Competition in Information Technology: an Informal Learning

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Abstract

Competitions play an important role as a source of inspiration and innovation. Information technology (IT) contests named "Beaver" may be the key to the potential of new knowledge and attractive way to bind up technology and education. The history of the first Lithuanian "Beaver" contest took place on October 21, 2004. It was participated by as many as 3470 pupils from 146 schools. Interest in competitions essentially depends on problems. Attraction, invention, tricks, surprise should be desirable features of each problem presented to competitors. The problems have to be selected carefully, taking into account the different aspects of each problem. The paper deals with the methods and ways of creating and selecting problems of IT and their impact on student learning.

Keywords

Information technology, computer science, problem solving, competition, learning.

1. Introduction

Today, we are more open and more eager to learn about information technologies (IT), quickly adopt and utilize them in order to enrich our lives. New knowledge and competences are continuously required. However, innovation is not something that falls from the sky like a rain – it has to be planted.

Information technology, management science marketing – all of these areas of human activity offer employment and fair pay for those who are skilled in analytical thinking and problem solving.

When designing curricula for the teaching of IT, one should consider the attractiveness of teaching methods and students motivation (Dagiene 2004: Dagiene 1997; Grigas 1993). The following aspects should be taken into account: 1) practical activities are more interesting and attractive than theoretical studies for school students; 2) elements of competition stimulate the learning process.

Competition makes the teaching of various subjects more attractive (Katz, 1992). When students start learning basic concepts of computer science they very soon can find a place where they are able to demonstrate their skills, their projects, share their interests and to compare themselves with others. This wish might be one of the reasons why a lot of students soon after they have started learning IT choose one of the areas where they are able to demonstrate their work immediately, e.g. creation of html pages, computer graphics (Papert, 1980).

For those students, one of the most powerful means which endorses their motivation is competition. There the students meet their peers from all over the country and form other

countries, make friendships, wait for the next competition ready to show their abilities which have improved since the last competition. For example, in the programming competitions students develop algorithms and improve their problem solving skills.

2. Organizing structure of the IT competition

The idea of the competition in IT for school students started a few years ago. Only the name for the competition was lacking… The thought rushed into head during the travel around Finland in 2003. The activity of beavers on strands was so noticeable, that it suggested the symbol of the contest… Beavers look like persistent stickers, who endeavor for perfection in their field of activities and beaver away to reach the target. Their everyday job seems to be a trial: the one who pulls down more trees will stem more streams... Therefore, our competition was named after the hard-working, intelligent, and lively beaver.

The main principles of the "Beaver" are borrowed from the international mathematical contest "Kangaroo", which is very popular in Europe (International…, 2005). The Lithuanian tournament involves about 60 000 participants annually with more than 2/3 of schools taking part in it. Moreover, there is a very similar game "Lwionko" (lion cub) in the Ukraine and Poland in physics, and in Belarus and Russia schoolchildren participate even in a few games in different educational disciplines. The idea of Kangaroo started in the 1980's in Australia, and its originator was Peter O'Halloran, a famous mathematician and teacher. The goal of the competition is to evoke interest in larger and larger numbers of students around the world. Because there is no qualifying contest, all who are willing can participate in the competition. The rules of the Kangaroo competition are simple: the contest takes place in every country on the same day. The students solve the same problems translated into their native languages. The time limit is 75 minutes and the format is that of multiple-choice test.

Our hope is that Lithuania will gain fame with "Beaver" someday.

2.1. Aims and scopes

Understanding and handling the basics and foundations of computer science is more important than knowing a lot of details.

The use and interpretation of results comes prior to being able to prove results.

Controlling computations, calculations and estimations is more significant than being able to do computations by oneself.

Of course there is the need to learn very well the basic computer managing technique, but computers has to be understood at many levels, including: as a fundamental culture and not as a collection of buttons and instructions; as a development of ideas not a finished work; as a explanation of the concepts.

