

# ABSTRACTS FOR THE TRACK OF FULL PAPERS

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## ABSTRACT FOR 21147

### Use Technology in Secondary Mathematics Teaching: Preparing Teachers for the Future

**AUTHOR:** Munindra Mazumdar

**AFFILIATIONS:** MPS College, Guwahati, India

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Technology is an essential tool for learning mathematics in the 21st century and all Modern school classrooms have access to a range of potential technologies, ranging from calculators and computers to the Internet. This paper examines the use of Information and Communication Technology (ICT) for supporting the teaching and learning of transformations of functions in terms of linear, quadratic, cubic and trigonometry in the secondary school; and identifies some of the ways in which the teaching of functions might be supported by the availability of various forms of technology. An exam was applied and performance comparison between computer and paper-and-pencil groups. Modern technology provides an excellent mean of exploring many of the concepts associated with functions. This paper suggests some of the avenues for exploration.

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## ABSTRACT FOR 21160

### Homothetic centers of three circles and their three- dimensional applications

**AUTHORS:** Yoichi Maeda

**AFFILIATIONS:** Tokai University, Japan

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In this paper, we recall the famous Monge's theorem of three circles. There are several proofs for the theorem. One of the proofs is that of using three similar right cones. Inspired by the proof, we propose a three-dimensional problem of the same angles of elevation: For three similar right cones on the ground, find the places from where three angles of elevation are equal to each other. There are at most two places. With dynamic geometry software, we can simply construct the solutions. In addition, the relation between two solutions is cleared.

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## ABSTRACT FOR 21179

### Two examples on discrepancy potentials of dynamic geometry software

AUTHORS: Yip Cheung Chan

**AFFILIATIONS:** Department of Curriculum and Instruction, The Chinese University of Hong Kong

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It is unavoidable that a computer program has its constraints. In a mathematics pedagogical program such as dynamic geometry software (DGS), the constraints may lead to deviations of mathematical representations from its intended mathematical concepts. If it is used properly, the deviations can open up pedagogical opportunities and hence may be called as discrepancy potentials of the tool. In this paper, examples of developing mathematical discussions by using the discrepancy potentials in two DGS tasks are discussed. It aims at elaborating the idea of discrepancy potentials in the design principles for effective DGS-based tasks. This paper relates to the topic  $\S$ Mathematics Education using Information Communication Technology.

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## ABSTRACT FOR 21183

### Connection Between Multiplication and Division of Fraction Using GeoGebra

AUTHORS: Boo Jia Yi, Leong Kwan Eu

**AFFILIATIONS:** University of Malaya

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Several studies had shown that fraction multiplication and division were the most challenging concepts to teach at the primary level. Previous research also found that elementary pupils lacked conceptual understanding when learning fractions. The purpose of this study was to identify Year Six pupils' understanding of the connection between multiplication and division of fraction using GeoGebra. The theoretical framework of this study was based on the radical constructivism theory of integrating mental image, representation, interpretation and problem solving about fraction multiplication and division using GeoGebra. The case study research design was utilized and intended to support pupils building their own understanding among the connection between multiplication and division of fraction. Data for this study includes both verbal and non-verbal behaviors were gathered from seven pupils based on five clinical interview sessions and used to collect data to answer the research questions. The findings revealed that (1) pupils performed better after using mental image with GeoGebra, (2) pupils were able to construct visual representation with GeoGebra to explain its connection between two operations, (3) pupils were able to give meaning about the connection between multiplication and division of fraction after using GeoGebra and (4) pupils faced difficulty in solving problems of multiplication and division with the use of GeoGebra. Interestingly, this study would benefit primary

school teachers' teaching and learning methods on the conceptual understanding of multiplication and division of fraction. This study would also further develop pupils' conceptual understanding of fractions using GeoGebra.

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## ABSTRACT FOR 21191

### The Courselab a VLE: Its Effect on the Achievement and Students Perception Toward Learning Algebra

AUTHORS: Carmelita Ragasa

**AFFILIATIONS: University of the East Manila, National Research Council of the Philippines, MTAP-TL, Philippine E-Learning Society**

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Courselab, a Virtual Learning Environment was used to design classes in algebra. Its effect on the achievement of the students was tested. Pretest and posttest were given to the experimental and control groups. The findings showed that there was no significant difference in the achievement of students taught with lecture and the use of Courselab. A survey questionnaire showed that majority of the students disagree that they learned better using computer based materials. Seventy two percent agree that they learned better by reading a good textbook and with face to face discussion. Seventy seven percent agree that they learned better by listening and by reading and rereading materials. The perception of the students on the effectiveness of Courselab in learning college algebra was not favorable. Fifty seven percent disagree that it was clear how Courselab modules fitted into learning algebra and that they also disagree that the scoring system in Courselab was useful for students in preparing their subject's test. On the other hand, half of the students think that they can easily understand and deal with the interface and more than half think that the platform tools were easy for students to use. This means that Courselab was not the problem but it was learning algebra in Courselab where the difficulty was.

