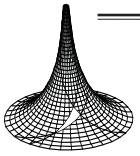

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Teaching
Mathematics and
Computer Science

# Report of Conference
# XXXIX. National Conference on Teaching Mathematics, Physics and Computer Sciences
## August 24 – 26, 2015 Kaposvár, Hungary

The XXXIX. National Conference on Teaching Mathematics, Physics and Computer Sciences (MAFIOK) was held in Kaposvár, Hungary between 24 and 26 August, 2015 at the Faculty of Economic Sciences of Kaposvár University. It was organized by the Department of Mathematics and Physics. The 67 participants - including 5 invited lecturers and 54 lecturers - came from 5 countries and represented 16 institutions of higher education. After the welcome speech of professor János Kelemen, who is the deputy dean of education of Kaposvár University, the conference was opened by associate professor Eleonóra Stettner, head of the Department of Mathematics and Physics. She welcomed the participants and asked the first two invited lecturers to hold their presentations about the light cocktail made by a physicist and the polynomial complexity of pivot algorithms on network flow problems. After a short break, in the next plenary session, the chairman of which was Sándor Molnár - the president of the Programme Committee - the topics of the presentations were: Erode or enhance? The "Digital Immigrants" dilemma of "Digital Natives" learning of mathematics, and the GEOMATECH competition in Hungary. On the second day of the conference educational and research experiences and results were presented by the participants, which were then discussed in small session groups of mathematics, physics, computer sciences and Experience Workshop of art, science, play, innovation and education. In the afternoon of the second day the participants were invited to take a guided tour at the Rippl-Rónai Museum and in the town, and in the evening they visited the

Zselic Park of Stars. On the same afternoon those interested could participate in the workshop activities organized by Experience Workshop. On the last day the lectures and discussions continued in session groups. There were three plenary lectures, the chairman was Professor József Kispéter - who is one of the founders of this conference and also the honorary president - about optics and art in the spirit of the year of light, MR Imaging and what a demonstration observatory is good for. Alba Regia Technical Faculty of Óbuda University has undertaken the organization of the next conference; therefore the representative tutor received the itinerant cup of the conference, indicating that the host of the next conference will be Székesfehérvár. This report contains the abstracts of every lecture presented at the conference, grouped by plenary sessions and areas of interest: mathematics, physics and computer sciences, in alphabetical order of the names of the authors in each group.

## List of abstracts from sections of Mathematics

Szabolcs Baják: *The Arithmetic-geometric mean*

In this talk we investigate the arithmetic-geometric mean, which was first discussed by Gauss. The generalization of the iteration defining the arithmetic-geometric mean will lead us to the so-called invariance equations, which form an important field of research in the theory of two-variable discrete mean values.

Árpád Bánhalmi: *Are university rankings of any use?*

Public opinion regarding universities is greatly affected by rankings made public in connection with those institutions. Overall rankings, comprised of evaluations and rankings reflecting various considerations applied in connection with such institutions, are characterized by a high degree of methodological diversity. In examining ranking parameters, we have focussed on the availability of conditions needed for overall rankings to be considered capable of achieving a required degree of fairness throughout the evaluation process. In examining those conditions we have found that not all conditions considered crucial in achieving fairness can be met via one particular kind (or any kind) of overall ranking. Moreover, we have pointed out the manipulative nature of overall rankings stemming from the formal characteristics of those rankings. Based on our findings, university rankings fail to produce a fair ranking of those institutions, therefore they cannot be applied in preparing decisions related to or advocating quality control. Their

function is one of quality assurance, which does not go beyond the manipulative aspects of functions affecting public view.

Gyöngyi Bánkuti: *Maple based operational research courseware created at Kaposvár University*

Kaposvár University took part in TÁMOP supported project for developing courseware, supervised by Debrecen University (members PTE and Eszterházy College). I wish to present the 5 chapters that were my share of the research not only on project level but also including the additionally developed Maple based interactive tools. The chapters are as below (with the interactive ones highlighted): linear programing, parametric and multiobjective problems, sensibility analysis, net theory, game theory. For the LP problems the Simplex Tableau is generated automatically, the basis change is optional from the menu, there are virtual buttons available for stepping back and further among the Simplex Tableaus, and even the graph of the 2 and 3 dimensional problems is generated. For the net theory the tool does not only calculate the critical path, but also draws the net. In the game theory part, the tool helps in calculation from the method of dominancy through the minimax method as far as the graphical solution of two dimensional problems.