The main aim of the "Beaver" is to promote interest in IT and informatics for all school students, to motivate students to learn and master IT. The competition should help to engage children to take an interest in computers and IT application from the very beginning at school.

The IT competition should encourage children to use modern technologies in their learning activities more intensively and creatively. It should bring all school students together and encourage them to brainstorm and share their experiences.

As IT becomes a commonly used tool of education, this playful contest could ensure that boys and girls will equally benefit from it. We hope that „Beaver" encourages students to learn the skills that will be needed in the labour market of the future.

Cognitive, social, cultural and cross-cultural aspects are very important while using technology – the competition will put strong emphasis on culture and language.

"Beaver" competition should help educational community to clear up school students who can use IT in most creative and profound way.

Develop students' ability to derive pleasure and satisfaction through intellectual life.

2.2. Participants

There are three mentoring schemes: the Junior (aimed primary at pupils), Senior (for basic level) and Advanced (for secondary level). The competition is designed for all school students. But the first contests was developed for three different groups according to the structure of Lithuanian school: 11-14 years (5-8 classes), 15-16 years (9-10 classes), and 17-18 years (11-12 classes).

2.3. The first "Beaver" contest

The history of "Beaver" began on September 25, 2004, when experimental trial, in which 779 school students participated, was held. Its aim was to check selected technologies of the contest and to evaluate the level of complexity of the presented problems. After a month, on October 21, the first Lithuanian "Beaver" contest took place. As many as 3470 pupils from 146 schools participated.

During the contest, each participant has 45 minutes to solve 18 problems of various levels of complexity: 6 problems for 3 points, 6 – for 4 points, and 6 – for 5 points. Correct answer adds as many points as indicated to the problem, incorrect one – minuses 25% of the indicated points (i.e. – 0,75, – 1, and – 1,25 point, respectively), unanswered problems – 0 points. To avoid negative results, each participant must start having the amount of points equal to the total number of the problems (e.g. 18 points in the "Beaver-2004"). By the way, the competition was subject of individual participation, like Olympiads, but the schools were rewarded for active involvement.

Each group was given two hours to perform the contest, collect the results, and send them to the organizers. Preliminary results were calculated and announced the next day. All participants of the contest, as well as local organizers, received certificates of thanks from "Beaver" Organizing Committee. Winners of every age group, as well as the prizemen of each class, were awarded with "Beaver" diplomas and valuable prizes established by sponsors.

2.4. Technology

We have briefly described the structure of the contest, expecting that it would be helpful for the organizers in other countries.

For the contest the PDF technology was selected, taking into account that PDF is universal file format that preserves fonts, images, graphics, and layout of any source document, regardless of the application or platform used to create it. It was also clear that schools possessed different equipment and different level of IT knowledge.

The local organizer had to download from the official "Beaver" site (www.bebras.lt) the software (Acrobat Reader 5.0 CE with some extra programs for testing computers and collecting results) and PDF registration form (its aim was to collect the basic information about the participants: contacts, OS, number of students and computers involved). Filled in

forms had to be uploaded to the server of the National Examination Center (NEC), which organized collection and preliminary processing of the results. One week before the contest, local organizers could download the packages of problems for each group.

On the day of contest, at fixed time known in advance, the "Beaver" site reveals the passwords for opening of the problems. The contest starts when the first problem is opened and ends when the participant pushes the "Exit" button or when time allowed for solution expires. The program forms the coded answer file. The local organizer must collect these files (via local network or manually) and to upload them to the server of the NEC. When the answers are collected, the program investigates them, calculates the results, sorts them according to schools, regions, age groups, etc.

3. Attractive tasks – keystone of contests

Problem solving is an individual's capacity to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution path is not immediately obvious.

The ability of students to solve problems in real-life settings is of prime concern to educators and policy makers. Students should be able to understand the information given, identify the critical features and their interrelationships, construct or apply an external representation, solve the problem...

