Innovation and Technology for Mathematics Education

Abstracts of the Nineteenth
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Tilak de Alwis, Southeastern Louisiana University, USA
Wahyudi Wahyudi, SEAMEO QITEP in Mathematics Indonesia

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Introduction

On the behalf of the State University of Yogyakarta, Yogyakarta, Indonesia, members of the International Program Committee of the ATCM conference, we are honored to introduce the papers of the ATCM 2014 – "*Innovation and Technology for Mathematics Education*".

We are fortunate to have presenters from a wide spectrum of scientists and educators, whose presentations and workshops will demonstrate the most current trends in technology for mathematics and mathematics with technology. Papers and presentations address a very wide spectrum of topics and ideas. We can find papers concentrating on using computer software in teaching mathematics, papers on using Internet, multimedia, and other tools for interactive and online mathematics courses delivery, as well as research papers from pure mathematics where technology was used to produce some new results.

Thanks to evolving technological tools, we are able to explore more interdisciplinary areas such as science, technology, and engineering with Mathematics which we could not before. Therefore, integrating technology into mathematics teaching, learning and research will definitely allow us to expand our knowledge horizon in mathematics. We encourage all authors and readers to contribute your new findings to our next ATCM or the Electronic Journal of Mathematics and Technology (eJMT: https://php.radford.edu/~ejmt/).

We would like to express our appreciation to the local organizers, in particular to the State University of Yogyakarta for the enormous task of planning and preparation of ATCM 2014 – one of the most enjoyable and instructive conferences in the World. We thank also the members of the International Program Committee and external reviewers for their great contribution in reviewing papers.

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ABSTRACTS FOR INVITED PAPERS

ABSTRACT FOR 20495

MANAGING ALL THE CHANGE AND KEEPING TEACHERS MOTIVATED

AUTHOR: DOUGLAS BUTLER

AFFILIATIONS: ICT TRAINING CENTRE, OUNDLE (UK), AUTOGRAPH-MATHS

Software and hardware solutions for mathematics teaching are evolving all the time, leaving many teachers bewildered by the ever increasing kaleidoscope of possibilities. Douglas will attempt to bring this audience up to date with some exciting lesson plans drawing on a new generation of hardware independent resources, the emphasis always being to let the mathematics shine through.

The arrival of mobile devices delivers an exciting new dynamic for the mathematics classroom, with students, parents and teachers all in touch with each other. Such collaboration, coupled with GPS and camera facilities, mean that there is much more chance that students will be able to discover mathematics for themselves – be in in the classroom or on the bus going home.

The downside of this is that the mobile devices are small, touch driven and an order of magnitude less powerful than desktop computers. It is likely that older technology will still be the technology of choice for complex mathematical or publishing tasks.

Textbooks are rapidly being digitised, and a new generation of HTML-based software is allowing texts to come to life interactively. So as well as the obvious lack of weight to carry around, students will find that their text books are far more engaging.

All this change puts great demands on the need for quality professional development. Furthermore those delivering it need careful training, and are having constantly to re-evaluate new tools and teaching methods.

ABSTRACT FOR 20498

TEACHING EXPERIMENTAL MATHEMATICS: DIGITAL DISCOVERY USING MAPLE

AUTHOR: BILL BLYTH

AFFILIATIONS: AUSTRALIAN SCIENTIFIC & ENGINEERING SOLUTIONS, RMIT UNIVERSITY

One of the ``Recommendations" (by Klaus Peters) on Jon Borwein's LinkedIn page starts with: ``Jonathan Borwein is a world-renowned research mathematician and one of the leaders in the emerging field of experimental mathematics to which he has made many original contributions. He has written several books that have helped to define the field." Examples include finding closed forms of integrals by numerically computing high precision approximations (accurate to hundreds of decimal digits) which is used to identify the answer. Knowing the correct answer facilitates the proof of its correctness.

Here this experimental mathematics approach is taken with a couple of traditional ``find the maximum \ldots " problems suitable for senior school or first year undergraduate students (who could even be pre-calculus students). We use the Computer Algebra System, Maple, for experimentation (and visualization) to compute high accuracy numerical approximations to the answer. Maple's identify(~) command is used to identify the exact answer. Knowing the answer, we prove that it is correct - without using calculus. We use small group collaborative learning in the

computer laboratory, so we parameterize the problem and recommend the use of Computer Aided Assessment (such as provided by the package MapleTA).

Students engage with the visualization, are active learners with deep learning of the concept of maximum and gain a gentle introduction to the important new field of experimental mathematics.

ABSTRACT FOR 20506

COMPARING MATHEMATICAL MODELING METHODS VIA EXCEL

AUTHOR: DEANE ARGANBRIGHT

AFFILIATIONS: DIVINE WORD UNIV., PNG (EMERITUS)

We use the spreadsheet Microscope Excel in an innovative manner with selected examples to compare the nature and educational effectiveness of several modeling methodologies – discrete recursion and iteration, differential equations, numerical analysis, and interactive graphics. All of these approaches have been used in classroom and on-line teaching. In the process, we demonstrate ways to incorporate diverse features of Excel, including animated graphics, to enhance each approach.

ABSTRACT FOR 20573

CAN TIGHTLY PACKED CIRCLES BE MOVABLE?

AUTHOR: JEN-CHUNG CHUAN

AFFILIATIONS: DEPARTMENT OF MATHEMATICS, NATIONAL TSING HUA UNIVERSITY, HSINCHU, TAIWAN 300

Stereographic projection is an important transformation linking circles on the sphere and that on the plane. Whenever an animation involving circles on a sphere, their stereographic images on a plane can be implemented by taking the inversion with respect to an appropriate sphere. Through this transformation, every closed Steiner chain on the plane can be thought of as the inversion of a pair of circles sharing the same axis together with symmetrical arrangement on n circles packed between the two. Based on the idea that an arbitrary pair of disjoint circles on a sphere can be inverted simultaneously into a pair of circles having the same axis, we are to display various contact graph preserving dynamic circle packing phenomena.

ABSTRACT FOR 20577

TECHNOLOGICAL TOOLS HAVE ENHANCED OUR TEACHING, LEARNING AND DOING MATHEMATICS, WHAT IS NEXT?

AUTHOR: WEI-CHI YANG

AFFILIATIONS: RADFORD UNIVERSITY

In this paper, we give an overview why technological tools have advanced so fast since ATCM 1995, and yet the adoption of exploration activities have not been widely implemented in many mathematics curricula. We also give examples to demonstrate the types of exploration that require the integration of CAS and DGS. We outline the components needed when developing an interactive online system, which is crucial for communications and collaborations on mathematical fields now and in the near future.

ABSTRACT FOR 20578

PROFESSIONAL DEVELOPMENT FOR TEACHERS IN MATHEMATICAL MODELLING

AUTHOR: KENG CHENG ANG

AFFILIATIONS: NANYANG TECHNOLOGICAL UNIVERSITY, 1 NANYANG WALK, SINGAPORE 637616

The importance of mathematical modelling and its value in mathematics education has been discussed and emphasized by various researchers in the field. However, it is widely acknowledged that mathematical modelling can be demanding for students and teachers. Many teachers, including experienced practitioners in Singapore, do not have any formal training in mathematical modelling as a student either at school or in the university, and teaching it has been very challenging. Very often, a teacher's decisions, from planning of a mathematical modelling task to its execution in the classroom, depend on his orientation, resources and goals. Unless a teacher has been properly trained, adequately prepared and well resourced, his decisions are unlikely to result in a successful mathematical modelling lesson.

In this paper, we discuss a school-based professional development (SBPD) programme aimed at preparing teachers to teach mathematical modelling in the classroom. This programme has been successfully carried out in several schools in Singapore over a period of about two years. A case study will be presented to illustrate the key principles of the programme. Examples of student work and modelling tasks designed by participating teachers will be presented. In addition to the observation that there is a definite paradigm shift in the teachers' orientation and goals in teaching mathematical modelling, it is also evident from these examples that technology had played a crucial role in the success of the modelling lessons designed by the participants of the SBPD programme.

ABSTRACT FOR 20579

REFLECTIONS ON TEACHING APPLIED MATHEMATICS WITH TECHNOLOGY

AUTHOR: PAUL ABBOTT

AFFILIATIONS: SCHOOL OF PHYSICS M013, THE UNIVERSITY OF WESTERN AUSTRALIA, CRAWLEY WA 6009, AUSTRALIA

In most applied mathematics courses, simulation and modelling are taught by stressing numerical techniques, while visualisation often requires a range of specialised software tools. Standard texts teach computation by having students develop or edit procedural code fragments to model a particular physical problem or system. This approach requires the understanding of many details of a procedural programming language such as Matlab, Fortran or C. Although learning procedural programming is very useful it detracts from the desired goal of teaching exploration.