Róbert Barna - Anna Klingné Takács: *Mathematics in the morning and at noon / mathematics in coffee breaks?*

We bump into mathematics every day, whether we realize it or not. At new places (like a conference) it happens that we drink the coffee out of a cup different from our usual one at home. At these times we face the problem: how much coffee should we pour into the cup to get the usual amount? We had a proven method, which we can call a hypothesis, as well, that the coffee should just cover the bowl of the spoon. Certainly, this is only an approximation because the shape of the cup matters, not to mention the difference in the spoons. We examined how precise this method is. For our examination we used Maple software.

Zsolt Biró: *The brachistochrone problem*

The aim of this presentation is to investigate the famous brachistochrone problem, which is almost three hundred years old and Galilei, Newton, Leibniz and Bernoulli also dealt with it. The problem can be solved by the method of variational calculus, but we present Bernoulli's elementary solution which had been proposed using the optical analogy of Fermat's least-time principle. This solution and connected material as the problem of minimal surfaces are explored in this presentation.

László Budai: *Measurement of spatial abilities with dynamic, interactive tests*

The development of the spatial abilities we have several opportunities between lesson frameworks and it without. We can realize these with different visual communicational and mathematical devices (models constructing, software, virtual reality, Lénárt-sphere, 3d-s the drawing of objects from different viewpoints. Their standard measurement but till now happened just paper-based, or in on-line environment static tests. Present days there is an opportunity the forming of a so simulated dynamic environment, which one helps in the everyday spatial-perception development and can be used as a measuring device also. We can accomplished an existing, standardize static tests to dynamic, interactive GeoGebra adaption, on which one we made a pilot based congruent validity.

We look for the answer for the next questions: what kind of criteria it is possible to use the dynamic adaption of a given static test task, how the dynamic adaption fits into the model of the given spatial ability system, distributes the ability being due to the same one, than the static test task suiting.

Edith Debrenti: *At word problems school*

Developing thinking involves developing problem-solving and learning skills. In order to effectively improve problem-solving skills and divergent thinking pupils must be exposed to as many word problems as possible. These should be unfamiliar to the pupils who should decipher the steps to the solution, the algorithm on their own. In teaching mathematics a great importance is laid on understanding word problems, on the correctness of steps leading to the solution, on eventual representations, and on applying the solution to the real world. Word problems play a crucial role in developing text understanding.

We have tested how third and fourth grade pupils can apply their mathematical knowledge and problem-solving skills by asking them to solve word problems the topic of which raised their interest, and which were not included in their textbooks.

Andrej Ferko - Lilla Korenova: *Project "E-MATIK+" in University Bratislava*

Gathering more than ten years of experience, we offer two courses on using ICT in teaching mathematics on elementary and secondary schools. At Comenius University, the students of the first course learn the tools, both software and hardware, which are available in Slovakian elementary and secondary schools. The second course is focused to the didactics of teaching mathematics using ICT. Our students defended tens of diploma works in the field. Thanks to the ESF EU

"EMATIK" (2006 - 2009) funding, over 1000 teachers were trained in ICT-based education with e-learning. In the year 2012 we succeeded in accreditation of a lifelong education unit, named Digital technologies in teaching mathematics on elementary and secondary schools. Nowadays, we continue working in a KEGA grant No. 094UK-4/2013, targeted on testingt of novel methods with teachers, mainly from high schools.

László Gaál: *Additional data to activity in mathematics of the Hungarian Academy of Sciences in 19-th century*

We are considering the arrangements of the Hungarian Academy of Sciences towards organizing and coordinating domestics scienticfic issues in the decades following its formation. We are providing new data for forming the institutional framework, its changes as well as its working.

Gábor Horváth: *Some refinements of the Cauchy-Schwarz inequality*

Let $U$ be a real inner product space, and let a and b be arbitrary elements of $U$. Then the absolute value of the inner product of $a$ and $b$ is not greater than the product of the norm of $a$ and the norm of $b$, where the norm of an element $v$ of $U$ is the square root of the inner product of $v$ with itself. We will consider some refinements of this inequality, and we will investigate the classical case, that is, the case of finite sequences of real numbers.

Tibor Illés - Richárd Molnár-Szipai: *Polynomial complexity of pivot algorithms on network flow problems*

We start the presentation with summarizing the most important types of network flow problems, then we focus on the maximum flow problem, reviewing the basics of some of the efficient combinatorial solution methods. Next we turn our attention to the linear programming approach of the maximum flow problem. We introduce the graphic meaning of the technical tools of pivot algorithms, as they are applied to network flow problems. Then we present a polynomial complexity primal simplex algorithm of Goldfarb and Hao. Finally, we display a variant of the Anstreicher-Terlaky MBU simplex algorithm that also runs in polynomial time on maximum flow problems. The notable feature of this result is that the algorithm is neither primal, nor dual in nature. We end the presentation by proposing further research directions and possibilities for generalization.

