



MATHEMATICS B-DAY IN SLOVAKIA

SONA ČERETKOVÁ

ABSTRACT. *The experience of the competition Mathematics B-day in Slovakia is discussed in the article. The process of finding schools, preparing assignment and organisation of the contest day is described. The attention is paid also to the process of assessment of pupils reports. Some hints for future research in mathematics education are posed.*

KEY WORDS: *mathematics competition, open ended task, assignment, assessment*

ABSTRAKT. *V príspevku sú opísané skúsenosti s organizovaním tímovej matematickej súťaže Matematický B-day na Slovensku. V článku sa nachádzajú informácie o tom, ako boli oslovené školy, ako bolo pripravované zadanie súťaže a ako bola súťaž organizovaná. Pozornosť je venovaná aj hodnoteniu žiackych riešení úloh súťaže. V článku je načrtnutých aj niekoľko námetov k ďalšiemu výskumu v teórii vyučovania matematiky.*

KLÚČOVÉ SLOVÁ: *matematická súťaž, otvorené úlohy, zadanie, hodnotenie*

CLASSIFICATION: *U44, A84, D54*

Introduction

Department of Mathematics, Faculty of Natural Sciences, Constantine the Philosopher University in Nitra, Slovakia and Freudenthal Institute for Science and Mathematics Education, Utrecht University, The Netherlands (FIsm) are project partners within 7FP project PRIMAS¹. The contest Mathematics B-day is in described as follows:

„In Dutch upper secondary education, students can choose between two math courses: mathematics A (preparing for social sciences at university level) and mathematics B (preparing for mathematics and natural sciences at university level). Mathematics A is less formal than mathematics B. At the end of the final year (grade 12) a national exam assesses knowledge and skills. Since 1999 assessment should also include process skills. A timed written exam is not appropriate for that. For that reason an 'alternative' assessment is developed. For the mathematics B program, this assessment is called the Mathematics B-day.

At school, teams of 3 or 4 students work for a whole day on an investigative, open ended task. At the end they hand in a report with their findings. The presented problem does not necessarily reflect the typical math B subject matter. Instead, students are challenged to show process skills in developing strategies, making conjectures and try to prove or reject them, logical reasoning, critically reviewing models and adjust them and also co-operate.

Officially, the Mathematics B-day is a contest for teams of students. Most participating schools use the task for the school exam of the process skills; the result is part of the final grade. About half of the schools is involved in the contest. The best papers are sent in and are ranked by teachers in four regional groups. The final ten best papers are ranked by a national jury.²

No experience with this kind of group competition has existed in Slovakia to date. There are group competitions, organised for the same age group of pupils, but the spirit and the content of those competitions is different. Mainly are based on short standard

¹ <http://www.primas-project.eu/>

² <http://www.fisme.science.uu.nl/fisme/en/projects/indexorg.php>

problems with the content in the school curriculum. The contest session lasts a maximum of four hours. Group work is not based on communication within the group, nor in developing one common set of findings, but in dividing tasks between group members and solving the task individually. The group result is then based on adding points for the correct solutions of individuals.

The B-day spirit and philosophy of preparing one set of findings as the result of competition is a completely new experience for pupils as well as for their teachers in Slovakia. The assignment is complex mathematical text with the length of about 10 pages. Teams are asked to hand out the set of findings, complex mathematical text, within seven hours of intense work. The atmosphere in the room is very open, pupils in teams discuss their findings openly. There is possibility to use internet or “call to friend” or use some books or journals during the solution of problems and writing reports. Some good communicative teams had lot of fun the whole day.

Finding schools, teachers and pupils

The contest Mathematics B-day has been piloted in Slovakia in 2011 and 2012. The competition attracted 40 pupils from six schools and two towns in 2011, and 117 pupils from 15 schools from 9 towns in 2012.

The Department of Mathematics is in active contact with many secondary schools in region and with mathematics teachers who work there. Contacts are based on long-term cooperation with schools

- in teacher education – schools serve as training schools for regular practice of student teachers;
- in organising Mathematical Olympiad (MO) competition (it is the 62st consecutive year of MO this school year in Slovakia and the Czech Republic);
- on other national and international project activities, for example: workshops for teachers with new study materials, textbooks and innovative, active pedagogies in math education promotion;
- in undertaking experiments, schools serve as a research location for PhD students.

