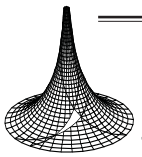

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Teaching
Mathematics and
Computer Science

Report of Meeting
Researches in Didactics of Mathematics and Computer Sciences
February 1 – 3, 2019 Štúrovo, Slovakia

The meeting Researches in Didactics of Mathematics and Computer Sciences was held in Štúrovo, Slovakia from the 1st to the 3th of February, 2019. It was organized by the Doctoral School of Mathematical and Computational Sciences of University of Debrecen.

The 63 participants – including 17 PhD students – came from 7 countries, 22 cities and represented 36 institutions of higher and secondary education. There were 4 plenary, 42 session talks and 7 poster presentations in the program.

After the warm welcome of Emília Szitasová, Head of the Private Buisness Academy, Štúrovo, the conference was opened by professor András Ambrus, Founding Member of the Didactic Program of the Doctoral School of Mathematics and Computer Sciences, University of Debrecen. He welcomed the participants and emphasized the importance of the fact that the conference was held this year at a new location, in Stúrovo, in Slovakia.

The subjects presented in the lectures and posters of the conference were of great variety. Beyond the use of alternative methods in teaching mathematics, as well as surveys on students thinking there were several lectures on digital technology using in mathematics and computer science education.

The conference venue, Štúrovo is a small city on the banks of the Danube with a beautiful view of the Castle Hill of Esztergom. A very memorable event was the visit to Esztergom Basilica, the seat of the Catholic Church in Hungary.

In his closing speech, professor Károly Lajkó, ex-Leader of the Doctoral School of Mathematics and Computer Sciences, University of Debrecen appreciated the high quality of the lectures, with special regard to the works of the invited lecturers and PhD students. He also gave his thanks to all the lecturers, the chairs of sessions, and also to the head of the Organizing Committee Eszter Kónya, whose work essentially contributed to the success of the conference.

Subsequently, we provide the abstracts of the lectures in alphabetical order of the authors' names.

List of abstracts of lectures

András Ambrus: *How can we reach the practicing mathematics teachers?*

There exists no for all mathematics teacher obligatory in-service teacher training in Hungary, we don't have scientific journal for school mathematics teaching. How can we reach the simple mathematics teachers working in small towns, villages or everywhere? In my talk I will present some ideas about a new project. In this project the practicing teachers get theoretical summaries about the basic question of mathematics teaching, the teachers study these materials, and based on their teaching practice they make comments, give concrete examples, ideas from their practice. What is clear: it is very hard to convince the teachers that they should reflect on the theoretic materials and on their teaching practice. In the talk we present some teacher comments relating the aim of mathematics teaching, the teacher role and the learning models.

Gabriella Ambrus: *Open, reality-based word problems among teachers and teacher training students*

World problems–which solution requires the consideration of the reality-based situation–got more and more attention in the last decades. Although the use of such problems in the mathematics education is expressed already in the teaching theory of Tamás Varga, you can find hardly any in the Hungarian teaching praxis.

Within the Project of the Hungarian Academy of Sciences (Content Pedagogy Research Program of the Hungarian Academy of Sciences) we made a wide-span cross-sectional research among elementary and secondary school students and teacher training students to evaluate that how do they solve such a word problem. According to our findings (and personal experience) students in the school and at the university often have problem to find a solution based on "open, realistic considerations". That's why we started to research how to put this subject in

the university training of teacher students and teacher training course. In this presentation we discuss our first results.

Éva Ádámkó, Gusztáv Áron Szíki: *ProfKit application to reduce the administrative burden in higher education*

Teaching mathematics and informatics at a secondary school or in higher education means not only preparing for the lessons, and then passing on the knowledge to the students, but also a lot of additional administration. As tutors, working in higher education, we usually handle huge student groups, and it is necessary to register the presence or test results of students in a traceable and verifiable way. It is also important to make all the data available to students. In secondary school, for the above purpose, there is the e-register which is available on a PC, laptop or even a smart phone. In higher education the Neptun System is used, but it is not suitable for the above purpose. Because of that, we present the plans of an self-developed mobile application, which can be an easy solution for the above problem. The ProfKit application is working on a MySQL database, it is implemented in Java and PHP for Android, and can handle a lot of administrative problems.