Antal Joós: *Packing points in the 4-dimensional unit cube*

Let $f(n)$ denote the maximum number $f$ with the property that one can place $f$ points in the closed unit cube so that the minimum distance between them is at least $f$. We search for the greatest number $n$ such that $f(n) > \sqrt{2}$.

János Katona: *Dynamical images in teaching geometry*

Nowadays our technical opportunities are multiplied. Teachers do not need to use expensive hardwares or softwares to develop digital learning environment simply and rapidly. It is getting easier to design and share images for teaching geometry. (We should note, the students can reach the shared documents easier and easier with a computer, tablet or smartphone.) In order to make dynamical images we do not need more resources, either. Think of traditional video, interactive three-dimensional models and constructions making with dynamical geometry softwares. In my presentation I will review my experiences about designing dynamical images and using them in teaching geometry.

László Kiss: *Thoughts about teaching mathematics, 2015*

The teaching of mathematics, like any subject, must have a real life relevance, promoting the ability to think clearly. Keeping this in mind, questions such as the following are posed and answered:

- Is zero a natural number?
- What is a function?
- What is a logarithm?
- What constitutes a good definition?
- What is the geometric significance of the derivative of a real-valued univariate function?
- What circumstances surround the extrema of a real-valued univariate function?
- When and when not to apply L'Hospital's rule?
- What can be achieved by integrating a rational function?

In the presentation an attempt is made to describe the way to teach mathematics in a manner appropriate to the year 2015 and the 21st century.

Mihály Klincsik: *Numerical approximation of concentration for conservative tracer-mass spreading in liquid*

Together with my colleague Ernő Dittrich we developed two mathematical processes in MAPLE environment that is successful to decrease the error of

tracer-mass measurement results and to the precise calculation of the moments of corrected tracer functions. It was proved with the first process that the measured tracer results of horizontal subsurface flow constructed wetlands filled with coarse gravel can be fitting more accuracy with Frechet distribution than with the conventional used distribution functions. The second process is a divided convective-dispersive transport model makes a fitted response curve from the sum of two independent convective-dispersive transport curves, which show the contributions of the main and side streams. The analytical solutions of both curves are Inverse Gaussian distribution functions. We concluded that the most important role in the fast upward part of the tracer response curve is played by the main stream. The side stream shows slower transport processes in the micro-porous system, and this shows the impact of back-mixing and dead zones, too.

Judit Kollár: *Romania - mathematics maturity differently*

Education in Romania changed constantly in the last twenty years. Reforms appear to correspond to European trends. University entrance based on maturity exams has been introduced lately, and the circumstances of taking the maturity exam have been made more strict. The reinstatement of multiple level maturity exam, and university administered entrance tests are expected. In the Rumanian education system four different exam types are compiled each year: one for math-physics, another for science orientated classes. A different one is prepared for teaching oriented, and yet another one for other specializations' classes. In this exposition we open a view into secondary school mathematics in Rumania through looking at maturity exam exercises.

István Béla Kovács: *Frames in Hilbert spaces*

Last year we learned finite frames. We would like to characterize frame sequences of Hilbert spaces now. We introduce fundamental results on Bessel sequences first, and give sufficient conditions on the existence of the lower frame bound. We present duality and means of creating new fames out of old ones. Finally we prove an elegant theorem of P. Casazza that requires only introductory knowledge in functional analysis.

Anita Misetáné Burján: *Chess and mathematics*

Not only facts and subject knowledge should be taught in 21st century schools but it is more and more important to teach the ways and methods of thinking. Formation of knowledge, which can be used in practice, is an important task in the field of mathematics. Learning this way of thinking can also be a good adventure for generation Z (children of global and digital age), but it may be a

challenge for teachers. Chess may have a major contribution in the development of mathematical thinking at school age. The queen of science (mathematics) and the royal game (chess) are connected in several ways. The elements of chess game helps in developing students' ways of thinking, especially mathematical thinking. Through chess, students contact with different thinking processes in a playful way. Both mathematics and chess develop abilities and skills and form students' personalities. Although the "royal road" leads to neither of them, they both contribute to educating responsible, self-sufficient children who are able to think for themselves.