Personal visits to schools and detailed explanations to cooperative teachers and their headmasters about B-day was crucial in attracting schools, represented by teachers of mathematics, to take part in the B-day.

The visiting of schools and recruiting of teachers and their pupils should be accomplished several weeks before the B-day. An official letter addressed to headmasters and teachers and signed by university/faculty/department authorities is crucial. Personal and e-mail delivery of the letter is essential; anonymous sending by regular post or e-mail is not recommended, as it does not achieve the desired results.

Teachers nominated their pupils. The list of pupils should be obtained one week before the B-day.

Teachers’ presence during the day is not required, but might be welcome and recommended to allow teachers to see what their students are able to do in group work.

Assignment

The original assignment is in English and is sent by FIsme coordinator. Cooperation with some other colleagues (but maximum two) in proof reading of the assignment translated to Slovak language is necessary. It helps to avoid misprints, to adjust the text if it is more readable (Slovak, not English in Slovak words), and to avoid mistakes.

A little cultural problem occurred: the style of the original assignment in English is not very official; it is a kind of informal mathematics text. An experienced colleague, a professor in the theory of mathematics education, who was asked for proof reading, required a more official version of the text in Slovak. He corrected the assignment text similar to a journal article or textbook style and asked for numbering of the pictures for instance. An acceptable compromise was found. The tuning of the Slovak version of the assignment took several hours of intensive communication, comparison with the original text, and explanation of expressions, words and sentences. It was a very profitable period and very important for the final version of the assignment. The question about the effect of different language versions of the assignment and its effect to pupils' reports subsequently has been raised as an interesting subject of following research.

Some colleagues were sceptical of the topics of the B-day 2011 and B-day 2012; of the tasks and of the whole process of finding solutions. They explained their doubts about the attractiveness of the topics and tasks. They were very curious if tasks would be attractive for pupils. Their doubts were not fulfilled.

Time estimate for the assignment finalization completion: minimum one week for proof reading, several hours for discussion with colleagues, and separate discussions.

Time for copying assignment and for preparation of folders for pupils is about one day. Doing this on the last day before the B-DAY is not recommended, but two or three days before are reasonable. If the B-DAY is on Friday, Wednesday is the last chance to avoid stress. This depends on the technical equipment and competence of the technical staff.

Competition

Pupils worked very intensively from the very beginning. Group work and cooperation was evident. It was created by the spirit of the tasks: playing games in 2011 and folding stripe of paper in 2012. Some of them did not read the first page of the assignment, where the instructions are described, very carefully, so some questions about the report, what is necessary to solve, were raised several times during the first part of the day. Pupils missed the numbering of the tasks, which is familiar for them from textbooks or standard school materials. Some pupils were confused by relatively long text of explanations. Nobody missed the picture numbering, because the pictures are the coherent part of the particular text or task in the assignment. Pupils used recommended manipulatives, wrote their initial solutions to the tablecloth, square paper was used for marking the initial solutions, too. Some teams photographed their pictures and included pictures to the final file. Coloured pen and pencils were in very good use, too.

Pupils did not stop thinking about problems during the lunch-break, either. Some of them used napkins for drawing pictures with solutions during lunch. The mood and atmosphere was very friendly, almost relaxed, but the deep thinking and inner concentration of individuals was evident even during the lunch break. Pupils were instructed to concentrate on the result file after lunch.

There was constant assistance from organisers during the whole time of the competition. Some pupils commented upon their immediate feelings. The most impressive comments:

(1) *“We did not need school mathematics today, but also simple mathematical thinking was not possible to use. We had to start to think in some way and then needed to keep track all day. And it was that.”*

(2) *“What a pity that I cannot come next year...I finish secondary school this school year and the next year I am at university.”*

Evaluation of pupils reports

University teachers, teacher educators and PhD students in Theory of Mathematics Education were asked to evaluate the results files handed in by pupils. There were eight persons in the team of evaluators. A set for each evaluator contained printed materials: the complete assignment and result files handed in by pupils' teams.

The evaluators were given comfortable time for the evaluation. Two main dilemmas were found by evaluators:

- evaluate the whole result, performance as a whole - or to put the main focus of the evaluation on the final solution(s) only,
- evaluate mathematical knowledge performance or the essay style of the report.

Particular evaluations were put on the table and the winning group was very clear both years.