Szilvia Árvai-Homolya, Attila Körei, Szilvia Lengyelné Szilágyi: *Reducing drop-out rates and supporting learning activities by organizing a summer math camp in the University of Miskolc*

According to our experiences students applying for higher education in engineering and information science possess very difference level of mathematical knowledge. It is a regrettable fact that recently there is a significant increase in the number of the students who drop out of their study. First-year students with insufficient mathematical knowledge have very difficult task; they have to learn a lot of new information to pass the exam and beside this they continuously have to retrieve the missing chapters of the secondary school learning material. Discussing and considering our possibilities we decided to elaborate a program aiming to improve mathematical skills in course of a weeks? lasting summer camp. Our main aim is to create a pedagogical environment for our prospective students who have learning difficulties in order to obtain the lacking mathematical knowledge avoiding defeats as it is possible.

Tünde Klára Baranyai: *The ability of menthal calculation of teacher training students*

This paper presents a research on teacher training students of Babes Bolyai University, Satu Mare. We presents some techniques, trucks that they using in

menthal calculation and 10 interventions with mathematical games. After that interventions we compare the students ability on menthal calculation.

Beatrix Bačová, Ján Gunčaga: *Students of the technical universities and diagnostics of their attitudes towards mathematics before and after the reform of education*

The process of mathematical competences acquisition is strongly determined by the attitudes of individuals towards mathematics. In the paper we present the results of our research conducted with the students of the 1st form of BC study programmes studying the subjects Mathematics 1 and Mathematics 2 at three different technical faculties of the University of Žilina, Slovakia in the academic years 2010/2011, 2014/2015, 2015/2016, 2017/2018. Participants of the research have been both the students who were studying mathematics at their secondary schools before as well as after the content reform. On the basis of a four-year research we could compare and generalize not only all the observed students? study results and thus make valuable deductions but also confirm the fact that acquiring and retaining mathematical skills as well as developing mathematical thinking depend to a large extent on the work and attitudes of the students themselves, on their personal relationship to mathematics, although influenced by several different factors.

Benjamin Rott: *Models of the Problem Solving Process: Students' Approaches to Solving Geometric Problems with and without Technology*

How do students' approach (geometric) problems? And how can their behavior in the corresponding processes best be described? Most models of the problem solving process – like the famous four-step model by Pólya – are normative, i.e. they are used to tell students how to proceed. Such models, however, are not suitable to describe and analyze problem-solving behavior. Therefore, in the talk, the development of a descriptive model will be presented. This model can be used to differentiate between students who are able to regulate their processes and students who lack the appropriate metacognitive skills. The model also reveals significant differences in the processes of students working with paper-and-pencil and students using Dynamic Geometry Software.

József Borján: *Online, Link, Anaglyph*

I'll present examples for three IT opportunities.

1. Online courses. In a cooperation with MEOSZ, we had two courses: 'Computer image manipulation/processing' and 'Sound editing with computer'. We made a successful online version for the image processing course too.

2. Hyperlinks for the education. I'll show examples of the usage of hyperlinks for education (NAT) and scientific purposes.

3. Anaglyp presentation. I'll provide the anaglyph paper-glasses. We used this technology at MEOSZ and at the Military Science Society for demonstration purposes.

You can see parts of my presentation at `http://jborjan.uw.hu`

László Budai, Tibor Kenderessy: *The development of plane geometry skills in primary school*

Well known, that the past social, public education, methodological changes happening in 10 years, with a serious effect has the daily teaching work. Several competences that can face up to the new challenges have to be at the educator's of the today's age disposal. One of the ones like this competence is the digital competence, which is a big weapon for the educators of the today's age. of our lecture is presented OKM based on results for Hungary's primary school students results the plane geometry on an area. we outline a development direction favoured with possible, digital devices based on own experiences then, which one complemented it till now known, was useful with devices, methods his more efficient educators–it may make teaching work possible on the mathematic courses.

Edith Debrenti, Balázs Vértessy: *The problem solving skills of teacher students*

Being familiar with various solving methods of word problems, has an important role in primary school. Word problems are important in developing reading comprehension as well. In the course of solving the exercises we can use multiple methodologies like visualization, fake perception, reversed way (backward induction), comprehension, elimination, evaluation. Students who are aware of various methods can solve different exercises much easier. It is essential that teachers have professional knowledge, since they have an important role in teaching word problems. The factors which influence problem solving thinking are: resources, heuristics, control, beliefs, as well as self-regulation. We surveyed teacher students with a test which can be solved with different methodologies. We were investigating the students' flexible thinking, the knowledge and the diversity of

their solving skills as well as their accuracy and the most common problems which occurred in the test.

Kornélia Éva Dékány: *My first experience of applying recall method in university mathematics education*

During this semester (Autumn 2018) at the Faculty of Mechanical Engineering of the Szent István University I elaborated the curriculum of Engineering and Economic Mathematics on MSc level students using recall method. In the presentation I will introduce what modifications and tools I have used, and summarize my first experiences.