A second approach is to develop custom "black-box" applications for illustrating specific mathematical or physical concepts. When well done this approach has the advantage that such applications can be used with little instruction, and the focus is entirely on the situation under investigation. A disadvantage is that the student may not learn any computational techniques, though sometimes reading the source code can be enlightening.

The third way is to use an integrated computational environment. But how best to integrate technology into teaching in a non-trivial way? Buchberger (1990) proposed the White-Box/Black-Box principle (WBBB) to describe learning with a computer algebra system (CAS):

In the stage where area X is new to the students, the use of a symbolic software system realizing the algorithm of area X as black boxes would be a disaster. Students have to study the area thoroughly,

that is they should study problems, basic concepts theorems, proofs, algorithms based on the theorems, examples, and hand calculations.

In the stage where area X has been thoroughly studied, when hand calculation for simple examples become routine, and hand calculations for complex problems becomes intractable, students should be allowed and encouraged to use the respective algorithms available in symbolic software systems.

Kutzler (1999) modified the WBBB principle (MWBBB): students who do not master certain topics can use CAS as a scaffolding to help understand higher level topics. Drivers (2000) proposed inverting the sequence—Black-Box/White-Box (BBWB)—using a CAS as a generator of examples and as an explorative tool that confronts the student with new situations. The explorative Black-Box phase can lead to (directed) discoveries. In the White-Box phase the results of the explorations are examined and can lead to the development of new concepts.

Teaching mathematical concepts using Mathematica as a tool for problem-based learning (PBL), allows the use of all three approaches—WBBB, MWBBB, and BBWB. Mathematica is used in my courses immersively as both a presentation environment and a computational tool. In this talk I will demonstrate my approach, which has three main advantages:

[1] Doing the problems leads to a deeper understanding of the concepts involved;

[2] Students learn problem-solving techniques;

[3] Students learn Mathematica by “absorption”.

ABSTRACT FOR 20608

BAR MODEL AND GSP: THE EFFECTIVE STRATEGY IN SOLVING WORD PROBLEMS

AUTHOR: KRONGTHONG KHAIRIREE

AFFILIATIONS: INTERNATIONAL COLLEGE, SUAN SUNANDHA RAJABHAT UNIVERSITY BANGKOK THAILAND

The purpose of this paper is to illustrate the effective strategy in enhance students’ understanding in solving word problems and to develop their representation in mathematics. By using bar model, students will develop their visualization skills to assist in processing information, making connection, and solving problems. The Geometer’s Sketchpad (GSP) is an effective tool that provides opportunities for teachers and students to use their ability to access, drag, animate and create graphical representation. The research finding showed that bar model strategy can be used not only as problem solving technique, but also to develop in students a deeper understanding of the four operations concept in mathematics. The students can explain, knew what to do and knew why they had to do. In addition, the students revealed that with GSP and bar model strategy they were able in visualizing and creating graphical representations, which will enable them to develop their mathematical thinking skills, concepts and understanding. The students explained that it was fun in learning mathematics by this method.

ABSTRACT FOR 20613

MODERN GEOMETRY VIA DYNAMIC TOOLS

AUTHOR: MA. LOUISE ANTONETTE DE LAS PENAS

AFFILIATIONS: ATENEO DE MANILA UNIVERSITY

Dynamic Geometry Software has been often used in teaching Euclidean Geometry concepts. Not much has been documented on the use of technology in the study of more advanced geometry. In

this talk, we focus on our experiences in the Modern Geometry classroom, where dynamic tools facilitate an interactive and engaging learning environment.

The first part of the talk will focus on the role of dynamic geometry software in the students' understanding of the Non-Euclidean geometries- Hyperbolic and Spherical Geometry. We present the advantages on the use of the software in studying a new geometry. For instance, in discovering geometric figures, investigating their properties and comparing these with familiar concepts in Euclidean geometry. We also give instances on how the students have used dynamic geometry as an aid in conjecture making and formulating proofs; including those that pertain to unanswered research problems.

The second part will pertain to Transformation Geometry. This will include connecting concepts on isometries to tilings and patterns in the real world. In our case, we look at geometric artwork created by Philippine indigenous communities.

ABSTRACT FOR 20614

A Capstone Course to Improve the Preparation of Mathematics Teachers on the Integration of Technology

Author: Antonio Quesada

Affiliations: The University of Akron

A decade after the first set of NCTM standards were published, and when a large percentage of USA secondary students were using graphing calculators in the mathematics classroom, we began to study the degree of readiness of pre- and in-service mathematics teachers in two key areas. First of all, to what extent were they prepared to use research-proven teaching and learning approaches recommended by the standards? Concretely, had these future math teachers being properly exposed to inquiry-based teaching and learning, to team work, and to exploration and discovery? Secondly, besides learning how to use graphing calculators, were these students ready to properly integrate this technology in the teaching and learning of mathematics? Our initial research pointed to a weak theoretical exposure with very little or no practices whatsoever conducing to the internalization of the approaches aforementioned. On the other hand, most students knew how to use the very basic functions of a graphing calculator, but could not use numerical and graphical techniques, let alone any of the new mixed techniques, to solve problems. Further research indicated that they lacked the basic conceptual understanding that the exposure to proper integration of technology promotes. Unaware of any existing course or textbook focusing on the problems outlined, we developed a capstone course aiming to address these deficiencies. In this presentation we will review the mathematical content, technology, teaching tools, strategies, and type of assessments used. In addition, quantitative and qualitative evaluation on the results of this course will be presented.

ABSTRACT FOR 20625

Interactivity and flexibility exemplified with Cabri

Author: Colette Laborde

Affiliations: University Joseph Fourier

This presentation will support an approach in the development of digital technology, in which student use and teacher use are taken into consideration. This kind of technology enables the development of students centered resources fostering exploration and inquiry by students but also enabling teachers to adapt them in relation with their pedagogical aims and the needs of their students. Such technology scaffolds a progressive process of integration and instrumentation of technology by teachers while teachers may in a first step experiment ready-to-use resources in their classes and then make changes increasing over time as they are more confident and gain experience.

ABSTRACT FOR 20628

INTEGRATING TECHNOLOGY IN TEACHING AND LEARNING (MATHEMATICS)

AUTHOR: PAULINA PANNEN

AFFILIATIONS: DIRECTORATE GENERAL OF HIGHER EDUCATION, MOEC, INDONESIA

With the rapid development of ICT and its ramification in our world, especially education, can we envision how will education look like in the future, especially in Indonesia, and in the teaching and learning of mathematics? Employing Zappa's Envisioning The Future of Educational Technology (2013) and NMC Horizon Report 2014 K-12 Edition, this paper will reflect on the effort of ICT integration in teaching and learning, especially in the teaching and learning of mathematics, in Indonesia. Taking stocks of the existing Government's policy on ICT and ICT in Education, also of the facts and figures of Indonesia's ICT profile, this paper discusses initiatives, practices, and studies on ICT in Education, integration of ICT in the teaching and learning of mathematics, what technology and how to integrate in the teaching and learning of mathematics, and some future prediction on the evolution of teaching and learning due to emerging technologies.

ABSTRACT FOR 20629

RECONCEPTUALIZING GOOD PRACTICE OF MATHEMATICS TEACHING THROUGH LESSON STUDY IN INDONESIA

AUTHOR: MARSIGIT

AFFILIATIONS: YOGYAKARTA STATE UNIVERSITY

Currently picture of Indonesian educational practices changes very fast at all level of dimensions; it offers the hopes and the challenges to re-conceptualize good practice of teaching. The implementation of the new Curriculum (Curriculum 2013) can be the starting point for mathematics teachers to reflect and move their old paradigms of teaching; due it offers flexible and various approaches of teaching. It encourages the teachers to evaluate the strengths and weaknesses of different approaches in order to make informed choices and, when necessary, should be prepared to learn new skills in the interests of effective teaching learning mathematics. Through this new curriculum, the mathematics teachers need to be able to respond to individual children as it is identified because the relevant curricular experiences and skills of children vary greatly and they need then in a better position to draw upon support services to enhance their classroom practice. The management of the range of support services should be available to maximize their effect in helping teachers to work towards good practices and to implement new curriculum. Lesson Study activities provide the schema for the teachers to promote good practice of mathematics teaching. It also gives the chance to the government officials of education in Indonesia to look in-depth the implementation of curriculum in the class-room level. However, re-conceptualizing good practice of teaching does not only emerge amides the reflection and monitoring of the new curriculum as the new schema to operate education; but also at any chance of initiating education improvement in which Lesson Study program can be implemented.

