# Bebras Contest for the Blind Analysis of Tasks for the Blind Pupils at Lower Grades of Secondary Education

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## Abstract

The Bebras contest has become an essential part of school informatics in 30 countries all around the world. However, not all pupils can participate, especially some pupils with special educational needs. We have been doing a research in the area of teaching computer science with focus on the blind pupils (Jašková, 2013). We think that also these pupils should develop their informatics skills. Because the Bebras contest offers number of interesting informatics tasks, we have decided to explore the possibilities of making this contest available also for the blind pupils. The tasks used for this category of pupils were adjusted from the original ones suggested for intact pupils. In the article we present some of them with the description of adjustments that were needed to be done in order to make these tasks available for the blind pupils. We also compare the results of both, intact pupils and the blind pupils. Finally we analyse factors that can have an influence on success rate of the blind pupils and we offer some recommendations for making the suitable tasks.

## Keywords

Bebras contest, algorithmic thinking, visual impairment

## Introduction

In this paper we describe our experiences with execution of informatics contest Bebras (Degienė, 2005) for the blind pupils. We describe the tasks and realisation of the contest. We focus in detail on tasks adaptations. The original tasks of categories Little Beaver / Benjamins are listed as well. We analyse all tasks and interviews with pupils and based on this analysis we propose improvements of tasks (not simplification but better intelligibility). At those tasks that we have not been changed significantly we compare success rate of the blind pupils to success rate of intact pupils. We discuss reasons of difficulties in solving some specific contest tasks.

## The tasks

When looking for appropriate contest tasks we decided to use the contest tasks currently included in categories Little Beaver (Tomcsányiová et al., 2011) and Benjamins. At first, we chose those tasks that could be used for the blind pupils without changes. There were not many of them. Other ones needed just a little adaptation because they contained important information in the form of picture which is not accessible for the blind people (webaim.org).

Now we provide to each contest task its original version and the version adapted for the blind pupils. The order of listed tasks proportionally depends on amount of adaptations that had to be done.

### Photographs

This task does not contain any graphical information so we could use its original version.

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Jane wants to print her photographs. Which device must be connected to the computer?
- Speakers
- Data projector
- Printer
- Microphone

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**Fig. 1:** Contest task Photographs

### Places to play

The picture shows the original task.

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Beaver is deciding where he wants to play according the following rules.

- When it is sunshine today, but it was raining yesterday, he wants to swim in the river.

- When it is sunshine today and it was sunshine yesterday as well, he wants to play in send on the river bank.

- When it is raining today, but it was sunshine yesterday, he wants to play with meccano at home.

- When it is raining today and it was raining yesterday as well, he doesn't want to play at all.

Following table illustrates the weather in previous days.

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| Dátum | 3. 11. | 4. 11. | 5. 11. | 6. 11. | 7. 11. | 8. 11. |
|-------|--------|--------|--------|--------|--------|--------|
| Počasie | ☂ | ☀ | ☀ | ☂ | ☂ | ☀ |

Where did the beaver play on November 7th?

- on the river bank
- at home
- he didn't play at all
- in the river

**Fig. 2:** Contest task Places to play

This task contains graphical information, however not important for getting to the solution. We have not used it in task for the blind pupils and we used the open question instead of the multiple choice task. The following picture shows the adjusted task.

Beaver is deciding where he wants to play according the following rules.

- When it is sunshine today, but it was raining yesterday, he wants to swim in the river.
- When it is sunshine today and it was sunshine yesterday as well, he wants to play in send on the river bank.
- When it is raining today, but it was sunshine yesterday, he wants to play with meccano at home.
- When it is raining today and it was raining yesterday as well, he doesn't want to play at all.

Where did the beaver play on November 7th, if it was raining that day and day before too?

**Fig. 3:** Adjusted contest task Places to Play

**Cabins**

In original task there were used colours and their overlapping. This was inappropriate for the blind pupils. In addition to that this task was interactive. The eventual colours of windows pupils could set by clicking on the picture of boat.

Boat glasses are either clear or lightly tinted. When looking through two such glasses one will see either clear, lightly tinted or darkly tinted glass as shown below.

Captain installed windows with either clear or lightly tinted glasses into one side of his new yacht as shown below.

Windows on the other side are shown below.

A fisherman standing at appropriate place on land could see through all corresponding pairs of windows installed on both sides of the yacht. What colours did fisherman see on the windows?