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## ABSTRACT FOR 21192

### Introducing MATLAB into High School Mathematics

AUTHORS: Ian Allan Thomson

**AFFILIATIONS: Ormiston College, Australia**

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MATLAB (Matrix Laboratory) is technical software that is widely used in STEM-related courses and industry. This paper gives an account of how the use of MATLAB was introduced into assessment tasks for high school mathematics students at Ormiston College in Queensland, Australia. In this context, "high school" refers to Years 10 to 12 of secondary school. The tasks were designed in such a way that as well as giving students experience in mathematical modelling and problem solving, they also provided a gentle introduction to the use of MATLAB. This gave these school students valuable experience in working with the software that they are highly likely to use when moving on to tertiary institutions after leaving school. A productive partnership between the school and the manufacturer resulted in a curriculum

development project through which a collection of mathematical modelling and problem solving tasks were made publicly available. The way that coding was incorporated into the tasks is demonstrated through examples of students' responses.

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## ABSTRACT FOR 21196

### Using Dynamic Geometry Software to Enhance Student Understanding of the Concept of Speed

AUTHOR: Wee Leng Ng, Foo Him Ho

**AFFILIATIONS: National Institute of Education, Nanyang Technological University, Ministry of Education, Singapore**

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The authors of this paper have conceptualized and constructed a tool, using dynamic geometry software, to simulate scenarios of word problems involving speed, and used it to help students acquire the concept of speed and solve speed problems involving two objects moving toward each other. This paper demonstrates how such a tool can be created using GeoGebra, and describes how the use of this tool had improved understanding of speed concept, and ability to solve speed problems for a class of sixth grade students in Singapore.

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## ABSTRACT FOR 21198

### On Simple Representation of Locally Closed Sets

AUTHORS: Yosuke Sato, Ryoya Fukasaku, Katsusuke Nabeshima

**AFFILIATIONS: Tokyo University of Science, Tokushima University**

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A locally closed set of an affine space is defined as a difference of two varieties. Simple representation of locally closed sets is of great importance in many areas of computational mathematics. We presents a practical simplification algorithm of locally closed sets. Our algorithm consists only of computations of Groebner bases, it does not use any heavy computation of polynomial ideals such as a primary decomposition.

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## ABSTRACT FOR 21201

### Finding the signature matrix of minimizing the Cayley transform by using Computer Algebra

AUTHORS: Dexuan Zhang, Yongbin Li, Haocheng Zhou

**AFFILIATIONS: School of Mathematical Sciences, University of Electronic Science and Technology of China, School of Mathematical Sciences, University of Electronic Science and Technology of China**

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Given an orthogonal matrix  $Q$ , we can choose a diagonal matrix  $D$  with diagonal entries such that  $I+QD$  is nonsingular and then that the Cayley transform  $(QD)=(I+QD)(I-QD)^{-1}$  is well defined. Evan O'Dorney has proven the existence of the diagonal matrix  $D$  with diagonal entries plus or minus 1 (called a signature matrix) to make sure every entry of  $QD$  is less than or equal to 1 in absolute value. The remaining question is how to compute  $D$  directly. In this paper, we present a method for computing the signature matrix  $D$  based upon Grobner basis and Real-Root-Classification in the case of  $n=2$ . Our approach is helpful to develop the interest of learning computer algebra and using computer algebra systems in researching

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## ABSTRACT FOR 21204

### Hexagrammums

AUTHORS: Vladimir Shelomovskii

**AFFILIATIONS: University of Technology-Papua New Guinea, Deoma-Russia**

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In this paper we consider hexagrammums, plane geometric configurations based on six points. Pairs of given points form straight lines. Points of intersection of these lines form the new daughterly points. We get the net configuration of points and lines. The work is based on firstly, delightful drawings of Hirotaka Ebisui [1], and secondly, the GInMA software [2], which makes it easy to explore the geometric configurations and exercise their conversions. Typically the only one unusual point found by Ebisui has served the source for the study. As a result, the net has been found. In each case, the method of barycentric coordinates has been used for the formal proof. The evident solutions have been found in many cases with the use of collineations. This may introduce solutions of problems into standard courses of geometry. All the pictures in the paper are interactive. So they come to life, install on your computer GInMA software from the website [2]. Free basic version will allow you to get acquainted with all the materials, to conduct a study, to create your file, but not to keep it. See the video How to convert pictures from the text in interactive drawings.