András Ferenc Dukán: *Bridges and gaps between the secondary and tertiary school*

My research is focused on the much-studied secondary-tertiary transition. With Éva Erdélyi and Csaba Szabó, we investigated why the freshmen of the universities do not know the material for the (Hungarian) mathematics high school graduation. The results of our examination, in which ca. 300 students participated, reinforce the hypothesis that the students are not confident enough about the requirements of the written exam, independent from how they performed earlier at the high school. Our hypotheses are based on the recent models of mathematical thinking. According to these, we have found that last year (after the repetition) performance is better but it is still not enough. The relevance of neurobiology on mathematical didactic is confirmed about the importance of spirality.

Emese György: *A Combinatorics Teaching Experiment based on Tamás Varga's Heritage*

In 2015 our research group conducted a middle and secondary school teaching experiment and research on teaching combinatorics. The research group, lead by Ödön Vancsó (ELTE), using a grant from the Hungarian Academy of Sciences examined which ideas of Tamás Varga's "complex math teaching experiment" (1963-1978) can be used these days and developed worksheets for 6-10 hours of combinatorics instruction. The teaching experiment started with a pretest in the experimental and control groups, followed by the use of these worksheets in the experimental groups, and ended with a posttest. In the talk I will also show some of these teaching materials and some teaching tools we used (Logical set, wooden/paper figures, Poliuniversum). I will also talk about the larger, 4 year follow up research project (2016-2020) our extended research group is doing

now. (This study was funded by the Content Pedagogy Research Program of the Hungarian Academy of Sciences.)

Krisztina Fodorné Faragó, Eszter Kónya, Zoltán Kovács: *On the experiences of a problem-centered teaching method*

Based on the didactical principles of Tamás Varga's complex mathematics teaching experiment, we designed a new experiment, focusing on problem-centered learning material, critical thinking and classroom discussion. We constructed and implemented lesson plans for 5-11 Graders. Four teachers were involved in the work, each of them taught 6 lessons. In our talk we present the aim and methodology of our research, furthermore some experiences which are analysed from teachers' and learners' perspective as well.

Béla Finta: *The complex version of a result for real iterative functions*

The purpose of this presentation is to show a complex version for complex iterative functions of a result for real iterative functions and to give some applications for complex nonlinear equations using the complex Newton's method, chord method, parallel method and Steffensen's method.

Ákos Győry: *Research of proof skills in geometry of secondary grammar school leavers specialized in mathematics*

One of the most difficult areas of mathematics education is the development of students' proof skills. According to the framework of the mathematics curriculum, students must attain the level of ability to produce an exact logical chain to prove some simple problems by means of their thoughts and acquired knowledge. As a first step of a comprehensive, long-term research, we monitored the approach to proof of secondary grammar school leavers specialized in mathematics through geometric problems, with the help of a test from the publication Van Hiele Levels In Secondary School Geometry by Zalman Usiskin. We were curious about how students draw up a geometry diagram, how to differentiate between hypothesis and conclusion of a statement, what their written communication is like, and how they reason in case of simple statements. The presentation will be about analyzing the experiences of the survey which we would like to use to create a development research.

Ivan Kalas: *Programming in Primary Education: How to understand and harness its potential?*

Present computing education strategies consider programming a key instrument and manifestation of computational thinking. Digitally developed countries

have therefore set ambitious requirements for new computing (or informatics) education, usually launching it in lower primary years already. However, the question remains how to meet those requirements. There are several portals and on-line resources claiming to have the answer to that question. Our main concern, however, is that those resources and the expertise behind them often originate from after-school experience, focusing mostly on isolated flashes of learning, often neglecting complexity of important basic computational constructs and practices, plus failing to harness the potential of primary education. In our on-going research and development, we set out to better understand what distinguishes after-school programming environments and approaches from systematic and appropriate pedagogies for lower primary computing. In my plenary I will present our emerging approach for transforming so called 'basic' computational constructs into thoroughly constructed and iteratively verified gradations of short units of programming tasks which the pairs of pupils–and then the whole class–try to explore and solve, envisage and discuss, compare, share and explain, exploiting the 5Es pedagogical framework of our earlier ScratchMaths project. I will give reasons why we decided to develop new set of programming environments with Emil to implement our strategy and I will formulate our key design principles and explain which powerful ideas we want pupils to experience and explore so that they get the opportunity to gradually build deep understanding of several computational constructs (or pre-constructs) and practices in appropriate progression. I will also comment on how we use this new intervention for better understanding the cognitive demand of essential computing constructs.