ABSTRACT FOR 20637

EDUCATING THE EDUCATORS: TECHNOLOGY-ENHANCED MATHEMATICS TEACHING AND LEARNING

AUTHOR: LEONG CHEE KIN

AFFILIATIONS: SEAMEO RECSAM

Educational research has shown that teaching quality is one of the most important factors in raising student achievement. There is a compelling need for educators to keep abreast of the important developments that are taking place in educational arena. One of the educational areas that have massive development is on the use of technology to enhance teaching and learning especially in mathematics. Having this development the need for professional development among educators comes in. Being a regional science and mathematics education centre, the Southeast Asian Ministers of Education Organisation Regional Centre for Education in Science and Mathematics (SEAMEO RECSAM) has always been cognizant of the importance of these developments. Its training programmes are planned for in-service teachers, teacher educators and ministry of education mathematics officers are planned to incorporate these developments. As the Centre''s mandate it aims to ensure that these participants from Southeast Asians countries as well as those from outside the region are equipped with emerging educational technology tools which can enhance teaching and learning of mathematics. This paper will share the Centre’s experiences in continuing professional development among mathematics teacher, teacher educators and officers from the ministry of education on educational innovation and technology.

ABSTRACT FOR 20638

MATHEMATICS INTELLIGENT LEARNING ENVIRONMENT

AUTHOR: HONGGUANG FU, XIUQIN ZHONG, ZHONG LIU

AFFILIATIONS: UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY OF CHINA, UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY OF CHINA

An interactive intelligent learning system in mathematics is the trend of educational technology, where users can practice homework problems and take practice tests online. However, developing such a desirable online environment is still an open research area and far from perfect. In this paper, we will present a Mathematics Intelligent Learning Environment (MILE) that provides an automatic theorem proving for geometry and automatic equations solving for algebra. Initial design is focused to provide an interactive intelligent learning environment for junior high schools mathematics www.ihomework.com.cn. The MILE can automatically check if a student¡¯s homework is correct step by step. The system not only can determine the correctness for each step, but also provide assistance on each step if student chooses option for help. It is therefore a powerful learning tool for students working as a personal tutor.

ABSTRACT FOR 30004

WHY TECHNOLOGIES ARE NECESSARY FOR THE CURRENT CURRICULUM REFORM?

AUTHOR: MASAMI ISODA

AFFILIATION: CRICED, UNIVERSITY OF TSUKUBA, JAPAN

There are two major issues for curriculum reform in these days. Firstly, developing the Skills for 21st Century are one of the main issues for the curriculum reform in the world. Current meaning of ICT might be not the same as future one. On this meaning, it will be a long term issue on the curriculum reform. On this demands, Mathematics are expected subject to develops the competency for

producing future scenario thorough searching the unknown-operative variable and for using plausible reasoning. Science, Technology, Engineering and Mathematics (STEM) movement enhance the usage and the way how to use mathematics with technology more. It is a short term issue for the reform. The devices change the meaning of technology in the classroom. This lecture confirm the possibility for using technology in the classroom on these two demands and push the discussion for the future ATCM. dbookPro is the example for e-textbook in current status and a tool for imagine the future. Indonesian edition is distributed by SEAMEO Qitep in Mathematics.

ABSTRACT FOR 30006

THREE TRAINING STRATEGIES FOR IMPROVING MATHEMATICS TEACHER COMPETENCES IN INDONESIA 2015-2019 BASED ON TEACHER COMPETENCY TEST (TCT) 2012-2014

AUTHORS: WIDODO, M. TAMIMUDIN

AFFILIATIONS: HEAD OF PPPPTK IN MATHEMATICS BPSDMPK PMP DEPT. OF EDUCATION AND CULTURE INDONESIA, AND PROFESSOR OF MATHEMATICS GADJAH MADA UNIVERSITY YOGYAKARTA INDONESIA
INSTRUCTOR OF PPPPTK IN MATHEMATICS INDONESIA

In this paper we will present the Three Training Strategies for Improving Mathematics Teacher Competences in Indonesia 2015-2019 based on Teacher Competency Test (TCT) 2012-2014. These three strategies are:

1. Basic Training, in on in, at MGMP with Facilitators: Instructor from PPPPTK Mathematics and Master Teacher at MGMP (Musyawah Guru Mata Pelajaran) in every district (Kabupatan/ Kota)

2. Basic training, face to face, at MGMP with Facilitators: Instructor from PPPPTK Mathematics and Master Teacher at MGMP (Musyawah Guru Mata Pelajaran) in every district (Kabupatan/ Kota)

3. Structured E-Training for Improving the Competences of Mathematics Teachers in Indonesia.

We will present the best practices for Structured E-Training for Improving the Competences of Mathematics Teachers that has been done in PPPPTK Mathematics in 2013-2014.

We will define Structured E-Training as an E-Training equipped with Hits record for every participant. Here, Hits is defined by the numbers of total access into the E-Training Systems. Hits consisting of login, logout, reading the content, activeness in discussions, assignments done by the participants. In addition we have tight criteria for passing this E-Training such pre-test, post-test, activeness and assignments.

In this paper we present best practices of PPPPTK in Mathematics in doing this E-Trading. In the year of 2013 and 2014 PPPPTK in Mathematics has successfully done this Structured E-Training for hundreds mathematics teachers from many islands in Indonesia such as Jawa, Sumatera, Kalimantan, Maluku, Papua, Bali and West Nusa Tenggara, etc. The durations of the E-training are 15 days, 21 days and 45 days. We note that most of participants comes from rural areas. Most of them have high enthusiasm to participate, have their own initiative, and about 80 percent pass the E-training.

FULL PAPERS

ABSTRACT FOR 20493

VISUALIZATION OF SPECIAL ORTHOGONAL GROUP SO(3) WITH DYNAMIC GEOMETRY SOFTWARE

AUTHOR: YOICHI MAEDA

AFFILIATIONS: TOKAI UNIVERSITY

In this paper, we try to visualize special orthogonal group SO(3) with dynamic geometry software Cabri 3D. Every element in SO(3) is an ordered triple of unit vectors orthogonal to each other. Every element in SO(3) is also given as a rotation of the orthogonal bases around an axis with an angle. With this geometric aspect, multiplication of matrices is simply visualized. In this visualization, spin-like movement of the axis is observed. Through the investigation of this phenomenon, geometric meaning of multiplication becomes clear.

ABSTRACT FOR 20504

REVISITING GEOMETRIC CONSTRUCTION USING GEOGEBRA

AUTHORS: GLENN LAIGO, ABDUL HADI BHATTI, LAKSHMI KAMESWARI PULIPAKA, HAFTAMU MENKER GEBREYOHANNES

AFFILIATIONS: DEPARTMENT OF MATHEMATICS AND APPLIED SCIENCES, MIDDLE EAST COLLEGE, OMAN

Construction problems have always been an important part in learning Geometry. Mastering construction helps students in logical reasoning. In this paper, we will take a look at traditional construction problems and create these constructions using GeoGebra. GeoGebra, as a software, has many functions. However, in this paper, we will only make use of functions that mimics the traditional compass and straightedge construction.

We will start with simple construction such as constructing angles and triangles. We will discuss construction of angle bisectors. We also use construction in showing certain properties of geometric objects, such as triangles and circles. We look at properties of angle bisectors and side bisectors of triangles, as well as chords of a circle. Finally, we will build upon these basic construction techniques to eventually show and construct more complicated theorems.

ABSTRACT FOR 20561

EXAMPLES AND TECHNIQUES OF MORPHING WITHIN CAS AND DGS ENVIRONMENTS (CABRI AND TI-NSPIRE). A WAY OF ENRICHING OUR TEACHING AT ALL LEVELS

AUTHOR: JEAN-JACQUES DAHAN

AFFILIATIONS: IREM OF TOULOUSE

Proportionality has always been a very important part of all curricula in all countries. This concept is used both in geometry and algebra (similar triangles, linear functions for example). This paper aims to give another approach of this concept in showing the power of dynamic geometry to create motivating activities of morphing for our students at all levels, from middle school to university. As DGS software is mostly based on the continuity property, the other one is “determinism”, we will show that some of them, such as Cabri 2 Plus, Cabri 3D and the geometry application of TI-Nspire are really appropriate to help us modelling lots of examples of morphing in 2D and 3D. At a higher level,

the connection between the different software of TI-Nspire and especially between CAS and geometry will allow us to model for example, problems of morphing in relation to curves in 2D and 3D (modelling a floating flag).

