “many in one” solution, accessible price, large community support, availability. Most efforts in the field of Educational Robotics focus on working with the construction sets. The success of their utilization lies in their open-ended nature, supporting the activities based on Constructionists’ approaches. Together with the self-assembled robots, robotic sets are the most often used and most suitable platform for the robotics competitions.

4 Overview of Robotics Contests

One could try to successfully argue that events as robotics competitions are in a very corner of any decent educational program or process, unless considering the specialized students in tertiary education program who study robotics, control engineering, or artificial intelligence. Admittedly, there are no particular reasons why robotics would be taught at primary or secondary level. In fact, participants of most robotics competitions are hobbyist individuals, or teams from clubs or free-time centers. Some of the schools, where robots are used to teach programming, may be interested in setting up a school team; however, that still requires a heroic sacrifice of the time and energy of the teacher. This kind of positive deviation indeed is a rarity. Recalling our arguments from sections 1 and 2, we honestly believe, this is a pity.

Organization of robotics contests world-wide depends on individuals who are steeling time from their other duties. This process is not dissimilar to that of the development of local cultures. It is a bottom-up competition for the survival of the fittest. We see both positive and negative consequences:

1) (+) Approaches that are more interesting, having better impact and stronger potential, survive the selection process and become more established;
2) (–) Different players have different starting positions. Distributors of specific construction sets and their network has a much stronger position than a group of academics regardless the actual value of the activities;
3) (–) Efforts, materials and resources get wasted, when teams decide to discontinue challenges they joined earlier. Some interesting ideas can never get implemented.
4) (–) The organization is more exhausting, taking its toll on the organizers, hampering the progress. It usually depends on private sponsorship, which requires enormous efforts in the fund-raising activities, leaving less time to provide a better service and content.

That, however, is a real-life, and the situation in many areas of the society. As [2] nicely put it: “*Everybody in the orchestra tries to convince the others to use their instruments and to play in a local club that is not able to accommodate the* *orchestra*". Somewhat different situation can be observed in some Asian countries, which, undoubtedly, took over the technological lead in various fields already.

To provide an overview of the robotics contests, we must start with the initiatives of the US FIRST association, which probably has the largest impact. US FIRST cooperate with many associations around the World to prepare global educational challenges for children at different age levels.

Namely, *Junior FLL*, for ages 6-9, where children build models with moving, possibly motorized parts containing simple machines. They present a poster on their model. Despite the popularity of this contest, we are not convinced that children are mature enough for it. Playing is vital at this age, not so much the contests, and the stress to produce something. Having a sensitive didactic approach can be very helpful.

FLL (*FIRST LEGO League*) for ages 9-14 in the US, and 10-16 in Europe [12] is the most popular one, students having 3 months in their clubs to prepare 1) a robot to complete a course consisting of multiple independent challenges of varying difficulty, and 2) a little research project on a specified topic. The children's solutions are often so good that college students who are given the same task are unable to equate their performance. We find this competition to be very useful and effective. Watching the showpieces prepared by the children makes the organizers very proud and usually suggests that a very hard work has been done on the side of the team coach, who is typically a teacher. And here we do not mean the work on the model or research project, which, of course is forbidden, but the didactic work done on the team, on the children. The FLL experience leaves a strong learning trace in the children. Our only concern relating FLL is the style of the challenge specification for the research project. The children are expected to perform a study and develop a solution in one of the areas that are of a critical importance to us all. Recent challenges dealt with issues such as climate changes, biomedical engineering, safe transport, or safe food. The children are asked to find plausible solutions to real problems pertaining in our world. While it is excellent to give them a reason and motivation to learn more about the World around them, it is also very unrealistic to believe they can possibly recognize a real problem and suggest a plausible solution to it. Perhaps, one in thousand can, but all play. The challenge thus either becomes just an obligatory ride, or a competition in teams getting hold of a "smartest" consultant who brings both the questions and the answers. We believe, there are interesting creative scientific projects students may be able to work on that are at a suitable difficulty and knowledge level. The outcome, however, would not be a novel solution. Rather, the outcome would be the learning experience, a *personal* discovery of facts, principles, and phenomena. And yes, they could even be demonstrated or approached in novel ways, if the team chose to do so.