Enikő Jakab: *Neither priest speak twice, listen to him once! Learning with help of recall (testing) method*

My research topic is the development of mathematical competencies with ICTs. In the next stage of my empirical research I compare the effectiveness of mathematics learning, teaching process in such an environment where ICTs are used and in a classical environment. I teach the experimental and the control classes myself according to the Ukrainian curriculum, we learn such geometrical conceptions as perpendicular and parallel lines and coordinate plane. I have experienced more times that the lessons with ICTs are interesting for pupils but the planned experiences and consequences have been lost or at least have been faded by switching off the computer. I would like to do against this with the help of the recall method. We use paper-based and electronic worksheets. In this way we not only support the recall method, but we also document the pupils? activity.

Jozef Hvorecky: *Numbers, Calculations, and Common Sense*

For common people, "Mathematics = Calculations". For educated ones, Mathematics = Abstraction + Symbolic representation + Formal manipulation. Such opinions degrade its important role in our social life and, consequently, build an inappropriate starting point for its education and comprehension.

In our contribution, we will demonstrate that such opinions do not consider the extensive amount of tacit knowledge necessary for effective and efficient exploitation of Mathematics in its real-life applications. The tacit knowledge is incorporated in Mathematics in two ways: (a) inside its body, it serves for selecting optimal representations and manipulations, (b) outside its body, it serves as a tool for finding the best representation of external world by mathematical apparatus and for interpreting the outcomes. In the end, we will demonstrate how to build "external" tacit knowledge i.e. "user's" comprehension of links between Mathematics and reality.

Sándor Kántor: *Comments on the teaching of probability theory*

My opinion about the secondary school teaching of probability theory is based on the currently used textbooks. My hypothesis is the following: the owerwhelming majority of problems arising during the teaching of probability theory in secondary schools is due to the fact that the education is stuck between two definitions (the one based on relative frequency and the axiomatic).

Sándorné Kántor: *Stephanus Hatvani, Polyhistor professor of the Refformed College of Debrecen, Forerunner of the theory of possibility and statistics in Hungary*

I. Hatvani was born 300 years ago. He was a famous polyhistor professor of Reformed College of Debrecen. He lectured physics with demonstration experiments. He was the first to introduce ordinary lectures on chemistry into Hungary. His main work is Introductio ad Principia Philosophianae Solidoris (Debrecen, 1757). In part Appendix, he determined the geographical latitude of Debrecen. In mathematics, he was the first to describe, the theory of probability and present his work on statistics. .

Renátó Kazinczi: *Improve the CSFLOC Algorithm by Variable Clustering*

The CSFLOC algorithm was introduced in a previous article, in which we showed that it is a sound and complete SAT solver algorithm. In this work, we discuss the issue of effective implementation of CSFLOC, including the impact of the order of variables on its speed. The abbreviation CSFLOC stands for Counting Subsumed Full Length Ordered Clauses, that is, counting full-length ordered

clauses. The clauses are ordered because the variables in them are ordered. As expected, the order of the variables affects the runtime. Several hypotheses were studied. In practice, one of the best performing variable sequences is based on the sorting of variables that often appear side by side in multiple clauses. This is called variable clustering. The article introduces the implementation of CSFLOC by giving C++ code snippets and we also show runtime results.

Tibor Kenderessy: *From the experiences of introductory talk of The Day of Hungarian Science*

The Celebration of Hungarian Science was organized for the fourth time at Apor Vilmos Catholic College. At the Morning of Young Naturalists several hundred schoolkids and their teachers were hosted by the college. The introductory talk to the playful science, mathematics and IT shows was about the history of data storage. Here I presented the evolution of informatics to the pupils of three classes. Children could finger tools that we take precious care of. The highlight of the workshop was a live video show of the inside of a working Winchester.

Márton Kiss: *Metacognitive activities in problem solving*

In our research, we wanted to pick up information about what characterizes the metacognitive activities of students during their problem solving. The investigation of metacognitive activities was compartmentalized into comprehension, planning, construction and retrospection. Our main question is how much the phases before and after construction influence the solution of students in the 9th grade, who have higher qualification in mathematics than the average. The written survey edited by us consisted of two tasks. In order to direct students to do metacognitive activities, they had to answer further questions before and after solving the tasks. Six aspects belonged to a task: (1) noting down the gist of the tasks, (2) writing an idea or a plan, (3) conducting the solution with justification, (4) checking, (5) trying out another method, (6) editing a similar, easier task. Our observations show that students do not know the significance of activities besides conducting the solution. They are not able to reconsider or modify either the result they got while solving the task or the method.