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## ABSTRACT FOR 21205

### Enhancement of Plotting Environment of STACK with Gnuplot

AUTHORS: Kenji Fukazawa, Yasuyuki Nakamura

**AFFILIATIONS: National Institute of Technology, Kure College, Graduate School of Information Science, Nagoya University, Japan**

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In this paper, we explain our approach to building an enhanced plotting environment in which, for example, graphs of implicit functions and surfaces described by functions containing two variables could be visualized. This enhancement is achieved by creating Maxima functions, which produce the appropriate scripts of gnuplot, which is then called with these scripts. This approach enables us to make full use of the power of gnuplot, and can be applied to any plotting software other than gnuplot, such as matplotlib, and Pyxplot. Several examples of questions with enhanced plots are presented.

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## **ABSTRACT FOR 21206**

**A Study of gamification on GeoGebra for remedial pupils in primary mathematics**

**AUTHORS: KAI CEAT LIM, KWAN EU LEONG**

**AFFILIATIONS: FACULTY EDUCATION, UNIVERSITY MALAYA**

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Remedial pupils are often more engaged in their learning when the content delivered uses games-based-activities. This study integrated gamification using technology in learning mathematics which is one of the 21st century learning approaches. In this paper we report the results of a study on lessons using 2 learning games based on GeoGebra with reference to remedial pupils' motivation in learning primary mathematics. The respondents consisted of 4 remedial pupils from a primary school in Selangor, Malaysia. Data were obtained through observation on lessons and questionnaire on students' perception in gamification on GeoGebra. Observation by using video recording indicated that the sample showed high motivation in learning mathematics. Questionnaire result also showed students' positive interest in using gamification on GeoGebra. In conclusion, this study found that using gamification on GeoGebra is highly effective in helping remedial pupils to learn primary mathematics besides increasing their motivation in learning. This study strongly recommends the implementation of gamification on GeoGebra to facilitate mathematics learning at the primary level especially in geometry.

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## **ABSTRACT FOR 21210**

**IMPACT OF USING TINKERPLOTS IN STATISTICAL REASONING**

**AUTHORS: Leong Kwan Eu, Pavethira Seloraji**

**AFFILIATIONS: Tenby Schools Setia Eco Park, Universiti  
Malaya**

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In this 21st century of learning, students are not only required to know how to do the calculation procedures but more importantly they must be able to justify their solutions by reasoning. This is particularly important in the teaching and learning of statistics in schools. This study aims at investigating the impact of using TinkerPlots in statistical reasoning among Year Five pupils. The research was conducted in an international school. The research utilized the quasi experimental research design. Two intact classrooms were selected with one classroom as the control group while the other was the experimental group. The experimental group went through intervention using TinkerPlots whereas the control group went through the traditional method. The research conducted pre- test and post-test for both the groups. The findings show that a significant difference existed between pre-test and post-test for the experimental group. In conclusion, the students' statistical reasoning results improved using TinkerPlots. The study implies that using TinkerPlots enhances students' reasoning skills. Implementing teaching and learning statistics using TinkerPlots would help students explore data, concepts and test their conjectures. This would support the student-centered learning where teachers facilitate the students to develop their ideas and knowledge.

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## ABSTRACT FOR 21211

Exploring generalizations of a result about cubic  
polynomials

AUTHORS: Alasdair McAndrew

**AFFILIATIONS: Victoria University, Melbourne Australia**

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For a real cubic function with three distinct roots, the tangent at the mean of any two of them passes through the third. This elegant and elementary result seems to have first surfaced as an investigation for students studying the International Baccalaureate. There are number of ways for generalizing this result; in this article we look at two of them: higher degree polynomials, and polynomials over the complex numbers, and the quaternions. Thus we show how the result can be defined in considerable generality over general domains. This may be considered as a case study in the use of a CAS to generalize a simple result.

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## ABSTRACT FOR 21216

Are Mathematics Students' Learning Styles Related to Their  
Preferred Method of Learning How to Use Advanced  
Calculators?

AUTHORS: Hazel Tan

**AFFILIATIONS: Monash University, Australia**

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One of the learning styles models used for investigating students' preferences is based on the Visual, Aural, Read-Write or Kinesthetic (VARK) modalities for receiving information. This paper presents the research findings of a survey study on Singaporean and Australian students, contrasting students' VARK preferences with their instructional learning preferences when using graphing calculators and calculators with computer algebra systems (advanced calculators). Students filled in an adapted 7-item instrument about their VARK preferences, and were also asked to indicate their most preferred instructional method of learning how to use the calculators to solve mathematics problems. It was found that students generally preferred visual and kinesthetic instructional methods when learning how to use calculators, regardless of their VARK preferences. Results also show that there were regional differences in students' VARK preferences. Overall, the results suggest that students adapt their learning preferences to different contexts, and that advanced calculators lend themselves to visual and kinesthetic modalities of learning.