ABSTRACT FOR 20570

EFFECTS OF SPREADSHEET TOWARDS LEARNERS' USAGE OF MATHEMATICAL LANGUAGE

AUTHORS: KOK FUI CHIN, SHARIFAH NORUL AKMAR BT SYED ZAMRI

AFFILIATIONS: TAYLOR'S EDUCATION GROUP, FACULTY OF EDUCATION, UNIVERSITY OF MALAYA, MALAYSIA

Language has been an essential element in mathematics education as it is a tool used between individuals to convey the information of mathematical concepts. Some researchers discovered that inconducive language usage impedes mathematics learning. This papers reports on the effect of spreadsheet to the language used by a group of 32 pre-university students in defining "limits". The data revealed that (i) spreadsheet changes learners' commandment of language in three aspects which are usage of examples, types of expressions, and accuracy of terminology; (ii) spreadsheet does change learner' choice expression while learning mathematics regardless their academic ability; and (iii) through spreadsheet environment, learners are able to find a suitable and conducive expression to learn mathematics. This study is significant in such a way that it gives insights to education researchers, educators or curriculum-makers about the roles of spreadsheet in language which then influences mathematics learning.

ABSTRACT FOR 20574

THE IMPACT OF A TECHNOLOGY-RICH INTERVENTION ON GRADE 7 STUDENTS' SKILLS IN INITIAL ALGEBRA

AUTHORS: AL JUPRI, PAUL DRIJVERS, MARJA VAN DEN HEUVEL-PANHUIZEN

AFFILIATIONS: UTRECHT UNIVERSITY, THE NETHERLANDS, FREUDENTHAL INSTITUTE FOR SCIENCE AND MATHEMATICS EDUCATION, UNIVERSITAS PENDIDIKAN INDONESIA, BANDUNG, INDONESIA, FREUDENTHAL INSTITUTE FOR SCIENCE AND MATHEMATICS EDUCATION, UTRECHT UNIVERSITY, THE NETHERLANDS

This paper describes a classroom experiment on the use of digital technology in initial algebra. Indonesian grade seven students of 12-13 year-old took part in a four session teaching sequence on beginning algebra enriched with digital technology, and in particular applets embedded in the Digital Mathematics Environment. The intervention aimed to improve students' conceptual understanding and procedural skills in the domain of equations in one variable. The qualitative analysis of written and digital student work, backed up with video observations during the experiment, reveal that the use of digital technology affects student thinking and strategies dealing with equations and with related word problems. Practical and theoretical consequences of the results are discussed.

ABSTRACT FOR 20588

EFFECTS OF USING CASIO FX991 ES PLUS ON ACHIEVEMENT AND ANXIETY LEVEL IN MATHEMATICS

AUTHORS: MARIA ISABEL LUCAS, ERLINDA CAYAO

AFFILIATIONS: PAMANTASAN NG LUNGSOD NG MAYNILA, MATHEMATICS TEACHERS ASSOCIATION OF THE PHILIPPINES, PAMANTASAN NG LUNGSOD NG MAYNILA MATHEMATICS TEACHERS ASSOCIATION OF THE PHILIPPINES

Mathematics anxiety has been a subject of research across levels. This study aimed at checking the effects of using Casio FX991ES Plus on the achievement and anxiety level of selected college students

in a chartered local university in Manila, Philippines. Researchers employed the quasi-experimental research design. There were two groups of respondents in this experiment namely: control group who utilized traditional lecture method while the experimental group used the Casio FX991ES Plus Calculator. Both groups were exposed to the same lessons in Fundamentals of Statistics particularly topics in Inferential Statistics. Diagnostic test was administered to both groups to establish equal footing in terms of their abilities. This first researcher handled both the experimental and control groups.Results revealed that the experimental group performs significantly better as regards to the mean score in the achievement test. It can be concluded that their performance is greatly influenced by the use of calculator. In terms of anxiety level, both groups revealed significant difference in the pre and post tests. Although both are significant, it is noteworthy that there is a marked improvement in anxiety level under experimental group as manifested by a greater increased in result. An increase in the score means a reduction in the anxiety level.

ABSTRACT FOR 20590

INTEGRATION OF PRODUCTS USING DIFFERENTIALS

AUTHORS: REBECCA TOLENTINO, JANETTE LAGOS

AFFILIATIONS: UNIVERSITY OF THE CITY OF MANILA, PAMANTASAN NG LUNGSOD NG MAYNILA (UNIVERSITY OF THE CITY OF MANILA)

This paper is an attempt to increase students' performance in Integral Calculus by the inclusion in the curriculum of a new integration technique, Integration of Products using Differentials, introduced by Dr. Tilak de Alwis. The study was conducted in the only locally funded chartered university in the Philippines. The study employed mixed method research design where student's performance and verbal feedbacks were analyzed. Results showed a ratio of 2:3 attempts versus no attempts. Findings showed that the performance of students who attempted to use the technique is not significantly different from the performance of students who did not attempt to use the technique. Among the attempts group, success rate is higher in items involving integration of products than their over-all success rate while for the no-attempts group success rate is not significantly different.

ABSTRACT FOR 20591

USE OF LECTURE CAPTURE IN THE TEACHING AND LEARNING OF STATISTICS

AUTHORS: CHEE-KEONG CHONG, MARZITA PUTEH, SWEE-CHOO GOH

AFFILIATIONS: UTAR, FACULTY OF SCIENCE AND MATHEMATICS SULTAN IDRIS EDUCATION UNIVERSITY MALAYSIA , FACULTY OF EDUCATION AND HUMAN DEVELOPMENT SULTAN IDRIS EDUCATION UNIVERSITY MALAYSIA

Lecture capture is a recent development in higher education, many higher education institutions use it to supplement and replace missed lectures. This is a preliminary study to find out the status of lecture capture implementation in Malaysia for the teaching and learning of Statistics. Statistics is a subject that needs multiple approaches in its teaching and learning because of its nature; it needs referencing to statistical table and implementation of statistical tests using software. Lecture capture is effective in delivering these to the students. In this study the general perceptions on using lecture capture are identified and these will provide some helpful information or guidelines pertaining to use of lecture capture in teaching Statistics.

ABSTRACT FOR 20610

Consideration on the Effect of the Lesson in Problem Solving by Few Children

Author: Tsutomu Ishii

Affiliations: Bunkyo univ.

This consideration analyzes about two existing lessons of Department of Arithmetic in the elementary school of Japan''s detached island of Okinawa. Literacy is examined in this analysis. The purpose of this monograph is to show the effect of problem solving by a small number of people. The analysis framework about the effect of problem solving by a small number of people is used. The framework serves as an affirmative viewpoint and a negative viewpoint. As a result, first it was pointed out that instruction according to one was substantial. Second it was pointed out that the tendency which exact instruction realizes was high. Third it was pointed out that the influence which a leader's ability and the quality of a lesson have was greater than the amount of the children's number.

ABSTRACT FOR 20611

Non-visual Expression Method for Mathematical Documents in Elementary Geometry

Authors: Ryoji Fukuda, Masato Kojo

Affiliations: Faculty of Engineering Oita University, Graduate School of Engineering Oita University

We propose a method for expressing mathematical contents in elementary geometry. To realize similar scenarios when giving information elements in elementary geometry documents for people with visual disabilities, we assume that graphical elements are input by a handwriting system, and the recipient obtains several types of documents on demand. We therefore need some functions for making a document graph from several graphical elements. We define the expression rules for translation functions and the output document graphs.

ABSTRACT FOR 20612

Applicability of Gaze Points for Analyzing Priorities of Explanatory Elements in Mathematical Documents

Authors: Ryoji Fukuda, Junki Iwagami, Takeshi Saitoh

Affiliations: Faculty of Engineering Oita University, Kyushu Institute of Technology

For this report, we studied the applicability of gaze points for analyzing the priorities of elements in an explanation of mathematical concepts expressed through figures. There are many informational elements in a mathematical document, and we can understand some of them through the help of attached figures. In non-visual communication, we can obtain such elements through spoken text or tactile information, but can grasp only a few at a single time. Thus, we must rely on the applicability of gaze points for understanding human intentions.

ABSTRACT FOR 30001

A MODEL FOR THE EDUCATIONAL ROLE OF CALCULATORS

AUTHORS: BARRY KISSANE & MARIAN KEMP (B.KISSANE@MURDOCH.EDU.AU, M.KEMP@MURDOCH.EDU.AU)

AFFILIATIONS: MURDOCH UNIVERSITY, AUSTRALIA.

Calculators can be used effectively for mathematics education in a number of ways, although frequently they are regarded merely as devices for undertaking computations. In this analytic paper, we describe and illustrate a four-part model to understand more fully the potential role of calculators for learning mathematics. The four elements of the model include representation, computation, exploration and affirmation. Effective use of a calculator by students learning mathematics will often involve more than one of these four components. The model has been derived from analysis of educational materials developed to support rich calculator use.