Rita Kiss-György: *The education and development of space concept and space representation in the light of fine arts. The research of geometric and drawing tasks*

The research is based on the evaluation of a test sheet, a questionnaire and a drawing task. Solving of the first three items of the test sheet needs appropriate space aspect and depth perception while students also need to brush up their

knowledge in mathematics and geometry. I am introducing the 2nd test item, the students' results achieved in the first three exercises, and the aspects of the categorisation of drawings. Comparing all these, it can well be seen that those who performed better in the mathematical part gained more points in the test as well, what is more, the drawing task results also correlate with the test results.

Judit Kollár: *Catch-up courses–reconsidered*

The Department of Methodology at BGE PSZK has been providing the opportunity to make up missing mathematical knowledge for students for several years. The catch-up courses, whose material is closely related to the calculus, are based on the educational experience of the previous years and the examination of the outcome of the courses, with more or less success. Until now, studies have shown that the catch-up of students below a certain level is almost impossible, and decreasing learning time strongly contributes to poorer skill development and rising rate of fallout. The new curriculum and the expectation to reduce the number of fallouts resulted in the re-thinking of the catch-up courses and the launch of learning aid trainings. In my lecture, I present our results and experiences on the new courses from the perspectives of knowledge, motivation and the willingness to learn. This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 'National Excellence Program'. These instructions give you basic guidelines for preparing camera-ready papers for conference proceedings.

Imre Kocsis: *How to teach integral transforms to engineering students?*

Since integral transform is one of the most frequently referred concepts in engineering training programmes, we must help students to be able to use it as an effective tool of thinking. Methodological questions arise due to the difficulties of this task. Purely theoretical presentation of this advanced topic gives a little chance for students to pick up usable knowledge about integral transforms, since understanding even the foundations of the integral calculus causes problems for the most of them. Many examples help students in the learning process from the decomposition of vectors in finite dimensional spaces to applications of the discrete Fourier transform. Students are motivated with detailed introduction of technical applications of the Fourier theory. Examples from the field of technical diagnostics and control theory are presented to show the wide range of areas where the integral transforms are used. Our practice introduced in the talk is a part of the problem-based approach we use in engineering training. We find this approach expedient in many fields of mathematics teaching.

Zoltán Kovács: *Can problem posing be taught?*

There are a number of arguments that problem posing should be embedded in the routine of teaching mathematics. The basic condition for this is that the teacher should be aware of the role of problem posing, the teacher himself could create a problem and know the advantages and disadvantages of using problem posing as a teaching method. In this paper, I will report on the experience of a course that I held in the autumn of 2018 to 22 prospective mathematics teachers. This course focused on the problem posing process. My goal is to characterize students' problem posing activity after half a year of experience.

Zsolt Lavicza: *Rethinking creativity for mathematics teaching: introducing multi- and trans-disciplinary approaches for schools*

There is a growing emphasis for encouraging creative thinking in mathematics education and needs to develop connections of mathematics with other subjects. Activities focusing on the creative process, rather than concentrating on achieving only results for posed problems, are being designed and trialled by innovative groups around the world. Often involving Arts, in a broader sense of design and creation, can be good a starting point for students to find their own interests and follow their own way of learning (Burnard et al., 2016). Such creative activities often involve the development of collaborative problem-solving skills utilising students' strengths in different areas that adds up at the group level (English et al., 2008). Furthermore, such activity designs and the opportunities offered by the availability of digital technologies inevitably afford new multi- and trans-disciplinary approaches for education. In my talk, I will introduce ideas and examples for mathematics teaching involving STEM to STE-A-M (by the inclusion of Arts) transitions (Fenyvesi, 2016). Examples will include STEAM research with the Experience Workshop Movement; studies related to GeoGebra and it new developments such as Augmented Reality, 3D Printing and mobile experiments; developing mathematical skills through robotics and connecting digital and physical worlds with 4D Frame; and possibilities to detect and nurture creative thinking processes from Big Data. An overview of such studies could offer new insights into developments of mathematical creativity, novel teaching approaches, and opportunities for further collaboration in these areas.

Tímea Mákné Karika: *Main role of understanding fractions in mathematical results*

We present some of the results of international research in recent years dealing with the difficulties of understanding rational numbers. There is a connection between successful problem solving and the mental representation of rational numbers. We rely on the results of international research that revealed the different representations of rational numbers and their relationships, the development of the rational number concept, and errors that occur during the execution of arithmetic operations with fractions. We present the results of our research, in which we investigated the errors Hungarian fifth grade students committed while executing operations with fractions.