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## ABSTRACT FOR 21217

Teaching methodology for smart students with less-developed abstract thinking skills

**AUTHORS:** Vladimir Shelomovskii

**AFFILIATIONS: University of Technology, Deoma**

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The author has been teaching statistics to students in Papua New Guinea for three semesters. These students are smart but their mathematical knowledge and abstract thinking skills require considerable development. The author is forced to build teaching on the basis of binding mathematical concepts with objects of the real world. The subject of the paper are examples of realizing this idea.

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## ABSTRACT FOR 21219

Parallel and Distributed Boolean Grobner Bases  
Computation in SageMath

**AUTHORS:** Akira NAGAI, Yosuke SATO

**AFFILIATIONS: Tokyo University of Science, NTT Secure  
Platform Laboratories, Japan**

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We introduce a parallel and distributed computation method of Boolean Grobner bases, which are implemented in the computer algebra system SageMath using the PolyBoRi library. We present an easy way to parallelize Boolean Grobner bases computation using a decorator for parallel computation supported in SageMath, we also present a way of distributed computation using a multiprocessing module in Python. Our software

achieves satisfactory speed-up comparing to our sequential implementation in SageMath.

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## ABSTRACT FOR 21222

Exploring Derivative Functions using HP Prime

AUTHORS: Betty, Wan Niu Voon, Ling Shing Wong

**AFFILIATIONS: Universiti Tenaga Nasional, Faculty of Health and Life Sciences, INTI International University, Persiaran Perdana BBN, Putra Nilai, 71800 Nilai, Negeri Sembilan, Malaysia**

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Derivative is one of the essential topics in calculus, which is an important basic skill should be mastered before integration comes in. Learning derivative in higher education can be achieved by using interesting graphing-calculator based learning. In this paper, activities using HP Prime to explore derivative function are outlined. The usage of Function and Statistics 2Var applets are emphasized and used in these activities. Through these activities, students are able to learn how to sketch the graph of a derivative from its original function, through observation on the changes of slopes and tangent lines in HP Prime.

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## ABSTRACT FOR 21227

Teaching and Learning of Geometry in Primary School Using GeoGebra

AUTHORS: Boo Jia Yi, Leong Kwan Eu

**AFFILIATIONS: University of Malaya, University Malaya**

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The purpose of this article is to discuss how GeoGebra can be used to teach the concept of angle in Geometry in elementary level. This result is obtained after 2 weeks of lesson exploration. Teachers used GeoGebra as a teaching tool to make the lesson more creative and innovative in order to show how geometrical shapes relate with different angles in different polygons. For students, they can use GeoGebra to construct, drag or apply the actual shape instead of drawing on a piece of paper. Besides that, all the works created by students can be saved as documents for future reference. At the end of two weeks' exploration, pupils were asked to answer survey question regarding their experience with using GeoGebra. Analysis of the survey showed that pupils are able to express their geometric imagination and understanding of mathematical concepts before and after the exploration. Hence, using GeoGebra can make the classroom lesson more enjoyable and interesting.

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## ABSTRACT FOR 21261

Solving Sudoku Puzzle by Evolutionary Algorithm

**AUTHORS:** Kedar Nath Das, Sumit Bhatia, Shubhin Puri,  
Kusum Deep

**AFFILIATIONS:** Assistant Professor, Department of Mathematics,  
NIT Silchar, Assam, India, Department of Computer Science and  
Engineering, The Pennsylvania State University, USA, Department  
of Chemical Engineering, IIT Roorkee, India

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“Sudoku” means “Single number”. “Sudoku Puzzle” is an interesting and popular Japanese game, where the non-givens need to be filled by a single number (from 1 to 9) provided no repetition occur in the corresponding rows, columns and sub-squares. Solving a Sudoku puzzle is challenging due to its easy rules and difficult inherent phenomenon. Although a number of approaches exist for solving a given Sudoku puzzle, it becomes a challenge among the researchers to solve it by using evolutionary algorithms. In this paper, a Retrievable Genetic Algorithm is proposed to solve a given Sudoku puzzle. A new fitness function is designed with puzzle-character-dependent constraints. The Genetic Algorithm is made “Retrievable”, since the population is reinitialized after a certain number of generations in order to escape from the premature convergence or from being trapped in the local minima. A set of 9 sample puzzles of different difficulty label have been considered for comparison. The superiority of Ret-GA is ensured from the comparative results and discussions.