Gyula Kem: *There needs to be a ground*

Where the enthusiastic youth faces challenge, solves problems that fitter knowledge, competes with others with similar abilities, develops the most, especially in thinking. According to experienced masters, exercises that the youth can just solve must be given to them. Hence the number, difficulty and complexity of their thinking schemas grow, and after a time, these are assembled to mechanisms, which help us in solving more difficult problems. KöMaL takes an exceptional role in offering the adequate problems. Its three committees comprise more than twenty committed high school and university teachers who invent the majority of the offered problems. The table above shows how efficacy in solving problems of the Journal facilitates success in the deservedly world-famous Kürschák competition.

Ildikó Perjési-Hámori: *Didactical questions of CAS one subject material-different levels, different students*

The University of Pécs, Faculty of Engineering and Information Technology offers special numerical mathematics courses for students of the MSc programs of information technology engineering, urban systems engineering and structural engineering in Hungarian and for the BSc and Erasmus students in English. The focus of the subject was solving model problems using Maple, a Computer Algebra System (CAS), sometimes substitute the exact mathematical proofing. Our experience is that we have to find the place of Numerical course in the engineering curriculum and we have to use the methods of blended learning and the didactics of CAS. Using well-prepared lecture notes, we have to take into consideration the students' different background knowledge in mathematics, in programing and in English: each course has its own way.

In my lecture our experience during the teaching of this subject is summarized.

Réka Szobonya - Gáborné Ország: *Development of education and employment in Hungary in counties and in time*

In Hungary the level of employment is much lower than the recommendations made by international convention, the unemployment and the inactivity rate are high. It would be desirable, to adapt continuously the issue of human resources of educational institutions with labour market requirements. The national figures conceal differences of the counties' labour market. Education policy or employment policy have also important effects, as well as internal migration or direction and magnitude of migration has not negligible impact of aggregated lagging. That backlog roles of the combination of educational differences, and differences of language knowledge, or the role of gender and in-country location, are important topics in it . Highlight the above factors, in conjunction with the most recent internal migration data, examined counties' data which are based on census.

Tiborné Petz: *The survey of teacher training students' knowledge, the opportunities of deficiencies' improvements in the frame of compulsory education*

At the beginning the faces of children cheer up when they realize that two bonbons are more than only one, they count with pleasure. Children calculate also gladly in the nursery, mathematics is good, they like it. Why? Then they go to the school bench and something happens somewhere, because getting into grammar school mathematics does not belong to the favourite subjects any more. At the university mathematics will be already a "dismissing-subject" directly. Why? What happens in the time between the years of the lower primary school and the years of the college? Lots of the students who are getting into the higher education do not know even the basic subject-matter that they had learnt in the primary school. That's why it is an interesting question: what kind of improvement do certain problem-ranges go in the students' way of thinking through, by the time from a primary school pupil will be a college student. Do the time make disappear the bad imprinting? With a survey I look for the answer to what kind of type-mistakes there are in the primary school and which ones there are at the college. Is there any agreement between them? Learning from the mistakes of the survey I would like to introduce in my presentation that in what kind of subjects and themes the concretizing and suppletory can be taught to the students in the frame of the college education.

Eleonora Stettner: *GEOMATECH competition*

The GEOMATECH project includes not only teachers' training and the development of teaching material, but also national competitions for Hungarians living in and outside Hungary. Problems that the compilers of the tasks had to solve:

- We had to set tasks which gave work to think about and to create enough for one month for the whole group.
- The tasks had to allow everybody to join in, not only the best matemeticians, but they had to contain enough challenge for the best ones, too.
- The tasks had to be new and interesting so that students feel the urge to enter.
- The use of GeoGebra had to be essential to the solution of the tasks.

István Talata: *Teaching centre of gravity computations with methods of computer geometry*

In the education of civil engineering/architecture students, centre of gravity computations are included in the topics of obligatory courses of mathematics and mechanics. However, the notion of centre of gravity (and centre of mass, resp.), its properties, and its applications are not acquired properly by many students during those courses. That is why we started to deal with centre of gravity computations during an optional geometry course, where geometric methods and their visualizations are included as well, by using computer modelling. There are several computer software that are suitable for the geometric demonstration of centre of gravity computations. During the course, we use GeoGebra to determine the centre of gravity of planar figures and polyhedra, and to visualize this process. Furthermore, we create a parameterized model of a polyhedron made by a homogeneous material that has a hollow part inside, and for appropriate choices of parameters that polyhedron has only one facet on which it can stand stably on a horizontal surface.