ABSTRACT FOR 30002

A PRACTICAL CASE FOR E-MATHEMATICAL EXPERIMENT WITH "GEOMETRY APPS" FROM HP PRIME

AUTHORS: YANG JIANYI (YANGJY505@TOM.COM), LIU CHENGYANG (KFCMKFC@163.COM)

AFFILIATION: QUANZHOU NO.7 MIDDLE SCHOOL, CHINA

Since 2008, The MCL (see (1)) project has initiated a preliminary inquiry of mathematical experiments (see [2]). The standard of setting up a mathematical laboratory for primary and secondary schools has also been a concern in the public. One objective of setting up a mathematical laboratory, which provides e-math services, is that it analyzes inquiry activity about analytic geometry. On one hand, it emphasizes providing opportunities for students to experience the whole process of mathematical inquiry; while on the other hand, it analyzes specific mathematical applications (especially the dynamic geometrical tools) which supports mathematical experimentation and includes "moving point trace function", "point line tool" and "slider tool". This type of e-mathematical laboratory program is likely to enrich students' mathematical experience.

ABSTRACT FOR 30003

APPLICATIONS OF INFORMATION TECHNOLOGY TO THE "FIVE POINTS" CONJECTURE

AUTHORS: REN-SHOU HUANG, YUAN-JING XIA, ZHEN-XIN YANG LING YAN

AFFILIATIONS: HUNAN EDUCATION SCIENCE INSTITUTE FOR RESEARCH, ZHOUNAN MIDDLE SCHOOL, CHANGSHA CITY, HUNAN NORMAL UNIVERSITY, CHANGSHA CITY, CHINA

Taking the "five points" conjecture for example, this paper shows some possibilities of using graphing calculators for exploring conjectures and offering promising directions for the proof of a conjecture. Through a process of making conjectures, evaluating experiments performed on a graphing calculator and theoretical proof in "five points", a pattern of information technology (IT) application can be experienced.

PAPERS WITH ABSTRACT ONLY

ABSTRACT FOR 20465

OPTIMAL STATISTICAL DESIGNS VIA DIRECTIONAL DERIVATIVES IN THE PRESENCE OF A NUISANCE PARAMETER

AUTHOR: RAHUL MUKHERJEE

AFFILIATIONS: INDIAN INSTITUTE OF MANAGEMENT CALCUTTA

Designing of experiments, with an optimal utilization of resources from a statistical perspective, is a necessity in diverse fields of scientific research but the associated combinatorics are often intractable. This is particularly so in a discrete setup when the underlying model involves a nuisance parameter which induces nonlinearity in the information matrix for the parameters of interest.

We propose a novel application of directional derivatives in order to address this challenging problem. Even though this calls for intricate algebraic manipulation of the relevant information matrix, we end up with a user-friendly algorithm for obtaining an optimal design measure over the design space. The issue of robustness to possible model misspecification is explored at length under a minimaxity criterion motivated by Bayesian considerations. Illustrative examples are given. The results are found to have immediate applicability in obtaining economic and statistically efficient plans for experiments in agriculture, industry and medicine.

ABSTRACT FOR 20470

APPLICATION OF FRECHET DERIVATIVES FOR OPTIMAL STATISTICAL PLANNING OF EXPERIMENTS WITH ASYMMETRICALLY DISTRIBUTED MEASUREMENT ERRORS

AUTHOR: MAUSUMI BOSE

AFFILIATIONS: INDIAN STATISTICAL INSTITUTE

Optimal statistical planning of experiments is of compelling scientific interest with immediate applicability to such diverse fields as industry, agriculture and medicine. Most of the literature in this area revolves around least squares estimation under normally distributed errors. In practice, however, the error distribution is rarely symmetric.

The present work investigates optimal experimental plans when the measurement errors have an asymmetric distribution and the method of second-order least squares estimation is employed. The problem becomes complicated because the information matrix of the parameters of interest then turns out to be a non-linear function of the design weights. We show how Frechet derivatives, coupled with a concavity argument, can be used to develop a comprehensive theory for addressing this nonlinear problem. This is applied to obtain intricate theoretical results as well as an efficient computational algorithm for the practically important case of binary design points.

ABSTRACT FOR 20473

An Algorithm for Solving Traveling Salesman Problem

Authors: Samrat Hore, Anup Dewanji, Aditya Chatterjee

Affiliations: Indian Statistical Institute, Kolkata, Department of Statistics, Tripura University, Department of Statistics, University of Calcutta

Traveling Salesman Problem (TSP) is one of the classical combinatorial optimization problems and has wide application in various fields of science. In the present paper, we propose a new algorithm for solving TSP, that depends on metaheuristics and uses the variable neighbourhood search coupled with a stochastic approach to find the optimal solution. The proposed algorithm has been found to perform better than the conventional TSP solving algorithms.

ABSTRACT FOR 20478

The Minimal Travel Time for Light Passing Through a Nonhomogeneous Medium

Author: Felino Pascual

Affiliations: Mathematics/Statistics, Winona State University

We are probably familiar with the image of the "broken" pencil in a half-full/half-empty glass of water. By numerically solving the differential equations associated with the phenomenon of light refraction and which are based on variational principles and Snell's Law, we determine the path that light takes and its travel time when the speed of light through a nonhomogeneous medium varies from point to point. We employ elementary techniques such as the Euler's Method and the Shooting Method to find the approximate solutions.

ABSTRACT FOR 20481

Using Spreadsheet to create rug patterns and designs

Author: Maryanne Bagore

Affiliations: Divine Word University

A spreadsheet is a powerful mathematical tool that is widely used by math educators and learners to comprehend and solve many mathematical problems. This paper will illustrate an innovative way on how Excel can used to create different artistic rug designs or patterns using the concepts of Geometry, Algebra and Calculus in a Spreadsheet Application. Mathematical models are created to show how a particular rug pattern or design can be created in Excel. My examples of rug patterns or designs would be taken from the traditional Papua New Guinean mats and/or rugs which are made mostly from the pandanas and coconut trees. In addition to PNG mat/rug designs, other examples will include rug patterns or designs from different countries and cultures such as the ‘kilim’ from Turkey. Through my examples, the main point is on how Excel can be seen as an application that can used to create interesting, creative or odd things and not just for the fun of doing mathematics. The concept of this paper can be used in both the classroom teaching and teacher development.

USING THE IPAD AND CALCULATOR-BASED RANGER TO INTRODUCE FUNDAMENTAL CONCEPTS OF SLOPE TO YOUNGER STUDENTS

AUTHOR: WILLIAM SPEER

AFFILIATIONS: DIRECTOR, MATHEMATICS LEARNING CENTER, UNIVERSITY OF NEVADA LAS VEGAS

When introducing the concept of slope, make use of technology to have students encounter slope in "real-world" applications. Have students measure several different staircases and compare "rise" to "run" and discuss the "ease of climbing " in terms of the steepness. Compare staircases to roof lines in terms of steepness. Have students collect information on the grade of elevation of a road. Where appropriate, you might also measure ski slopes or skateboard runs. Consider the glide paths of aircraft as they approach (or depart) airports. Use photographs illustrating the concept of slope – perhaps a photo of a large family arranged by height, or a photo that captures a visual slope through the degree of perspective.

Discuss the steepness and direction of the graphs of various linear functions. Have students describe functions with words, tables, and graphs. Help students migrate readily between these representations.

Determine real-world situations that interest your students and develop activities to match these interests.

• Ask students to describe the various situations described in a graph illustrating the speed and distance traveled of two contestants in a bicycle race.

• Identify an average speed for a car. Have students make a table showing hours and total distance that might be traveled.

• Choose an item and its cost. Have students make a table with the number of items as the independent variable and total cost as the dependent variable and then graph the function and describe the meaning of the slope.

• Make a table and graph the relationship between two units of distance, weight or capacity. Students should realize that the slope is the conversion factor.

• Have students identify the slope and y-intercept for:

converting temperatures from Celsius to Fahrenheit and vice versa; relationship between increasing altitude and decreasing temperature for aircraft; relationship between the depth of a diver and increasing water pressure.

• Have students make tables and graphs for the following:

A situation with an initial charge and an additional constant charge per unit of time, such as a telephone service or a car rental. Students should understand that the y-intercept is the initial charge and the slope is the charge per unit.

• Have all students measure their height and arm span, record and graph the data. Use the graph to predict arm span given height or vice versa.

• Team with a science teacher and gather scientific data using a Calculator-Based Laboratory™. Have the student role toy cars of different weights from different heights. Construct graphs and use the graphs to make predictions.