The evaluation process should require special analysis and more arguing meetings perhaps - not for changing the final results of the B-day but for evaluators themselves, to be more aware of the focus of the evaluation. It is also a question of the individual experience and responsibility of the particular person-evaluator.

Important part of the evaluation is a jury report, assessment of the particular team work. The report is delivered to first ten best teams on the day of the official B-day evaluation event. The report is supplements diploma. An example of the jury report, which comments work of the best Slovak team in B-day 2012³:

Jury report

Compared to all other reports, this team delivers a very short report. The texts are concise and clear and demonstrate a deep mathematical understanding. The report is very well readable independent from knowing the task.

Beside the clearness of the report, this team demonstrates elegance which is highly appreciated by mathematicians. That is shown for example in the proof that every string of $2k$ letters L and R has discrepancy 0 or 2.

Very special is also the way in which this team uses the concepts of symmetry and reduction by skipping odd positions in clarifying most of their findings.

The report shows a very mature level of mathematical understanding. But a mathematical literate reader needs invest some thinking work to fully understand the correctness of most of the later parts in the report.

That is, apart from some small mistakes, the main reason why this team does not end up at a higher position. Some more elaboration on how this deep mathematical understanding was found should have been helpful.

Based on these considerations, in the opinion of the jury, the team of Gymnázium Jozefa Gregora Tajovského in Banská Bystrica fully deserves the fifth position for the Mathematics B-day 2012.

³ Jury report delivered to the best Slovakian team during B-day 2012 event in Utrecht, 15 March 2013

The jury report is a special type of assessment of the original investigative work in mathematics. The criteria of the assessment are related to the quality of the mathematical thoughts and formulations, content and organization of the B-day report. The comparison with other reports is an important point of such assessment. The question about methods of assessing investigative work and assessing creativity is raised. It is a challenge for practicing new skills in assessment of B-day 2012 reports evaluators and interesting topic for future research in mathematics education.

How to write mathematically, how to promote mathematical research of open tasks, how to master problem solving skills, how to describe mathematical knowledge and ideas clearly and detailed enough for any reader are some other interesting questions for practicing these special skills and competences in mathematics teachers education, courses for gifted pupils and also on professional development courses for practicing teachers.

Conclusion

Experiences of piloting the competition Mathematics B-day with the target group for which it is originally meant are very positive for everyone involved in 2011 and 2012 in Slovakia⁴. The other B-day assignments: *In the Hands of Time* and *Zig-Zag Functions* has been translated into Slovak and promoted to student teachers, PhD students in Theory of Mathematics Education and mathematics teachers within professional development course: Inquiry Based Learning and Teaching Mathematics. The successful and challenge B-day story in Slovakia is to be continuing. The project PRIMAS activities and ideas in inquiry based learning mathematics will continue besides the project itself is finishing in December 2013. The competition Mathematics B-day is an excellent example of sustaining ideas and sharing activities which have been opened by the research project.



Figure 1

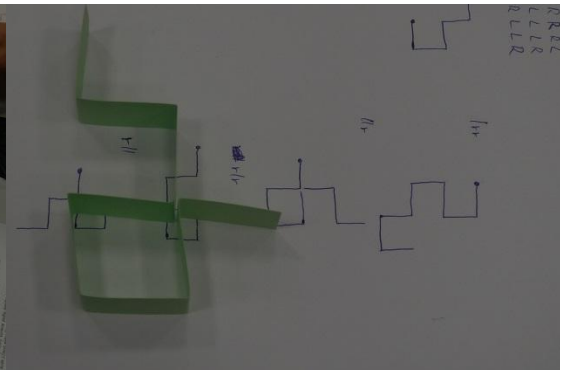


Figure 2

B-day 2012 (Cr)easy! folding stripe of paper

⁴ <https://www.ukf.sk/udalosti/2212-Netradicna-matematicka-sutaz>
<https://www.ukf.sk/udalosti/2313-Vyhodnotenie-timovej-matematickej-sutaze-B-DAY>
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Address

doc. PaedDr. Soňa Čeretková, PhD.

Katedra matematiky, Fakulta prírodných vied, Univerzita Konštantína Filozofa v Nitre, Tr. A. Hlinku 1, SK – 949 74 Nitra; e-mail: sceretkova@ukf.sk

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