FTC (*FIRST TECH Challenge*) for ages 14-18 is an advanced competition where robots of multiple teams perform together on a field to solve a specific task consisting of multiple smaller challenges. Robots are much larger than in FLL, they are built of metal parts, strong motors, and typically have some kind of manipulator arms attached. During parts of the game the robots must navigate autonomously, while in other parts they are remotely controlled using a wireless network modules and joystick consoles. The schedule of the competition follows that of the FLL. A first pilot tournament in "Eastern" European countries was organized in 2011 in Romania.

FRC (*FIRST Robotics Competition*) is very similar to FTC – it has the same age level, and also contains autonomous and remote-controlled sections, different challenge every year, but involves more interaction with human teams, which are larger. It is organized in cooperation with NASA and requires even more advanced robots. Both FTC and FRC require lots of space for the field setup, and have a high budget frame. The format is one of a TV show, but represents a lot of learning and hard work behind.

WRO (*World Robot Olympiad*) is an Asian answer to FLL, with quickly increasing impact. It has a similar format in the sense a new challenge is announced every year, and it has strict and precisely defined limitations on the allowed material. WRO covers all age levels from the primary through junior high school up to senior high school categories (college students can participate in the open exhibit). The main (positive) difference to FLL is that the WRO competition is focused on one complex task instead of multiple smaller tasks typical for the FLL. On the other hand, WRO is crippled by a bizarre requirement that the participants must assemble, program, and test their robots during 150 minute session at the competition site. In practice, they build, program and test their robots in their clubs during the months between the challenge is announced and the tournament, but they bring their kits unassembled. Teams that better memorized the robot morphology and teams that are able to reconstruct the program faster have more time for testing, sensor calibration and tuning and thus higher chances to succeed. Our impression from 2007 when we were involved in this competition in Scandinavia was: this will change soon. It proved false, unfortunately.

RCJ (*RoboCup Junior*) is an academic educational initiative that annually organizes one major world event (combined with senior RoboCup leagues) [11]. It is similar to FLL in that it also has a network of regional competitions to select the teams for higher rounds. Notice though a few important differences to FLL/WRO:

1. RCJ does not restrict the use of materials, sensors, motors and control units. On one hand, this means the better access to electronics labs, hardware workshops, university students or teachers, industrial professionals the team has, the better are its chances to win or succeed. This puts the teams in an uneven starting position. On the other hand, this opens up the really free range of possibilities so important for creative learning. And it also creates important connections out of the conceptual box of the virtual game. The game becomes real.
2. Even though the challenges of RCJ slightly evolve from year to year, the main mission usually remains the same. That allows the successful teams to participate again, and again and eventually pass their robots on to younger team-mates, making the starting threshold for others ever more difficult.
3. The team size of RCJ is not so strictly predefined as in FLL and it is smaller, in fact individual participants are also welcome and not unusual. This leaves the teacher the option to choose the approach that is most suitable for his or her local situation. On the other hand, team focus of FLL gives the option to do more on the didactic side and to provide more tailored instructions and supporting material for the teacher/coach, leaving his or her job easier.

4. RCJ is organized on a voluntary basis (FLL employs some full-time professional organizers) and thus RCJ can never achieve the level of professionalism of FLL. On the other hand, RCJ events last more than one day and include social events.

RCJ consists of three challenges – robotic soccer with infrared ball, rescue challenge, and robot dance.

Line-following contests of various flavors are the most common type of local robotic contests. Building a simple line-following robot can be efficiently done by a complete beginner in two hours, but developing a fast robot with advanced sensors and algorithms that is to perform on complex track is difficult enough for professional engineers.