Zoltán Matos: *Teaching numerical systems in high school on the basis of mathematical history*

The maturity requirement from 2017 onwards for higher-level maturity requirements for numbering systems requires that the candidate *"Is able to translate numbers from a 10-digit number system to a n-based ($n < 9$) numerical system, and vice versa. You can add and subtract numbers written in n-based ($n < 9$) numbers."*

We can achieve this goal, and even more so, by teaching numerical systems embedded in history to students. Our local experiments at the practice gymnasium in Szeged showed that this teaching provided students with more lasting and comprehensive knowledge than we were trying to achieve the above goal.

Péter Négyesi: *Applications of a mathematical software supporting problem-solving*

In our study, high school students (n=46) solved self-made, number theory-based exercises with or without a self-developed mathematical software, including 6 web applications. We hypothesized that our software helps students solving the exercises more efficiently in those areas which are mostly not taught in high school. A user satisfaction method revealed that 80% of students found 5/6 web applications useful, besides the one presenting the Euclidean algorythm. When using the web applications, 92.03% of the students found the exercises 'easy' or 'very easy'; and 71.43% of the subjects judged the problems as 'difficult' or 'very difficult' when solved the problems without the software. The use of the web applications increased with 59.48% one week after the investigation compared with the experiment period, suggesting both the greater interest of students and

the efficiency of our software. In our future studies we aim to increase the sample size and develop new web applications.

László Nikházy: *Pósa-method in mathematics and computer science education*

One pillar of the Hungarian mathematics talent education is The Joy of Thinking Foundation, established by Lajos Pósa. We are working in a special way at the very successful mathematics camps organized by this foundation, we teach using the internationally renowned Pósa-method of discovery education. The basis of discovery learning is that the student is an active participant of the learning process, who creates his own knowledge through solving problems. Usually three goals are achieved: deeper knowledge, development of cognitive skills, increased motivation. In our maths camps we look after two main principles: let the children enjoy solving mathematical problems, and promote individual (or group) thinking. We plan to develop a computer programming education method based on similar principles, and start a new talent education program using it. In my lecture I present the elements of the Pósa-method, and analyse the application of them in computer science education.

Ilona Oláhné Téglási: *Complex Mathematics Lessons in Primary School*

Within the frames of the project "EFOP-3.1.2-16-2016-00001 Methodological Renewance of Education in order to Reduce Early School Leaving–Introducing Complex Basic Program in Educational Institutes" we have worked out several lessons with new approaches. I'd like to show the innovative approaches of such "complex lessons" and their roles in mathematics teaching with an interactive lesson simulation. In my lecture I cover the theoretical background, connection to the new National Basic Curriculum and the possibilities of implementing

Marianna Pintér: *Alfa-generations math education in the elementary school*

Does Alpha-generation exist? If so, how does it differ from the Z-generation? What can we say about the experience base of the born after 2010, about how do they get their knowledge? Are their knowledge and physical maturity predictably different before entering elementary school, and after that? How can they be taught mathematics if we continue to teach mathematics along the Varga Tamási principles: being careful about the building of mathematical concepts and deeper knowledge of them. I've been seeking the answers to these questions since 2015.

Ildikó Anna Pomuczné Nagy: *The way to create the concept of integers to an optimal concept of number and number sense in the new fifth grade textbook*

In my presentation I present the structure of the theoretical material of the fifth grade textbook. I will argue how essential it is to prepare the concept and how essential the student's active contribution for the preparation of the mathematical concepts. In the course of the preparation, we show the interest of the pupils with unusual, often surprising examples related to other scientific and artistic works, and with this we want to reach the students' interest. We want to bring mathematics to close to students with our questions about theirs experiences. With the activities recommended to students in the textbook we motivate their imagination, by this their activity let's they feel as experience-like feeling. With examples and counterexamples, we show a way for students to formulate definitions and statements independently. In my lecture I show some examples of what kind of activity the pupils have brought about in this kind of approach to conceptualization, and how have developed theirs conceptualization and their number-sense in the lesson at school in the test of the textbook.