Interest and engagement are very important in problem solving. However, most of the textbooks and teaching materials assigned to the students contain not problems but just small exercises in the best case. Mostly there are given only exercises to check syntax of particular programming language. When teaching programming via problem solving, it is very important to choose interesting tasks (problems). Therefore, one should try to present problems from various spheres of science and life, with a lot of real data. Processing large amounts of data becomes one of the most important aspects when learning programming.

Interest in competitions essentially depends on problems. Attraction, invention, tricks, surprise should be desirable features of each problem presented to competitors. The problems have to be selected carefully, taking into account the different aspects of each problem, i.e. what educational power it contains and how to interpret its' attractiveness to students (whether it stimulates the motivation of learning).

Problems can be of different types: starting from the most common questions of IT and their applications in the day-to-day life to specific integrated problems related to history, languages, arts, and, of course, mathematics. In our first „Beaver" some problems were related to the usage of various most common programs, others were related to hardware and software, and some of them were connected with the Lithuanian culture and language. So it could happen that some problems would not be applicable in some countries: some might appear too simple, and some – too complicated.

Also, it is very important to choose the problems in such a way that the participants of the competition could have as equal positions as possible, irrespective of the operating system or computer programs used by them.

One feature of the set of problems showed that they were rather well-balanced. There was not any problem that nobody would have solved, but also there was not any problem that would be solved by all participants.

Example 1

The computer calculator has a row of pale buttons. When are these buttons activated?

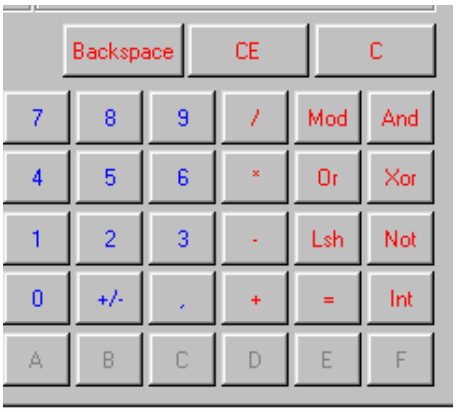

Figure 1.

A) When a hexadecimal system is used
B) Never, because they are not a part of calculator
C) When the text mode is used
D) When formulas that include letters are used

Example 2

Using Logo, a simple programming language, Rasa has drawn a rectangular spiral with the help of the following commands:

forward 10 – the turtle moves forward drawing a line of 10 steps (dots) long;

left 90 – the turtle turns left making an angle of 90 degrees.

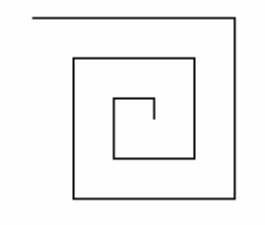

Figure 2.

Which of the following numbers express the length of the whole spiral in dots?

A 550
B 170
C 300
D 250

Example 3

Adam is writing his impressions about International Olympiad on Informatics in Greece. He would like to insert some foreign words in the text. May he use the Russian word *олимпиада* and the Greek word *Ελλαδα* in his letter?

A) Yes, if to use ISO-8859-1 encoding
B) Yes, if to use K018-R encoding
C) Yes, if to use Unicode (UTF-8)
D) No, in any case

Example 4

Logo Turtle may perform the following commands:

`forward` *n* – to move forward drawing a line of *n* steps long;

`left` *α* – to turn left making an angle of *α* degrees;

`repeat` *k* `[forward 30 left 60]` – to move forward drawing a line of 30 steps long and to turn left making an angle of 60 degrees; these actions are repeated *k* times.

The turtle looks up at the beginning.