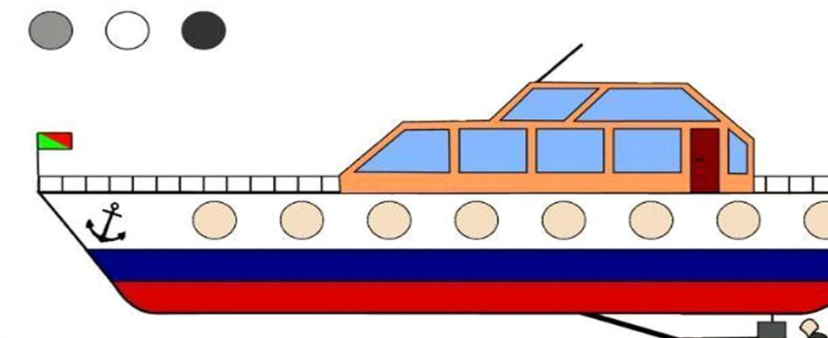Drag the colours to colour the windows on the following picture.

**Fig. 4:** Original contest task Windows

This task required more changes than other tasks. Our effort was to keep the nature of the problem as close as possible to the original version.

There are 6 cabins on the boat. In each cabin there are 2 radiators – one at the left wall and one at the right wall. The temperature inside each cabin depends on the state of radiators inside.

- When both radiators are switched off, it is cold inside the cabin.

- When one radiator is switched on, it is warm inside the cabin.

- When both radiators are switched on, it is hot inside the cabin.

> One day there were switched on radiators at left wall in cabins 1, 4, 6 and radiators at right wall in cabins 5, 4, 3, 1.
>
> What is the temperature in the cabins 2, 4, 6?

**Fig. 5:** Adjusted contest task Cabins

## Coloured snake

In the original task is snake created of coloured blocks. The picture shows the original task.

> Jane was playing with building blocks. She created the following snake.
>
> 
>
> Then she decided to create the new snake taking the blocks either from the left end (L) or from the right end (R) of original snake. This block she always put to the right end of new snake. When she took all the blocks from original snake and put them to the end of new snake she gradually received the following snake.
>
> 
>
> In what order was Jane taking the blocks?
>
> - R,L,R,R,R,L,L,R,L,R
> - L,R,L,R,L,R,R,L,R,L
> - L,R,L,L,L,R,R,L,L,R
> - R,L,L,L,L,L,R,L,R,L

**Fig. 6:** Original contest task Coloured snake

Because this task was visually oriented, we have used a snake that consisted of numbers. We also used shorter snake for better memorability (Pasch, 1995). We have created the following task.

Jane was playing with numbers. She created the following numeric snake.

7,9,1,3,5,8

Then she decided to create the new snake for her brother taking the numbers either from the left end (L) or from the right end (R) of original snake. This number she always put to the right end of new snake. When she took all the numbers from original snake and put them to the end of new snake she gradually received the following snake.

8,5,7,3,1,9

In what order was Jane taking the numbers?

- R,R,L,L,R,R
- L,L,R,R,L,R
- R,R,L,R,R,L
- L,R,R,L,R,R

**Fig. 7:** Adjusted contest task Numeric snake

## Analysis

In this part we analyse pupil's solutions of particular contest tasks aforementioned in previous part. We compare success rate of the blind and intact pupils solving the tasks for category Benjamins.

Contest took place at special school for the blind and partially sighted pupils. Group of contestants consisted of seven blind lower secondary school pupils. One of them was fifth grader, one sixth grader, one seventh grader and four of them were eighth graders. Some other pupils could not participate because of attendance issues (longer absence). Contestants were either totally blind, or with low vision - they have heavy visual disorder and have to use special aid to learn. We have to consider whether they are congenitally blind (from their birth) or they have lost sight later and they still have some visual imagination left.

Pupils got 40 minutes to solve all nine tasks (Allman, 2009). Tasks were provided in a form of text document. There were the instructions and important rules at the beginning. Each task contained also the area for the notes that could be helpful for pupils.