Péter Princz: *Experimental Programming in mathematics. The computer as demonstration and exploration tool*

The presentation discusses a teaching practice formed over the years, with a concrete example syllabus from the topic of projectile motion. Here, students discover the mathematical/physical problem at hand thru programming a computer. They explore the underlying concepts and the relations between them in a playful and interactive way, by changing parameters in an equation (of motion) and observing their effect on the resulting trajectory. The tool set of the method resembles the pedagogical principles of Seymour Papert and Tamás Varga, i.e. the turtle graphics of Logo but embedded into a modern (Python) programming environment, as well as playfulness during the immersion into the problem at hand. In the longer perspective, the goal with this method is to bring in the computer and programming to maths and physics classes the same way as test tubes are used in the chemistry class, i.e. as an exploration tool for every student instead of a frontal demonstration tool of the teacher.

Dóra Sipos: *Using the instant feedback method to evaluate the efficiency of Engineering Mathematics classes*

A survey was conducted in the framework of the Engineering Mathematics Course at the Faculty of Engineering in the University of Debrecen. Using the instant feedback method, we studied how well the students remember the lessons

learned in a class. Each class ended with an online questionnaire during the semester. Since some questions were related to topics learnt a week or two weeks before, we could study the long-term knowledge of students and checkhow successfully they can evoke the concepts. In this talk the structure of the tests, the opinion of students on the method, and the effect of the weekly tests on the efficiency are presented.

Stefanie Schallert: *Implementing augmented reality activities in flipped classroom environments to enable inquiry-based learning in mathematics education*

In traditional flipped classroom environments students have to watch videos prior to class and the in-class phase is used for different student-centered activities. But rather than simply presenting established facts or worked-out examples, the learning process in a flipped mathematics classroom can also be initiated with posing questions or problems and thus foster inquiry-based learning. According to Blooms taxonomy inquiry-based learning is fundamental for the development of higher order thinking. Only a few studies are available on how to design learning activities in a flipped classroom that encourage higher-order conceptual thinking. Furthermore, there is a lack of research highlighting how augmented reality learning activities can be part of flipped classroom environments. In my presentation I will display different flipped classroom scenarios where students through augmented reality activities have the opportunity to develop new knowledge that builds on their prior knowledge.

Gyöngyi Szanyi, Adrienn Vámosiné Varga: *About the need of mathematical bases in engineering education*

Mathematics is one of the most important base in engineering education. We investigated the curriculum of some engineering subjects in order to find those areas of mathematics which are very important for the learning of these subjects. After that we prepared a placement test in order to investigate whether the engineering students who started their higher education in the 2018 academic year have the required mathematical bases in the examined mathematical areas. In our presentation we will show the results of the test and its effect to successful accomplishment of the subject "Mathematics I".

Szilárd Svitek: *Open thinking in mathematics in secondary schools of Komárom and Komárno*

This study tried to measure how open minded the students of secondary schools of Komárom and Komárno were, with the help of a concrete open task

close to reality. This survey has been realized with the help of the Content Pedagogy Research Program of the Hungarian Academy of Sciences. Since the answer to the question was monotonous, we went further in the matter with the usage of mixed interviews, to get an idea of how the students are thinking.

Anna Takács: *In the wake of the mathematical beauty*

What means beauty in mathematics? What is beautiful for a mathematician and what is for a student in mathematics? What is beauty for a casual person? I have collected some psychological researches about this theme.

We are living now a digital revolution. How can we use digital tools on the classes? What experience could we make with them in mathematics for the students?

The point of view from a math teacher about an antique beauty who we all know.

Emőke Tóth: *Implementing a problem-based learning method: Teaching heuristic strategies in primary school*

In recent years, it has been shown in several studies that pupils' interest in mathematics has been decreasing. As a math teacher, I feel it is my responsibility to change something about this situation. My first steps to achieve this aim are based on holding some problem-based activities. In the presentation, we will discuss teaching methods and learning problem-solving strategies with regard to two different activities. Pupils were solving problems using different heuristic methods, these methods being working backwards and pattern recognition- generalization. The observations on the classes were analyzed by different factors, such as adapting to given lesson plans, difficulties of teaching, activity of pupils and mood in the classroom.

Attila Vámosi: *Mobile applications in education*

In the framework of the project EFOP-3.4.4-16-2017-00023, "Implementing innovative programs for entry into MTMI courses in the catchment area of the University of Debrecen", we have been able to create applications for mobile phones and tablets. Within the framework of the project, interactive mobile applications have been developed for the topics trigonometric functions, sets and complex numbers, force and work, circular motion, and alternating current, logical gates and the number representation. All applications include a list of definitions needed to understand a particular topic, as well as an interactive, animated presentation of the features and model examples of the topic. The data of the

presented tasks can be specified by the user, for example, the effect of the different inputs on the output can be checked.