Sumo contests are inspired by the human sumo wrestling, the robot's goal is to push the opponent robot out of a circular ring. The solutions usually have simple algorithms, the focus lies on the mechanical construction and electronics. How to create a reliable and strong robot? Many different size/weight versions exist from larger 20x20cm, 3kg robots, down to pico-robots of 12.5mm square footprint.

Micromouse contests are traditional single challenge maze-navigating contests that have been active for decades. Even though only little new can be invented here, the contest is a good benchmark and challenge for every truly dedicated roboticist.

RobotChallenge and *Istrobot* are annual Central-European contests that involve various categories including line-following, sumo, micromouse, but also other creative categories such as humanoid sprint, puck-collect, and humanoid sumo. The most creative category is free-ride, where the participants can bring and present their own robots of any kind. In other parts of the world, many other contests are organized, these include solving various maze tasks and racing tracks, for an example.

The contests mentioned above are suitable for young people from secondary or even elementary schools. Many other contests that are suitable for college students exist, among them Eurobot [9], Freescale Race Challenge, multiple categories of RoboCup including RoboCup@Home contest for indoor service robots, FIRA soccer competition, Robotour [10], and other.

5 Creative Robotics Contest

In the description above, we have omitted one distinguished type of contests that we find particularly interesting and useful. It is different from all the other types, and we

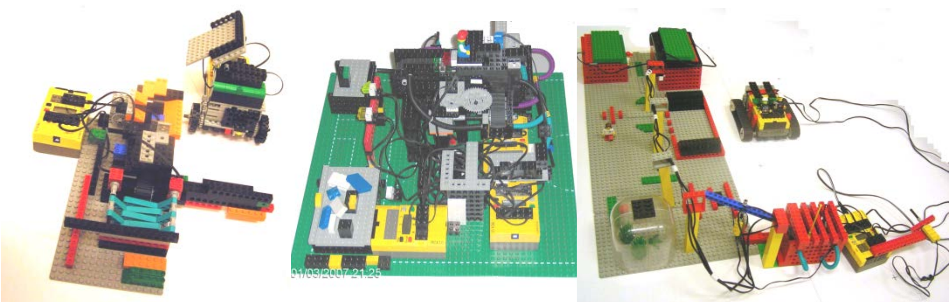

Fig. 1. Example models from the creative contest. See robotika.sk/rcj for more.

are not aware of others who would have been organizing it too.

The origins of the idea can be traced back to the 90s, when LEGO Dacta Control Lab construction sets were distributed to more than 100 schools in Slovakia as part of the government project. During this time, many teachers from elementary schools received training and acquired certificates. Pupils aged 10-14 took part in informatics classes typically in two or three different years, and the construction sets were actively used in the classes. Between 1994 and 1998, pupils from Czech and Slovak republics used to gather once a year in the free time center in the Czech town Hradec Králové. They were given or brought their own construction sets. The pupils were given a workplace with a computer and 4-5 hours of time. They constructed and programmed a creative model. At the end they have demonstrated its functionality and graded their own ideas by attaching cards to the models they liked the most.

The idea has been followed up in a Slovak national competition, with sporadic participation from the Czech Republic. It is organized since 1999 and more than 100 pupils participate annually. From 2001 categories of the RCJ contest (soccer, rescue, dance) were added to the competition, but the creative category remains. In this version of the contest, pupils were always assigned an area. Imagine the following example areas: agriculture, tourism, disabled people, space exploration. Their model was expected to demonstrate some important issue or solve a particular demand of people in the selected area. Pupils prepared a short presentation where they demonstrated the model and software functionality using a story they made up for that purpose. The jury graded the students in various categories, namely functionality, program efficiency, robustness, presentation, user comfort, and design. See figure 1 for examples of the models.