Ágnes Lencsés Vig: *Questions in solving mathematical problems*

Observing our think wise during solving mathematical problems we put up questions to answer to ourselves. If we follow the way of problem-solving: strategies, methods, principles, then we are able to elevate the competency of problem-solving for our students. "Using knowledge" competency must be analysed by the teacher first,- questions for each step - to be able to deliver the goods to the students later on. These questions will supervise the the thinking of students. We

have to observe ourselves and write down which are the exact questions that lead us to the solution. After solving the problem if we analyse again these questions we provide a helping tool to enhance the competency of problem-solving by our students. In my talk I will introduce few problems with solutions and the types of questions that we used for the solutions. Primarily we have to teach our students how to ask questions not at last with ourselves as living proof.

## List of abstracts from sections of Physics

Róbert Barna: *The principle and accuracy of GPS telemetry*

Within satellite navigation the GPS (Global Positioning System) became widespread and its use has become totally common nowadays. In the lecture (in this article) we will talk about the principle of positioning, the methods of measurement, and about their accuracy. We will also discuss the methods and errors of measurement.

György Hudoba: *Over the clouds - the HUNBALLOON experiment*

In 8th of June 2013 we successfully launched two high altitude meteorological balloons, with scientific capsules. Each capsule contained GPS receiver, several sensors, SSTV and high definition image capture camera.

The highest reported altitude was 37 332 m and we got nice SSTV pictures sent by one of the balloon. Pictures were received by several HAM stations and by the MASAT-1 cubesat satellite ground station of the Technical University of Budapest as well. APRS tracking was working perfectly, practically got all packets with no loss. Unfortunately we could not collect the capsule on the ground. As a consequence, most of the electronics, as well as the collected radiation, and other offline data have been lost. The most probable cause of loss was a stroke of lightning.

The second balloon, HA4BM-2 didn't send any data, because the different version of APRS tracker used in this capsule was dead. However it was found by an angler in the Lake Balaton. We were able to recover some of the off-line data.

Anna Klingné Takács: *GEOMATECH-Physics competition*

GEOMATECH competition is a playful Maths and Science contest, not a traditional educational competition, thus the organizers expect not only students who are excellent in Mathematics and Physics but creative communities as well.

During the contest children get opportunities to solve the tasks in groups, so they can develop not only their practical knowledge, but their communication abilities and their cooperative competency, which improves their social skills. They can do this in the unique, creative way of GEOMATECH competitions where tasks are not limited to the naked solution: students can exhibit, explain, and present the solved problems and their results with the use of computers, in group work or through experiments.

In our lecture we present the experiences in the starting of the competition, we show the wittiest, most creative solutions of the first rounds.

László Mosoni: *What is a demonstration observatory good for?*

Astronomy is perhaps the science which can be "sold" to the public the most easily. The demonstration observatory is located in the Zselic Conservation Area, in Zselic Starry Sky Park, and with its equipment, - telescopes and planetarium, - we can demonstrate several interesting phenomena of the starry sky, and thus, hopefully, we can arouse the interest of many in sciences, engineering and mathematics. Based on the short time since the opening in spring 2015 it is difficult to decide what is really useful in this respect, but we do hope that our popular scientific educational work will be successful.

László Nyirati: *The track of the gnomon's shadow*

Examining the gnomon's shadow is geographical positioning method, which is relying on the understanding the Sun's and stars' path on the sky. The method uses vertical stick on the ground, marking the endpoint of the shadow every day at noon. The geographical position can be calculated using the length of the shortest shadow, the length of the stick and the time zone.

During our measurements we are looking for the exact trajectory of the shadow's endpoint depending on the time and place. We are facing a geometrical problem with the conic sections, which can be solved using the Dandelin spheres.

Ervin Rácz: *Light cocktail made by a physicist*

For a physicist light is electromagnetic wave. It holds spectral components sensitive for human eyes, and it contains other wavelength ranges which are not sensitive for human eyes. Light plays deterministic and key role in life of plants, animals and humans. In order to aware of the concernment of the light and do not forget how important the light in our life is, UNESCO dedicated the calendar year of 2015 as the International Year of Light. The international event is sponsored by UN as well. Not only abroad, but here in Hungary many events

have commemorated the International Year of Light. This presentation honors the International Year of Light on the Conference of MAFIOK XXXIX.

In the presentation author will mix a cocktail using components of phenomena, principles, processes, inventions directly connecting to the light during the presentation. The mixed cocktail will be presented for Dear Participants. Author relies on presented cocktail will be spectacular and interesting, and it can worthily be called as real light cocktail. Furthermore, author believes, the mixture will be memorable for teachers of physics, mathematics and informatics as well.