ABSTRACT FOR 20502

USING GRAPHING CALCULATOR IN PROBLEM SOLVING TASKS

AUTHORS: KWAN EU LEONG, MARY ANN SERDINA PARROT

AFFILIATIONS: UNIVERSITY OF MALAYA

Problem solving has been the focus of mathematics curriculum in recent times. Today, problem solving is no longer a separate skill that should be acquired but it has become an integral part in the process of teaching and learning mathematics. Problem solving has now played an important role in school mathematics to enhance mathematical understanding in concepts. Furthermore, students are able to develop their mathematical reasoning and sense making by engaging in problem solving tasks. This study applies Polya's problem solving process such as understanding the problem, devising the strategy, carrying out the strategy and checking the solutions. The objective of this study is to investigate the impact of graphing calculator on students' problem solving process in solving linear equation problem. Students are able to apply various strategies in solving algebra problems through the usage of graphing calculator. In this study the research design used was the quasi-experimental non-equivalent control and treatment groups. Six tasks were developed for this study to measure the students'' performance in solving the problems using the graphing calculator. In addition, students were required to provide detailed explanation how they solved the tasks by using the problem solving phases. This study is pertinent as it investigates a different approach in teaching linear equation through problem solving tasks by integrating the latest graphing calculator technology in the lessons.

ABSTRACT FOR 20582

DEVELOPING THE TECHNOLOGY INTEGRATION COMPETENCY IN A PRE-SERVICE TEACHER TRAINING

AUTHOR: STEFAN OEYEN

AFFILIATIONS: UNIVERSITY COLLEGE LIMBURG ASSOCIATED CATHOLIC UNIVERSITY LEUVEN

In the teacher training department of CUCL (Catholic University College of Limburg – Belgium), we strongly believe that the impact of using technology in education on learning mathematics is high. Therefore teachers integrate ICT in different ways during their lessons with the TPACK-model (Koehler & Mishra, 2006) in mind. By doing this, they serve as good models.

However, the development of the "technology integration competency" by students needs more than only good examples. Students have to train this competency by using ICT in the domains where pedagogy, mathematics and technology meet each other.

In this presentation we show some mathematical problems which students themselves have to solve with GeoGebra. We'll discuss the solutions, the didactical approach and the students' experiences. The analysis of these results gives insight in the power of the right use of technology in math education.

TPACK : Technological Pedagogical Content Knowledge is a framework to understand and describe the kinds of knowledge needed by a teacher for effective pedagogical practice in a technology enhanced learning environment.

ABSTRACT FOR 20587

LOCATING POINTS IN 3D GRAPHIC SPACE AS MORE DIRECT INTERFACE TO THE LEARNING CONTENTS OF VECTOR EQUATIONS

AUTHORS: WATARU OHNO, KOTARO SHIMADA, HITOSHI NISHIZAWA, TAKAYOSHI YOSHIOKA

AFFILIATIONS: TOYOTA NATIONAL COLLEGE OF TECHNOLOGY

Learning contents that connect symbolic and graphic representations of vector equations interactively deepened students' learning greatly. With them, students could experimentally find the hidden rules and mechanisms by themselves. Because the knowledge was closely related to their experiences of tries and errors, they tended to stay longer in their memory and became the foundation of their learning.

Such learning contents had a limitation however when they had to handle three-dimensional (3D) graphic objects. Because computer screens and pointing devices such like mice or track-pads were 2D in nature, locating a point in the virtual 3D space required more complicated operations than in a 2D space. Because of this complexity, some students lose the connection between two representations and slowed their learning.

This presentation tries to present the authors two attempts to simplify the operations. The first approach is to set a virtual parallel surface to the display in the 3D space so the user could locate a point on the surface and move it on the surface. She needs to rotate the whole space to change the direction of the surface. The second one is to use a 3D sensing device as an input. The user could locate a point in the 3D space by holding her finger in the space above the sensing device. The point in the virtual 3D space follows the movement of her fingertip.

We implemented the two approaches to locate a point in the virtual 3D space by programming with a CAS system, MATHEMATICA, and used LEAP MOTION as the 3D sensing device. We would like to demonstrate how these approaches simplified the operations to our learning contents of 3D vector equations on the Web or to our stand-alone learning applications of the same.

ABSTRACT FOR 20589

TEACHING MATERIALS INCORPORATING INTERACTIVE GRAPHICS FOR COLLEGE-LEVEL MATHEMATICS EDUCATION

AUTHORS: SHUNJI OUCHI, YOSHIFUMI MAEDA, NAOKI HAMAGUCHI, SETSUO TAKATO

AFFILIATIONS: SHIMONOSEKI CITY UNIVERSITY, NAGANO NATIONAL COLLEGE OF TECHNOLOGY, TOHO UNIVERSITY

This report will look at the use of KETpic in the development of interactive graphics for mathematics and statistics education.

KETpic was originally developed as a macro package of Computer Algebra Systems (CAS) to generate TeX source codes of mathematical illustrations in 2005. Currently KETpic has constant development as a comprehensive support tool which enables us to make LaTeX and TeX documents with embedded high-quality graphic objects. The latest version of KETpic supports the making of easy-to-use 3D models.

Our project team has been involved with the development and implementation of KETpic with one aim being to create effective teaching materials for mathematics (including statistics) education, predominately at the early grades of tertiary education.

In teaching mathematics for students at this level, there are instances when we need to graphically present correspondence relations, solid figures and mathematical definitions to clarify students'' understanding of the material being taught. In the case of statistics education, visualizations of statistical chance phenomena and statistical concepts help novice learners better understand these complex ideas.

Towards this end, for the last few years we have been creating graphics through careful utilization of KETpic that dynamically illustrate mathematical concepts and ideas.

Examples of these include interactive graphics to show the intersection of a surface and planes parallel to the coordinate plane, and others based on simulated data sets generated by R.

We will introduce and demonstrate some teaching materials incorporating interactive graphics we have created to date.

ABSTRACT FOR 20595

How to construct a question of linear algebra by Mathematics e-Learning System STACK

Authors: Tetsuya Taniguchi, Yasuyuki Nakamura, Takahiro Nakahara

Affiliations: CIEC, Graduate School of Information Science, Nagoya University , Sangensha LLC

STACK, System for Teaching and Assessment using a Computer algebra Kernel, is a system of a computer-aided assessment for mathematics and works as a plug-in of Moodle, one of the Learning Management System (LMS). Moodle can provide a question for an on-line test with the help of STACK. We show a question about eigenvalues and eigenvectors and how to construct it by STACK.

ABSTRACT FOR 20597

THE MODEL OF PGSD-UT'S STUDENTS WORKSHEET BASED ON DISPLAY COMPONENT BASED THEORY AS A LEARNING STRATEGY IN FACE TO FACE TUTORIAL

Authors: suroyo n, Ngadi Marsinah, R. Sudarwo

Affiliations: Universitas Terbuka, lecturer

This study is a qualitative and quantitative study that aims to develop a model of the Student Worksheet (SW) based on Component Display Theory (CDT) (Merrill , 1994) as a learning strategy to help tutor to solve learning difficulties of under graduate Primary School Teacher Education (S1 PGSD) of Universitas Terbuka (UT) in learning PEMA4201 Statistics in Education course through the Face to Face Tutorial (FFT). The research method used classroom action research on 2 classroom of FFT by purposive random sampling on S1 PGSD students of semester VII in the district of Tangerang in Indonesia. The study was conducted at Public Vocational High School (SMK Negeri) 1 in Cikokol, Tangerang Cikokol . Analysis of qualitative data using portfolio assessment on CDT-SW and descriptive analysis of learning outcomes . The results shows that of CDT-SW model can be used by integrating self directed learning as expository learning module encapsulates the Presentation Primary Form (PPF) with a problem-based learning as an inquiry in the Presentation Secondary Form (SPF) and Inter Relationship Display (IRD) as a prescription in solve learning difficulties. Participant’s attitude scale showed that 51.55 % of participants stated on the quality of the FFT by using CDT-SW is good , where as participants showed that self-directed learning readiness is 49.65 % and as much as 48 % and agree with the application of CDT-SW to solve the problem of learning difficulties in learning the subject through FFT.

ABSTRACT FOR 20605

DISCOVERING THE CONCEPT OF LIMIT FUNCTION AT TENTH GRADE SENIOR HIGH SCHOOL WITH SCIENTIFIC APPROACH ACCORDING TO 2013 CURRICULUM USING CALCULATOR CASIO FX-991ID PLUS

AUTHOR: WIWORO WIWORO

AFFILIATIONS: PPPPTK MATEMATIKA, YOGYAKARTA

The implementation of 2013 Curriculum uses the scientific approach in the classroom teaching and learning process. There are five steps done by students in using the scientific approach to learn certain based competency in mathematics, namely observing, questioning, information collecting, associating, and communicating. The teaching and learning process of limit function subject matter at tenth grade, senior high school in Indonesia, before the implementation of 2013 Curriculum is merely restricted to find the numerical value of limit from an arbitrary function, and has not yet focused on what the limit is. Scientific calculator the Casio fx-991ID Plus can be used as a learning media to discover the concept of limit function using scientific approach.