Despite the popularity of the contest, teachers were giving us the following feedback: the task was too loosely specified, pupils often built the model they have prepared in their school or club, and made up the story and small minor adjustments during the contest to fit it the assigned area. Thus it was not the real skills they were showing, but the model they have learned to build in their club or school. In addition, the grading of the jury was complicated and subjective. We responded to this feedback by changing the rules as follows: the pupils were assigned a specific task instead of a general theme. They did not know the task in advance and learned all about it directly at the contest, where we have demonstrated the rules directly on the practice field. Then again, they had 4-5 hours to build, program and test the robots built from the construction sets. At the end, they demonstrated the performance of their robots, and they received an objective score based on points their models earned according to clear and unambiguous task specification.

We have tried this version of the contest in four consecutive years since 2008. The tasks (all prepared by the author) can function as virtual games outside of the competition contest during regular school or club activities. In that case, it is recommended to allot a longer time to this activity, approximately 10 hours divided to 2 or 3 meetings. The following sections describe the tasks we have prepared.

2008 – Ball collecting. The task was inspired by one of the tasks used in the WRO, but we have modified it to form our own version. The goal was to build a robot that can travel along the track marked by a black line that was interrupted at a few places and knock down coke cans that were placed on top of wooden prisms with triangular base. On the way back to the start, the robot could collect six table-tennis balls that were resting in the centers of black circles close to a wall, see figure 2. We have prepared two testing fields, where the students could try and debug their models during the building and programming phase. The score was assigned as follows: 10 points for entering a gate, 5 points for each ball brought to the start/goal, 10 points for each can knocked down, 10 points for successful return of the robot. In case of equal scores, the robot that was faster to knock down the first can won. 15 teams participated, and one of them scored 100 out of the maximum 120 points.

2009 – Hubble Space Telescope mission took place exactly at the same time when the Atlantis space shuttle was out in the space to repair the Hubble. This inspired us to formulate the following task. The space shuttle robot with a random direction heading is placed and started on the Earth, represented by a blue circle. The sun is represented by a strong light coming from a lamp mounted on the floor. Like Atlantis that was launched around midday, the robot was to turn towards the sun, and leave the Earth towards the orbit. After reaching the orbit – a black line around the Earth, the robot was required to start orbiting, i.e. following the line. The Hubble was a white cup, fixed on the floor surface. The goal of the robot was to put three little LEGO models into the cup – install the replacement instruments and unload the astronauts (space walk). Finally, the astronauts boarded the shuttle again, the robot turned back to the Earth and landed on top of it. Scoring: 10 points for starting towards the sun, 10 points for reaching the orbit, 10 points for orbiting, 4 points for each instrument installed, 5 points for each space walking astronaut, 10 points for re-boarding, 10 points for landing, and -2 points for each astronaut lost. This contest appeared to be of a suitable difficulty. 15 teams participated. One team earned the maximum 82 points, the following three teams in the ranking order earned 77, 69, and 67 points. The atmosphere during the building phase could be described as concentrated efficient dedication, and made the organizers were happy.

2010 – Life on Titan was a life-seeking mission to the largest moon of Saturn. The task was to collect a sample (set of table-tennis balls waiting in a tube to be unloaded to the robot), which was left and marked during a visit of previous space probe. Thus the robot should have followed a black line (the trace) which splits in two at some location. The correct direction was determined by a light beacon. Earlier than that, the robot must wait on a traffic light until its technical control will complete, indicated by the change of light color. After the sample was collected, the robot was to navigate to an evacuation location, a place marked by a flashing light. Thus robots needed to be able to distinguish between a steady and a flashing light (an interesting programming task). The field plan is shown in figure 2. Scoring: 10 points for reaching the traffic light, 10 points for reaching the light beacon, 10 points for reaching the sample, 10 points for each sample ball, and 10 points for reaching the evacuation location. 21 teams participated, while the best team acquired 140 points.