Which of the presented shapes is drawn by using the following command

```
repeat 4 [repeat 2 [repeat 90 [forward 0.5 right 1] right 90]
left 90]
```

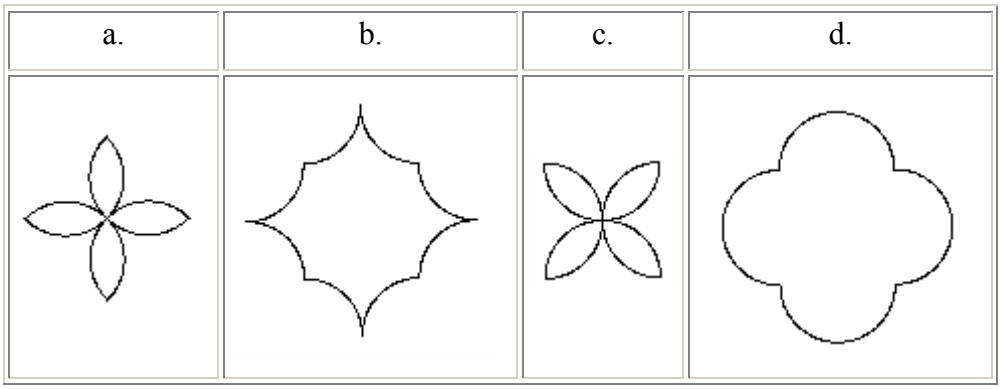

Figure 3.

A) a
B) b
C) c
D) d

Example 5

In a spreadsheet cell C1, some formula was written and then it was copied underneath.

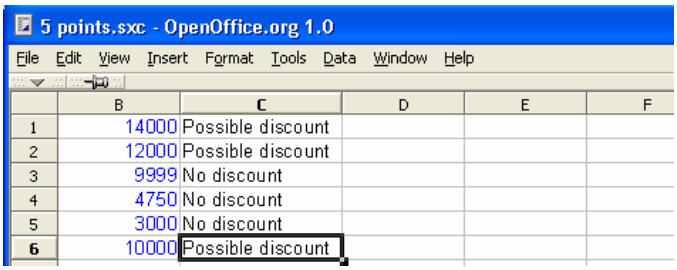

Figure 4.

Which of the formulas was written in the cell C1?

A) =IF(B1>=10000;"Possible discount";"No discount")
B) = IF(B1>=10000;"No discount";"Possible discount")
C) = IF(B1:B6;"Possible discount";"No discount")
D) =IF(B1>10000;"Possible discount";"No discount")

Example 6

Which format should be used in order to save a beaver picture so that it would continue to walk?

A) JPEG
B) GIF
C) PCX
D) BMP

4. Conclusions and discussions

Competitions play an important role as a source of inspiration and innovation. IT competitions may be the key to the potential of new knowledge and attractive way to bind up technology and education. We understand that if "Beaver" remains a local contest, its perspectives will be rather poor. Lithuanian "Beaver" Organizing Committee invites everyone interested in this initiative to think about our idea, to investigate the local situation and to contact us.

We are open for all kinds of proposals and ideas of collaboration and hope to find friends and partners in all countries. Integration of IT into teaching process should be our target, and we have to try to reach it together.

We are ready to share our experience, technology, and future plans with all who are interested. We expect that it will foster your own competitions similar to the "Beaver" or will encourage you to join us. We are sure that a well-organized competition with interesting, playful, exciting problems, and attractive awards will invite children of all countries to use IT reasoning and to explore understanding of realities, possibilities, and failings of IT.

References

Dagiene V., Skūpiene J. (2004) Learning by competitions: Olympiads in Informatics as a tool for training high grade skills in programming. *2nd International Conference Information Technology: Research and Education*. T. Boyle, P. Oriogun, A. Pakstas (Eds.), London, 79–83.

Dagiene, V. (1997) Learning via Electronic Mail: What and How? *Education for the 21st Century*, 2-4 December, Cape Town, 1–10.

Grigas G. (1993) An experiment of computer programming practice by e-mail. *Interpersonal Computing and Technology*, v. 1, N. 2, 1-10.

Katz L G and Chard S C (1992) *Engaging Children's Minds: the Project Approach* Norwood N J, Ablex.

Papert S. (1980) *Mindstorms: Children, Computers, and Powerful Ideas.* New York: Basic Books.

International mathematical contest „Kengūra":http://www.kengura.lt (in Lithuanian, 2005).