ABSTRACT FOR 20606

GEOMETRICAL PATTERNS OF YOGYAKARTA BATIK ORNAMENTS

AUTHORS: WIWORO WIWORO, NABILA RAHMA KHAIRUNNISA

AFFILIATIONS: PPPPTK MATEMATIKA, YOGYAKARTA, SMP NEGERI 8 YOGYAKARTA, INDONESIA

Batik is one of the Indonesian culture heritage that has a great value of art. Yogyakarta batik style, one of many batik style in Indonesia, has some ornaments. If these ornaments are connected to mathematics, they are related to some geometrical patterns, either Euclidean geometry or fractal geometry. This paper discusses about Yogyakarta batik ornaments and their relationship with geometrical patterns in mathematics.

ABSTRACT FOR 20624

ON THE SEPARATOR OF SUBSETS OF REGULAR SEMIGROUPS

AUTHORS: JANETH CANAMA, GAUDENCIO JR. PETALCORIN

AFFILIATIONS: MINDANAO STATE UNIVERSITY - ILIGAN INSTITUTE OF TECHNOLOGY

The aim of this study is to investigate the separator of subsets of regular semigroups, in particular, the full transformation semigroup and the symmetric inverse semigroup, with the help of GAP (Groups, Algorithms, Programming). GAP aids in conjecture making and providing illustrations and examples. The idealizator of a subset A of a semigroup S, denoted by Id(A), is the set of all elements x of S such that xA and Ax are subsets of A. The separator of A, denoted by Sep(A), is the intersection of the idealizator of A and the idealizator of S-A, where S-A denotes the complement of S in A. The separator of the following subsets of the full transformation semigroup on {1,2,…,n} is investigated: the set of all idempotent elements, any nonempty subset consisting of constant transformations, and any subgroup of the symmetric group on {1,2,…,n}. Similarly, the separator of the following subsets of the symmetric inverse semigroup on {1,2, … , n} is investigated: the set of all idempotent elements, the singleton set containing the empty transformation, and any subgroup of the symmetric group on {1,2, … , n}. Some of the results obtained with the aid of GAP are extended to the infinite case.

ABSTRACT FOR 20627

MATH INPUT INTERFACE BY MATHDOX FORMULA EDITOR FOR MATH E-LEARNING SYSTEM STACK

AUTHORS: YASUYUKI NAKAMURA, TAKAHIRO NAKAHARA, YUSUKE INAGAKI

AFFILIATIONS: NAGOYA UNIVERSITY, SANGENSHA LLC

STACK (System for Teaching and Assessment using Computer algebra Kernel) is one of the most popular e-learning system for mathematics. STACK can assess students'' answer that contain mathematical contents rather than multiple-choice questions. Therefore students have to input mathematical expressions but there is no practical math input interface. We have developed math input interface for STACK by the use of MathDox formulae editor which is a two-dimensional WYSIWYG interface. The editor is written in JavaScript and uses HTML5 canvas element in combination with jsMath sprite fonts to render mathematics. We integrated the editor into STACK and conducted a simple evaluation experiment. According to the evaluation, MathDox formulae editor can be a good candidate for math input interface for STACK.

ABSTRACT FOR 20639

DYNAMIC LESSON DESIGN USING TECHNOLOGY

AUTHOR: THOMAS YEO

AFFILIATIONS: TEXAS INSTRUMENTS

As Mathematics educators, teaching Mathematics effectively to our classes of students involves hard work and long hours of preparation. We want our students to understand our lessons and be able to apply the concepts, but our lesson plans do not always work out well, given that we have a multitude of different types of learners in our classes. Lesson design is an important part of any mathematics teacher’s work: To prepare and deliver an effective lesson for optimal learning.

How can mathematics teachers design a lesson well? In the modern world where our students are born digital-natives, lesson packages need to be engaging and fun for the students to participate actively and be engaged in learning. Using the TI-Nspire as a teaching and learning tool, we are able to create interesting yet brain-stimulating activities to achieve that goal. Concepts can be taught through activities and exploration of concepts. It can even be self-directed, at the student’s own pace. This hands-on approach encourages student participation in class and promotes critical thinking. The multi-representation and cross-apps capabilities of the TI-Nspire also facilitates students to make the connections between different concepts they have learned.

One other question mathematics teachers always get is “Why are we learning this?”. Through mathematical modeling via the TI-Nspire, mathematics educators can bring the world closer to the students, and show how the physical world can be modeled mathematically using real world data. This real-world approach encourages interest in mathematics in students, as mathematics will no longer be just numbers and formulae.

With these approaches, mathematics educators can move a step closer to our common goals: Higher engagement of students in lessons, deeper understanding of Math concepts and ultimately contribute to the students’ success.

ABSTRACT FOR 20641

On the Application of Technology to Solutions of Limits Involving Indeterminate Forms

Author: Maria Ailynn Diansuy

Affiliations: Pamantasan ng Lungsod ng Maynila, Mathematics Teachers Association of the Philippines-Tertiary Level

The paper discusses on the application of technology, particularly CASIO calculator (model 991ESPlus), to solutions of Limits involving indeterminate forms. The paper begins with a discussion of the theoretical aspect of solution in solving limits involving indeterminate forms, the L'Hospital's Rule. It then delineates to the application of calculator based solution in solving indeterminate forms. Based on student's outputs, it then concludes with a discussion on the implications of the calculator based solution to the teaching and learning of limits involving indeterminate forms.

ABSTRACT FOR 20660

MODELING THE MOHR'S CIRCLE FOR TWO DIMENSIONAL STATE OF STRESS USING THE SCIENTIFIC CALCULATOR

Author: Romeo Tolentino

Affiliations: National University

The Mohr's Circle is a graphical representation of the principal stresses and stress transformation using a graphical format. Mohr''s circle also tells you the principal angles (orientations) of the principal stresses without having to plug an angle into stress transformation equations . This article will model the Mohr's Circle using complex numbers. The location of coordinates of any point along the circle which represents stress transformation are computed using some keys in the complex mode of a scientific calculator and therefore will greatly simplify the computations required in analyzing the circle. The calculator model used is the CASIO FX 991 ES plus.

HANDS-ON WORKSHOPS

ABSTRACT FOR 20494

ENHANCING THE TEACHING AND LEARNING OF MATHEMATICS THROUGH HANDHELD TECHNOLOGY

AUTHOR: WEE LENG NG

AFFILIATIONS: NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY

Handheld graphing technology, if used appropriately in the mathematics classroom, has the potential to enhance the teaching and learning of mathematics by empowering students to learn across different visual representations of mathematical concepts. With the aid of such technology, teachers have the means to help students develop a deeper understanding of abstract mathematical concepts and sharpen their critical thinking skills.

In this workshop, participants will explore the use of the TI-Nspire CX handheld in helping students develop relational understanding of concepts in calculus and statistics at upper secondary and pre-university levels.

ABSTRACT FOR 20496

HANDS-ON WORKSHOP: AUTOGRAPH IN OLD CLOTHES AND IN NEW (FOR AGES 11-16)

AUTHOR: DOUGLAS BUTLER

AFFILIATIONS: ICT TRAINING CENTRE, OUNDLE (UK), AUTOGRAPH-MATHS

Delegates will be encouraged to bring both their laptops and their mobile devices so that the dynamic software ''Autograph'' can be compared in its former home, on a desktop (PC or Mac), and in its new ''mobile'' environment. The material will focus on the teaching of mathematics to ages 11-16

The advantages of the hands-on environment will be explored: the tactile pinch zoom, the ability to operate on any device, the use of GPS and built-in camera, and above all the ability to use it anywhere (especially if there is a good WiFi signal!)

The disadvantages will also be looked at: the lack of a mouse signal, the small size of screen, the lack of any right-click menus, the awkwardness of the multi-layered keyboard, but above all the weaker processing power that makes complex mathematics calculations slower.

ABSTRACT FOR 20499

INTRODUCTION TO E-TEACHING OF SECONDARY SCHOOL / UNDERGRADUATE MATHEMATICS USING MAPLE

AUTHORS: BILL BLYTH, DR ASIM GHOUS

AFFILIATIONS: AUSTRALIAN SCIENTIFIC & ENGINEERING SOLUTIONS, RMIT UNIVERSITY, AUSTRALIAN SCIENTIFIC & ENGINEERING SOLUTIONS (ASES)

Maple is a leading Computer Algebra System, CAS, used and developed continually for 25 years. At RMIT University, Maple has supported student learning for 20 years. This hands-on workshop offers different activities according to each participant's Maple expertise. Participants are invited to bring their own laptop: a 30-day free evaluation copy of Maple 18 (and several Maple files) will be provided. Participants will be encouraged to work collaboratively (in small groups) on the activities without lectures (but with tutor help), just as the students do.