There is a graph of success rate of intact pupils in contest category Benjamins on Figure 8, where tasks used for the blind pupils are marked by red. The number of participants in this category was 21466. On Figure 8 we provide graph of success rate of the blind pupils to comparison. For each task we provide a table to show dependency of success rate on age, degree of visual disability and frequency of work with computers. We also discuss suitable adjustments of tasks to improve their intelligibility for the blind pupils. At this stage we interview pupils in order to find out problematic parts of tasks.
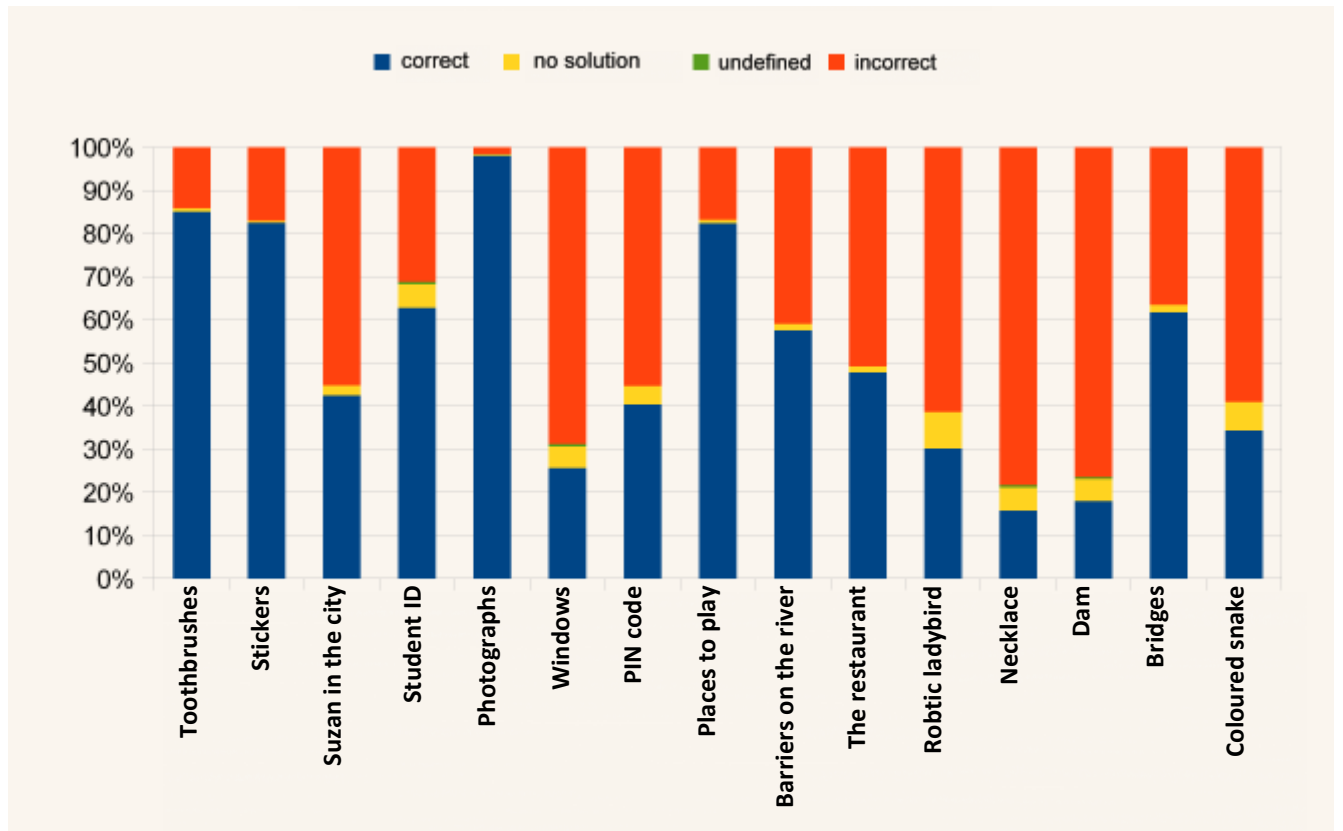