Ibolya Veress-Bágyi: *Do university students use mobile devices for mathematics learning?*

In an online questionnaire survey, we searched for the use of mobile devices (smartphones, tablets) by university students for learning especially for mathematics. The questionnaire was distributed in several countries, and with the help of the more hundreds of responses, we received a comprehensive picture about the status of integrating mobile devices into learning in case of university students. The aim of my presentation is to present the results of the survey.

Krisztina Vatamány: *Attitude of student teachers to integrate digital devices into mathematics education*

In my research I studied the attitude of the students at the mathematics teacher training course of the University of Nyíregyháza towards the use of digital devices in mathematics teaching. I analysed the self-reports of 206 students who attended this course between 2012 and 2018. These self-reports were processed by qualitative content analysis. My research hypothesis was that the majority of students reject the use of digital devices, and those in post-graduate training are more accepting than graduates, and there is no gender difference. Research has confirmed that there is no gender difference in the attitude towards using digital devices. The other two hypotheses of research have not been justified. While the proportion of those with ambivalent attitudes is high (32%), 55% of the students are accepting digital devices in mathematics teaching.

List of abstracts of posters

Sándor Bodzás: *Designing and modelling of bevel gear pairs by the application of numerical methods*

Based on the connection statement during rolling two bevel gear is connected correctly if the tooth surfaces are wrapped each other. Only one crown wheel is belonged to connecting two bevel gears. The tooth surface of the crown gear is generated for the teeth of the two bevel gears. That is why the connecting surfaces are wrapped each other. Considering the connection statement the surface of the connecting bevel gear could be determined for a bevel gear having a given profile

by mathematical way. After these the CAD modells of the gear pairs could be created with which geometrical, technological and TCA analysis could be done.

József Borján: *Anaglyph presentations*

As an example, I'll show anaglyph images and printed posters, I'll provide special glasses to view the images. We used this technology at MEOSZ and at the Military Science Society for demonstration purposes. The source of my presentation can be found on my site:`http://jborjan.uw.hu`

Ján Gunčaga, Lilla Koreňová: *Mathematics Education as a part of STEM Education*

We present in our poster mathematics education as a part of STEM Education. The acronym STEM (Science, Technology, Engineering, and Mathematics) has become very frequently word among many stakeholders in the school policy. There exists many educational interdisciplinary initiatives, which support this approach. One possibility is the Bridges Conference in Linz (see `http://bridgesmathart.org/bridges-2019/`), another possibility is call for papers in Open Educational Journal "STEM Education with better Understanding" (see `https://www.degruyter.com/page/1862`). The role of mathematics education in this way will be discuss.

Sándorné Kántor: *Stephanus Hatvani, polyhistor professor of the Reformed College of Debrecen (1718–1786)*

In the poster, we present some pictures connected with the lecture: some excerpts from Hatvani's works, and some evidence of a recurring problem in the teaching of mathematics in secondary schools.

Renátó Kazinczi: *Graph Connectivity Test by SAT Solver and Optimization*

In a previous work, we have shown that any directed graph can be represented as a SAT problem. We have shown that if the resulting SAT problem is unsatisfiable, then the graph is connected, otherwise not. Furthermore, we have shown that if a graph is connected, then the corresponding SAT problem is a black and white 2-SAT problem. We have also developed graph node ranking metrics that are neither local nor global, but locally global, so they can be more efficiently computed than global ones, but have greater expressive power than local ones. In this work, we study how the use of the above metrics affects the performance of our CSFLOC and BaW 1.0 SAT solvers and the performance of other well-known ones. We found that in case of CSFLOC the use of these metrics on sparse graphs results in high speed-up if the graphs are connected and contain many nodes, but

this does not affect the performance of BaW 1.0, and other SAT solvers are not effective on these problems.

Attila Vámosi: *Mobile applications in education*

Here as an illustration eight applications can be seen for the mobile device (smartphone or tablet) that uses the Android operating system. These applications prefer some areas of mathematics, physics and informatics. The applications can be downloaded for free from this link (the homepage of our department): `https://mat.unideb.hu/applikaciok`. The work is supported by the EFOP-3.4.4-16-2017-00023 project. The project is co-financed by the European Union and the European Social Fund.

Adrienn Vámosiné Varga: *Few pictures from a math textbook*

The number of foreign students at the Faculty of Engineering, University of Debrecen is increasing year by year. A textbook was made to present high-level Mathematics, especially Calculus and Linear Algebra. The language of the textbook is English. It provides either several applications of mathematics in the engineering life or some illustrations to use mathematical software. This material helps the students to prepare for the comprehensive exam.

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