Ervin Rácz: *Generation and acceleration of charged particles and ions using intense laser pulses*

Formerly, particle accelerator facilities - such as cyclotrons or linear accelerators - have been used to accelerate charged particles. Specifications of these facilities are: huge area used, huge devices. These parameters are proven by Fermilab, Tevatron, Stanford Linear Accelerator or the structure of the huge-size giant lab the CERN.

Since several decades, with appearance of high intensity lasers possibilities of generations and accelerations of charged particles and ions have been expanded. Nowadays, electrons, protons and ions can be generated and accelerated by intense laser fields up to several 100 MeV kinetic energy range. Sizes of experimental arrangements of the laser particle accelerators are much smaller than the sizes of facilities of traditional accelerators; so laser based systems are cheaper. This presentation will give insight into the possibilities of charged particle and ion generations, accelerations and uses based on intense laser pulses.

Dorottya Sebestyén: *Optics and art in the spirit of the year of light*

Optics and painting are in close connection since the 14th century. In the previous centuries numerous physicists dealt with the representation of a sight, as application of optics, nevertheless the painters dealt with the physical laws, which were able to do more enjoyable their works. A famous painter, who was at the same time an educated mathematician, was born just 600 years ago. One of his books deals with the mathematics of perspective. Some of the mathematicians and physicists were interested in the subject of perspective and we can say the same about some of the painters. Looking at some works of art we can discover direct influence of mathematical or physical laws, and some of them can be used to illustrate explanation of physical laws. This paper intends to illustrate the connection of optics and painting using examples from the history of art.

Éva Stefánkó - Tamás Orosz: *Modular Competency Improvement by Means of E-learning Technology: Newton's Laws in Classical Mechanics*

Usually a single or a couple of specific education theories are preferred and selected at schools. Although the contents of the relevant studies are considerably different at primary and grammar schools or even at university level, the chosen pedagogical methodologies play significant role in the learning progress of individuals and groups. The structure of lessons, the requirements, the feedback, the control points inside a curriculum highly influence the students' performance. Generally, however, there is a lack of time to account for each pupil individually. That's why a course commonly applies single familiar with E-education theory. This paper discusses an introductory Physics case study, focusing on the advantage of adjusting learning methods to individual students. E-learning technology is supposed to be applied as a comfortable tool for evaluating the learning process and altering.

Attila Tóth: *Some practical application of light properties*

The submitted paper deals with the possibility of using results of light-research in optics at secondary schools and universities. It contains specific outputs with an emphasis on endearing science subjects. I described the methods, how is the teacher able to make the subject interesting for students, but I found problems too, that would be suggested during the teaching or research. Students get homework with tasks that suppose detective designing of results. These facts cause in many cases that students start with the research but based on their own idea or theory. A lot of scientific student's works are inspired by their indiscretion of research which may appear among other in their grades at school. We are able to create a good basement with the real-life-oriented tasks in a physical subject too. The main increment of it may be the concernment of students of physical or natural sciences. Nowadays we have a lot of unanswered or unsolved tasks. Students discover the beauty of research work included the practical application and variety of lights. Tasks were constructed from the aspect of growing students' interests and their acquirement of syllabus. Through these tasks students should understand that every finding or discovering is achievement and makes sense, especially in the field of physics, like optics.

# List of abstracts from sections of Computer Science

Zoltán Bécsi - Beáta Bojda - Katalin Bubnó - Péter Domonkos - Anikó Kelemenné Nagy - Viktor László Takács: *Mobile programming with block languages*

Lajos Kossuth Grammar School of University of Debrecen won a tender for the second year in computer science in the National Talent Program. The program is popular among students because of the possibility of learning mobile programming. Pupils can develop mobile applications on Android platform from the beginning with the help of App Inventor 2 programming environment.

The goal of our talent program was the popularization of computer programming and detection of those gifted pupils who were not brave to start computer programming in the absence of adequate motivation of learning computer science seriously before.

In 2015 we actualized projects on mobile devices connected to 'The Year of the Light 2015' event. In this paper we show our results and experiences in details.

Mária Csernoch - Piroska Biró: *Functions beyond the maths coursebooks*

The phenomenon of function is one of the traditional links between mathematics and computer sciences. In spite of the obvious connections, we can hardly find any sources which prove the joint effort of the two subjects to develop the students' approaches to functions. Within spreadsheet environments, we have introduced a tool, entitled Sprego programming, which supports real world problem solving with concept and algorithmic based approaches. One of the advantages of the method is the frequent use of the multivariate functions and the highlighted application of the multilevel functions. Consequently, with Sprego programming we provide a tool both for the teachers of informatics and mathematics with which the students' algorithmic skills can be developed and also their concept of function.