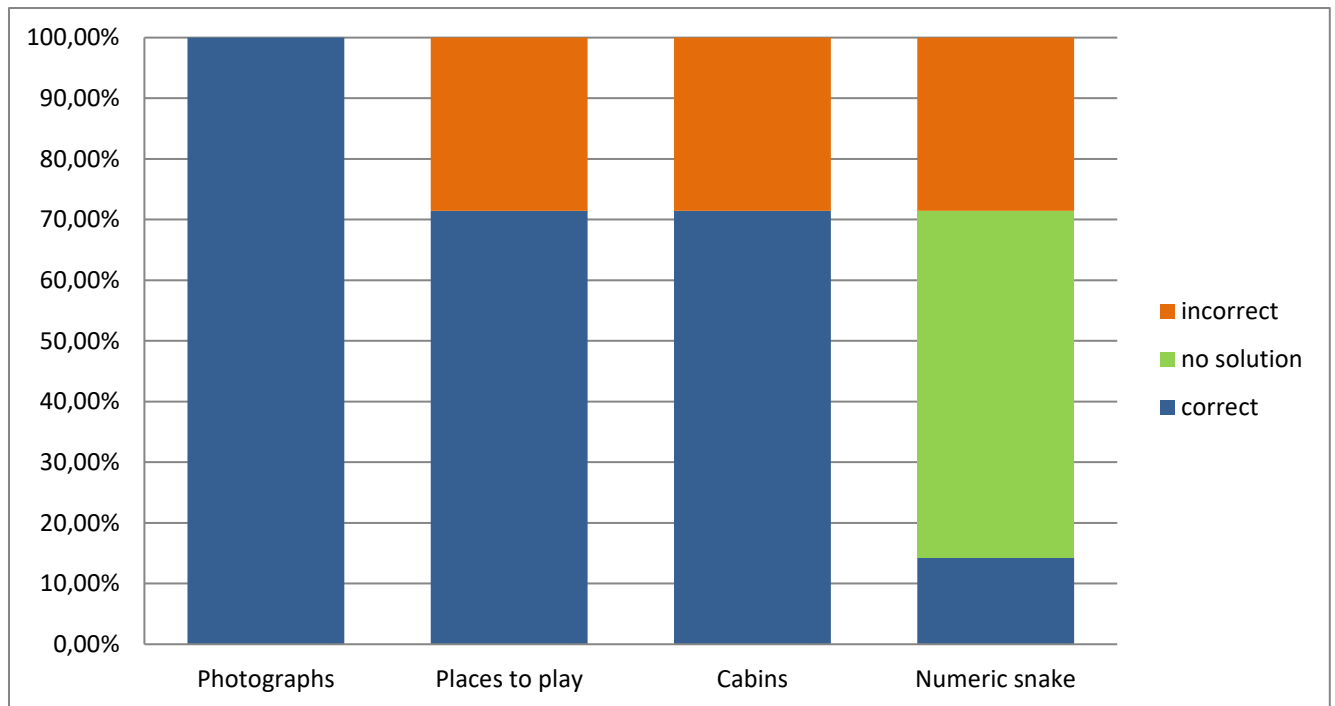**Fig. 8:** Graph of success rate in category Benjamins 2014/2015

**Fig. 9:** Graph of success rate in category Blind

**Photographs**

This task used in its original version without any adaptations, had very high success rate in category Benjamins. In category Blind it had success rate of 100%. We consider this task as easy for pupils.

**Places to play**

When we compare the success rate of the blind pupils and success rate of intact pupils, we can see that success rates are almost the same. In category Blind there were two incorrect answers. During our observation in class, we haven´t seen any significant problems. Pupils with incorrect solutions don´t use computer very often. One pupil (listed as last in the Tab.1) works with screen reading software only a short time, so she still has some problems to use it. She uses screen magnifier with very high level of magnification. It is difficult for her to keep the track of information. Therefore she was able to solve the contest tasks slowly and with difficulties.

| Places to play | | | |
|---|---|---|---|
| Grade | Level of visual impairment | PC frequency | Solution |
| 6 | blind later in life | daily | correct |
| 8 | partially sighted | daily | correct |
| 8 | congenitally blind | occasionally | correct |

| 8 | congenitally blind | occasionally | correct |
| 8 | blind later in life | daily | correct |
| 5 | partially sighted | occasionally | incorrect |
| 7 | congenitally blind | occasionally | incorrect |

**Tab. 1:** Places to play – Dependency of success rate on age, level of visual impairment and frequency of work with computers

**Cabins**

| Cabins | | | |
|---|---|---|---|
| **Grade** | **Level of visual impairment** | **PC frequency** | **Solution** |
| 6 | blind later in life | daily | correct |
| 8 | partially sighted | daily | correct |
| 8 | congenitally blind | occasionally | correct |
| 8 | congenitally blind | occasionally | correct |
| 8 | blind later in life | daily | correct |
| 5 | partially sighted | occasionally | incorrect |
| 7 | congenitally blind | occasionally | incorrect |

**Tab. 2:** Cabins – Dependency of success rate on age, level of visual impairment and frequency of work with computers

There were two incorrect answers in category Blind. On the other hand, the original task in category Benjamins seems to be quite difficult and only quarter of participants had correct answer. Some didn´t solve this task at all. In the category Blind, the task was easier, but we think, it was adequate for pupils. During our observation we haven´t seen any problems with this task.