2011 – Atmospheric Exploration required the teams to operate a balloon. The field was divided into several atmospheric layers, troposphere, stratosphere, mesosphere and thermosphere. Robot starting on Earth was to load two instruments (blue and red balls), board a balloon and fly up. Troposphere contained biological forms to be studied – birds represented by a black tape segments. Identification required to produce a sound after every bird has been detected. The mesosphere contained an illuminating cloud that was to be studied by one of the instruments. The other instrument was to be released in the direction of the sun. Robot was to jump out of the balloon and land on the Earth again. Scoring: 5 points for loading the instruments, 10 points for boarding the balloon, 5 points for leaving the Earth, 5 extra points for leaving the Earth with balloon, and 5 extra points for each instrument, 5 points for every bird that was correctly identified, 10 points for each instrument released, 10 points for leaving the balloon, 5 points for reaching troposphere, and 5 points for reaching the Earth. 22 teams participated, maximum score was 65 out of possible 95. The task appeared to be difficult and the teams with almost complete solutions were not lucky to earn all their points.

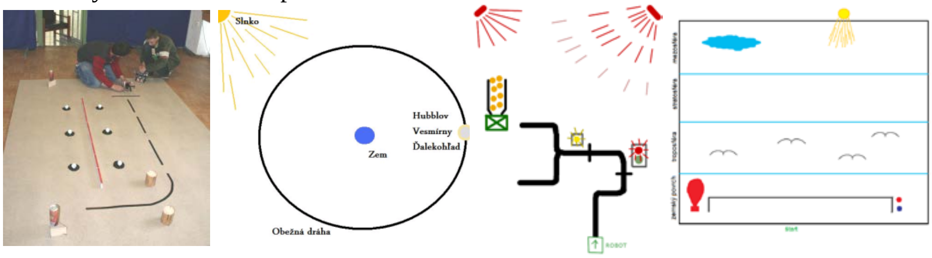

Fig. 2. Playing fields for the creative contest in 2008-2011. Details at robotika.sk/rcj.

Observations. One important observation is that the concept of virtual game works. The tasks kept the children focused, organized, and concentrated for several hours. Even the children that normally had difficulties concentrating accepted the working atmosphere and tried to obtain the best outcome. The scenarios always required creativity, experimentation, open thinking, discussion, and team cooperation. The children showed their true potential and could not be influenced by the advice of the teacher. Every mission was a valuable and memorable hands-on learning experience. We are very happy to learn that our past participants are currently successful and very active students, and continue to participate and even win in further robotics contests.

6 Supporting the Teachers

Despite the fact that LEGO provides good quality learning materials, teachers need inspiration, projects, and other type of help. Unfortunately, the NXT-G software has not been localized to Slovak language until today, which would definitely have had happened if it were an open-source project. We have written a reference manual in Slovak language, and translated the programming manual to NXC language [3], however, this cannot solve the difficulties of a 10-year old child facing English labels of various software controls. The icons are an advantage, but menus, dialogs, and labels are in English.

We have organized several teacher trainings for the recent LEGO NXT construction sets, and made the material with projects with solutions suitable for beginners available online [3]. We have specified a technical and didactic concept for robtivities portal [4], and implemented a prototype [5], which believe will be in operation in multiple languages during the conference at portal.centrobot.eu. Useful studies were compiled in final and master theses of our students and colleagues [6,7,8]. We are preparing further didactical materials to support the teachers.

7 Conclusions and Future Work

We have coined the term virtual games and explained some didactic purposes of competitions. We have discussed the frontline of robotics contests from a critical point of view. We explained what we think is one of the most suitable forms of robotics contests and provided examples that we realized and that can also be re-used as virtual games outside of the competition context. The article is a contribution to the ongoing discussion on the robotics contest. We think that the current initiatives are valuable and should continue, but that they absolutely need help in the institutionalization and coordination so that the organizers may save a lot of efforts and time they currently must spend on recruitment, fund raising and administration. This may allow integration of the efforts in the future – first signs of which can already be seen in a pilot integration of RCJ category into WRO this year.

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