István Füvesi: *Demands and opportunities in the education of the basics of informatics in the higher education*

Within the framework of teaching the subject called basics of informatics, mostly the tools and methodological elements suitable for the requirements of information society must be taught by discontinuing the previous practice, which spent too much time for the substitution of deficiencies in the field of informatics, which would have had to be learnt in the secondary education. Building upon that students know how to use the applications of the Office Pack, the teachers must

teach - besides the Google Drive - the utilization possibilities of Sulinet Digital Knowledge base and simple internet applications that can be easily used in classes. The students should be able to use multimedia editing tools, download, upload and edit image, audio and video files. They should come to know the features of e-portfolio and its role in the pedagogue assessment and learn how to use the Tablet PCs, interactive tables, mobile devices and the Prezi. The students should get familiar with the tools developed for supporting the realization of equal opportunities. With the gained knowledge they should be able to plan and coordinate the information-communication technology individually in the daily educational practice and use these tools in any area of life. In the course of the lecture, the above mentioned topics will be expounded and introduced.

László Gimesi: *The role of informatics in teacher training*

Nowadays' students grow up with the digital world surrounding them, they learn to use the tools of information and technology (IT) in early childhood. They do not obtain their knowledge in the 'classical' way or establish contacts in a traditional way. The big question of today's pedagogy is how to teach this generation effectively? Is a separate informatics subject necessary to teach information and communications technology (ICT), or can it be acquired individually or in other subjects' context?

How do we know what we should teach to current university students and teacher candidates, what they are supposed to pass on to future generations? Of course, we cannot now that, but such a fund should be created that will allow them to follow changes by self-education, and with the help of refresher courses. It is a basic requirement for Informatics - along with its pedagogic and methodological application - to get incorporated into professional courses. Students should be introduced to such applications (software) and technologies that can be involved in education. Thereby a skill can evolve which makes them capable of self-adapting to future technology developments.

Ildikó Papp: *New methods in the development of spatial ability*

The development of spatial visualization skills is very important in technical education. Visualizing 3D objects, representing them in the plane and solving the geometric problems formulated with them are the basic steps in this progress. The course Descriptive Geometry makes an important role in this work. Currently, grade-level lectures are implemented with very large groups on practices, and the traditional tools are replaced with smaller whiteboards, so new methods of teaching are necessary.

The aim of my talk is to present my infocommunication technology tools which have been applied at the Faculty of Engineering in recent years.

Ildikó Papp: *Geometry in science promotion events*

There are many projects to raise public awareness on the importance of natural sciences, technology and innovation. Geometry is one of the most attractive mathematical program components on science festivals even though the role of geometry was decreased in the secondary education. A program named "Playing SPACE" was developed by us with some variable components. The elements can be adapted to the location of the event, age group of the participants, and any other requests. We are engaged on Researcher's night, SEE Science festival, Girls' day, Science on Stage festival, Special days in schools, "Meet the professors" roadshow, and our program was the accompanying event of a math competition.

The aim of my talk is to present the components of the program, our tutorials and devices, and our experiences and some plans to the future.

## List of abstracts from sections of Experience Workshop

Ferenc Arató: *Re-structuring thinking - Results of cooperative paradigm and its effects on our approach to learning and teaching*

The presentation summarizes shortly the results of cooperative paradigm from the last four decades based on international and Hungarian researches. Following the presented results clarifies the most significant paradigmatic characteristics, symbolic generalizations, puzzles, exemplars providing a comprehension of the differences between cooperative and non-cooperative structures of learning. The outlined basic principles are applicable both in the cases of formal learning situations and working situations where the common goal is effective, efficient, and fair cooperation or/and learning.

Kristóf Fenyvesi: *Give me STEAM! Opportunities for mathematics education in the steam integrative approach*

As attitude-researches point out, students tend to sustain an aversion to mathematics, while remaining largely ignorant of how deeply embedded it is in the world around them. Most students however are able to recognize patterns and numerous research and empirical evidence indicates that they become easily motivated (and even fascinated) when mathematical connections are presented in ways which relate to their experiences by triggering their natural curiosities.