**Numeric snake**

When we compare success rate of visually impaired pupils to intact ones in Benjamins category, it is obvious that there is higher percentage of visually impaired pupils that did not solve the

task. It may mean that the task was too difficult, or incomprehensible. While watching pupils during the contest we noticed that they had troubles to orientate in the text when they were moving between the original numeric snake and a new one. We also think that difficulty of the task depends on length of snake. Visually impaired pupils need to remember the sequence of numbers and it is a risk of losing this information while moving through the text. We consider modification of this task to make it more appropriate. The sequence of numbers needs to be shorter and the snakes – old and a new one could be in lines following each other. This will help pupils to focus on the core of the problem and better understand the process of making the new snake (executing L and R commands). However, it is necessary to say, pupils had a chance to use the area below the task for their own notes and they could copy the snakes so that they follow each other. Only one pupil did so.

| Numeric snake | | | |
|---|---|---|---|
| Grade | Level of visual impairment | PC frequency | Solution |
| 8 | partially sighted | daily | correct |
| 6 | blind later in life | daily | no solution |
| 7 | congenitally blind | occasionally | no solution |
| 8 | congenitally blind | occasionally | no solution |
| 8 | blind later in life | daily | no solution |
| 5 | partially sighted | occasionally | incorrect |
| 8 | congenitally blind | occasionally | incorrect |

**Tab. 3:** Numeric snake – Dependency of success rate on age, level of visual impairment and frequency of work with computers

| Order | Score | Grade | Visual imagination | PC frequency |
|---|---|---|---|---|
| 1 | 36 | 8 | yes | often |
| 2 | 23 | 8 | yes | often |
| 3 | 21,34 | 6 | yes | often |
| 3 | 21,34 | 8 | no | occasionally |
| 4 | 18,68 | 8 | no | occasionally |
| 5 | 5,68 | 7 | no | rarely |
| 6 | 2,69 | 5 | yes | very rarely |

**Tab. 4:** Overall results – Dependency of success rate on age, level of visual impairment and frequency of work with computers

Table 4 shows the overall results achieved by the blind pupils. It is obvious that those of them who use computer often and have very good computer skills were the most successful. We noticed as well that pupils with good results are able to use visual imagination. It is therefore possible that visual imagination is desired for solving most tasks.

## Conclusion

In the paper we presented our idea for a new category in the Bebras contest dedicated for the blind pupils. We explained the way we select tasks and adapt them for the blind pupils. We described the procedure we used to execute the second run of the contest as well as the results of our analysis aimed at suitability of selected tasks. By analysis of pupils solutions of tasks, we can say, that there is some dependence on level of visual impairment and frequency of using computer, but it´s necessary to do extensive qualitative research. We plan to realise and analyse interviews with pupils to find out whether pupils really understood the tasks. We would like to check out the tasks with more contestants from other special schools (in Slovakia and Czech Republic). We offer our experiences to anyone who would like to implement the same category in his/her country.

## References

ALLMAN, C. B. *Test Access. Making Tests Accessible for Students with Visual Impairments: A Guide for Test Publishers, Test Developers, and State Assessment Personnel.* 4th edition. American Printing House for the Blind, Louisville, Kentucky, 2009.

DAGIENĖ, V. Competition in Information Technology: an Informal Learning, In: Proceedings Eurologo 2005, Warsaw, Poland, 2005. pp. 228–234. ISBN 83-917700-8-7.

JAŠKOVÁ, Ľ. Blind Pupils Begin to Solve Algorithmic Problems . In: Diethelm, I., Mittermeir, R.T. (Eds.): ISSEP 2013, LNCS 7780, pp. 68–79. Springer, Heidelberg (2013). ISBN 978-3-642-36616-1

PASCH, M. *Teaching As Decision Making: Successful Practices for the Elementary Teacher.* 2nd ed. White Plains, N.Y.: Longman Publishers USA, 1995.

Overview of exam access arrangements, RNIB, May 2014, [cit. 20150308]. Available from: http://www.rnib.org.uk/sites/default/files/Overview_of_exam_access_arrangements_May_2014.doc

TOMCSÁNYIOVÁ, M., TOMCSÁNYI, P. (2011) Little Beaver – A new Bebras Contest category for children aged 8–9 In: Informatics in Schools: Contributing to 21st Century Education, Berlin : Springer-Verlag, ISBN 978-3-642-24721-7. - S. 201-212 ISSEP 2011 : Informatics in Schools: Contributing to 21st Century Education : International Conference, [Bratislava , 26.-29.10.2011

Web Accessibility in Mind. [cit. 20150308]. Available from: http://webaim.org/