PISA and TIMSS results and recommendations are that students should find education enjoyable, develop self-belief and stamina to address challenging problems and situations. Experience-centered education of mathematics through arts and playful activities and the in-school and out-of-school implementation of the STEAM integrative educational framework might be an effective way to grasp the complex relationship between mathematics attitudes and joy of learning and support the students in their study achievements.

Sándor Klein - Julianna Kiss: *The role of games in math learning (The legacy of Zoltan P. Dienes)*

Schools have a difficult task to prepare young people to the unknown future. One thing seems to be sure future generations have to face again and again new, strange problems, and it will not help if they say: "we didn't learn that in school". Dienes games help to develop something which could be labelled as "problem facing ability".

Games have a wonderful property: intrinsic motivation. Dienes games are motivating children and adults to make efforts to understand mathematical structures. During these journeys the players use both their brains and emotions: while they enjoy the games their thinking is developing too.

Zsolt Lavicza: *GEOMATECH: Integrating technology into STEM teaching for students to enjoy their learning - a research perspective*

Technology is increasingly becoming an important part of mathematics teaching and learning in the 21st Century. There have been numerous attempts to integrate technology into education systems, but without serious development and research the success of these attempts had been limited. In my talk, I will highlight the importance of research in technology-supported education and describe some research projects I participated during the past decade. But, most importantly, I will outline the work that we are doing with colleagues in the Geomatech project in Hungary. Geomatech (`http://geomatech.hu`) is a large scale EU funded project, which aimed to develop high-quality teaching and learning materials for all grades in primary and secondary schools in Hungary. These materials (1200+ Mathematics, 600+ Science) will be embedded into an on-line communication and collaboration environment that can be used as an electronic textbook, a homework system, and a virtual classroom environment. In addition to material development, we offered 60-hour professional development courses for more than 2400 teachers in 800 schools in Hungary. Furthermore, we organized a wide-range of teacher and student activities including competitions, maths and

science meetings, and developed a network of schools for the long-term sustainability of the Geomatech project. We believe that this project became a test bed for future international projects and trialling ground for different educational activities.

Imre Nyögéri: *Disentanglement puzzles*

I will present some interesting puzzles, which is closely releated to the topology within knot theory, but don't entirely based on topological principles. These didactic and methodological aspects are interesting, because on the one hand we have to understand shapes and sizes in three-dimensional space and on the other hand we could experience the heuristic feeling in their solution. When we solve a seemingly impossible task we can experience a unique feeling.

Sára Sugár - István Büti: *Enriching STEM programs in the practice of Abacusan Studio*

Abacusan Studio, a registered Talent Centre has been running its educational and knowledge-spreading activities since 2010, focusing on sciences, information technology, robotics, mathematics and arts connected to STEM-STEAM disciplines.

Our programs are designed to raise interest in branches of STEM amongst primary and secondary school students. We aim to deepen their knowledge, foster creativity, help develop thinking and social skills, build on the students' talents and provide guidance in finding their future careers. Our educational work is supported by a wide cooperation of pedagogical and industry experts and organizations. Being independent from the public education system we work with the methodology of informal education: competitions focusing on research, creativity and teamwork, courses with modular and spiral design, camps using projekt structure to internalize complex topics. Our regular Family Days and our participation at school, town and other community events provide an opportunity for playful learning and building recognition of our activities. By exploring, showcasing and providing access to new educational toys from Hungary and other countries we popularize independent, self-driven STEM experiences in schools, communities and at home.

Tamás Szigeti: *Projections of Earth*

How can we get monographic projections of sphere? How can Globe-cube and Globe-tetrahedron be created, how can we fold them using a few identical origami-modules?

László Vörös: *Geometry and art in the shadow of hypercubes*

The 2D and 3D models of a hypercube and of their lower dimensional elements can be interpreted as shadows or projected images. Planar and spatial mosaics, impossible or seemingly impossible and ambiguous formations may be built with these. The result may be connected to the art of Victor Vasarely, M. C. Escher, Tamás F. Farkas, for instance, but the acquired knowledge is applicable also in own artworks. The geometrical properties of the projections can be showed with the sunlight and by photography, creating analogy to the modelling process. The periodical tessellations can be restructured in fractals. The amounts of different lower-dimensional elements of more-dimensional cubes are definable by planar and spatial patterns as well as in tables with simple arithmetic operations as guidance for the combinatorial methods. Using the modelled elements, mosaics can be built showing the types of symmetry patterns. The models and the initial edges of those may have connection to the Platonic and Archimedean solids as well and these can be grouped from a new point of view. Ergo, more-dimensional cubes can be simple and interesting tools of the complex learning.

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