Beginners will be invited to work through

B1. (some of) an Introduction to Maple,

B2. a basic “Polya: How to Solve It” file on maximizing the area of a fenced region,

(B2 contd.) a basic assignment, the Norman window problem, with parameterization.

Experienced users will be invited to

E1. OPTIONAL: bring their own work to seek advice.

E2. Work through B2; or some linear algebra; or more advanced topics such as

Taylor Series (which includes visualization and use of animation).

ABSTRACT FOR 20501

INTRODUCTION TO COMPUTER AIDED ASSESSMENT OF SECONDARY SCHOOL / UNDERGRADUATE MATHEMATICS USING MAPLETA

AUTHORS: BILL BLYTH, DR ASIM GHOUS

AFFILIATIONS: AUSTRALIAN SCIENTIFIC & ENGINEERING SOLUTIONS, RMIT UNIVERSITY, AUSTRALIAN SCIENTIFIC & ENGINEERING SOLUTIONS (ASES)

MapleTA is the major Computer Aided Assessment, CAA, system for courses using mathematics. Version 9.5 has very many features, for details and a recorded webinar, see http://www.maplesoft.com. Invisible to the student, MapleTA uses Maple as its Computer Algebra System, CAS. MapleTA keeps full records of student results and communicates directly with most Learning Management Systems, such as Black Board and Moodle. This workshop offers different activities according to each participant’s Maple expertise. Participants are invited to bring their own laptop: internet connection will allow live trial of some MapleTA materials. Participants will be encouraged to work collaboratively (in small groups) on the activities.

In this workshop participants will:

1. (internet connection permitting) use a guest login as a student to complete standard questions on first year calculus: chosen from MapleTA’s large data bank of questions.

2. Design a MapleTA question for a calculus problem using a parameter (to individualize the question). Option: include a diagram (generated by Maple, within MapleTA).

3. If time permits: Design a MapleTA question for Chris Sangwin’s problem: “Give an example of an even function”. We cannot specify all possible correct answers. MapleTA uses Maple to test required properties of the student’s response.

4. If time permits: Design a multistep MapleTA question.

Universities in many countries have decreasing staff/student ratios. First year courses, in particular, have large enrolments so MapleTA (the only commercially available CAS-enabled CAA) has much to offer staff in managing their marking load.

ABSTRACT FOR 20509

HANDS-ON WORKSHOP: AUTOGRAPH IN OLD CLOTHES AND IN NEW (FOR AGES 16-19)

AUTHOR: DOUGLAS BUTLER

AFFILIATIONS: ICT TRAINING CENTRE, OUNDLE (UK), AUTOGRAPH-MATHS

Delegates will be encouraged to bring both their laptops and their mobile devices so that the dynamic software ''Autograph'' can be compared in its former home, on a desktop (PC or Mac), and in its new ''mobile'' environment. The material will focus on the teaching of mathematics to ages 16-19

With more advanced content comes the need for an appropriate user interface and more processing power. There will be an opportunity here to see how the two systems compare, both in 2D and 3D.

ABSTRACT FOR 20562

MODELLING THE FLOATING INDONESIAN FLAG : TWO TECHNIQUES WITH CABRI 3D

AUTHORS: JEAN-JACQUES DAHAN, JEAN-MARIE LABORDE

AFFILIATIONS: IREM OF TOULOUSE, CABRILOG, GRENOBLE, FRANCE

Even if you are a beginner with Cabri 3D, you will discover the software as well as its power to model a floating flag in using especially the transformations tools. The first model is a good approximation of the floating flag: it has been used with middle school students. The second one, more accurate uses the unfolding of a regular polyhedron. During this workshop you will enjoy the pleasure of using math to achieve a realistic result. http://youtu.be/7cHEyIdjvDw

ABSTRACT FOR 20563

BECOME A BRICKLAYER, A CARPENTER AND MORE IN BUILDING A HOUSE AND THE DOUBLE STAIR OF THE CHAMBORD CASTLE WITH CABRI 3D

AUTHORS: JEAN-JACQUES DAHAN, JEAN-MARIE LABORDE

AFFILIATIONS: IREM OF TOULOUSE, CABRILOG, GRENOBLE, FRANCE

Building a house with Cabri 3D is a pleasant way to enter the wonderful 3D space world proposed by this software : you will use all the solids of space to model a house with the help of the transformation tools. Creating opening doors, windows, blinds and so on will help you to approach 3D geometry in a very powerful way. The famous double stair of the castle of Chambord achieved by Leonardo da Vinci will be easily modelled.
http://youtu.be/FbOvcGvjC80 and http://youtu.be/xDtqMXmUL4E

ABSTRACT FOR 20575

CHRYSTAL GROWING WITH RHOMBIC POLYHEDRONS, A CABRI 3D WORKSHOP

AUTHOR: JEN-CHUNG CHUAN

AFFILIATIONS: DEPARTMENT OF MATHEMATICS, NATIONAL TSING HUA UNIVERSITY, HSINCHU, TAIWAN 300

A rhombic polyhedron is a convex polyhedron with congruent rhombic faces. By taking successive reflections across edges of an icosahedral symmetric rhombic polyhedron an interesting crystal is formed. In this tutorial we are to guide the participants step by step the construction of this highly

symmetric object with Cabri 3D. If time permits, we shall also explore the construction of the dual object.

ABSTRACT FOR 20598

LEARNING ABOUT FUNCTIONS AND EQUATIONS WITH AN ADVANCED SCIENTIFIC CALCULATOR

AUTHOR: BARRY KISSANE

AFFILIATIONS: MURDOCH UNIVERSITY

A modern scientific calculator has been designed to support student learning of key mathematical concepts, especially for schools and students with limited economic resources . In this hands-on workshop, we will explore how the CASIO fx-991ES PLUS calculator can be used effectively by secondary school students to develop an understanding of important ideas and processes related to functions and equations. As well as being a device to undertake numerical calculations, a modern calculator can be used to represent mathematical concepts. The workshop will illustrate how to take advantage of these capabilities to engage students actively in their own learning. We will draw on materials recently developed by CASIO to support the work of mathematics teachers and their students. Previous experience with this calculator will not be assumed.

ABSTRACT FOR 20599

LEARNING ABOUT CALCULUS WITH AN ADVANCED SCIENTIFIC CALCULATOR

AUTHOR: BARRY KISSANE

AFFILIATIONS: MURDOCH UNIVERSITY

A modern scientific calculator has been designed to support student learning of key mathematical concepts, especially for schools and students with limited economic resources. In this hands-on workshop, we will explore how the CASIO fx-991ES PLUS calculator can be used effectively by secondary school or early undergraduate students to develop an understanding of important ideas and processes related to the calculus. As well as being a device to undertake numerical calculations, a modern calculator can be used to represent mathematical concepts, and is a powerful tool for experimenting with mathematical ideas. The workshop will illustrate how to take advantage of these capabilities to engage students actively in their own learning. We will draw on materials recently developed by CASIO to support the work of mathematics teachers and their students. Previous experience with this calculator will not be assumed.

ABSTRACT FOR 20600

LEARNING MATHEMATICS WITH A MODERN GRAPHICS CALCULATOR

AUTHOR: BARRY KISSANE

AFFILIATIONS: MURDOCH UNIVERSITY

A modern graphics calculator has been designed to support student learning of key mathematical concepts, adding the capabilities of a graphics screen to those of an advanced scientific calculator. In this hands-on workshop, we will explore how CASIO fx-9860G II graphics calculators can be used effectively by secondary school students to develop an understanding of selected mathematical ideas. As well as being a device to undertake numerical calculations, a graphics calculator can be used to represent mathematical concepts in various ways, including graphically, and is a powerful tool for experimenting with mathematical ideas. The workshop will illustrate how to take advantage of these capabilities to engage students actively in their own learning. We will draw on materials recently

developed by CASIO to support the work of mathematics teachers and their students with graphics calculators. Previous experience with these calculators will not be assumed.

ABSTRACT FOR 20601

MATHEMATICAL PROBLEM SOLVING WITH A GRAPHING CALCULATOR

AUTHOR: WEE LENG NG

AFFILIATIONS: NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY

Enabling students to acquire and apply the necessary mathematical concepts and skills to solve problems in a wide range of situations is one of the primary aims of mathematics education. On the other hand, empowering students to make effective use of a variety of mathematical tools, including technological tools, in the learning and application of mathematics is identified as an important objective of many school mathematics curricula. Problem solving activities involving the use of technological tools have the potential to contribute to meeting the two aforementioned goals of mathematics education.

In this workshop, participants will engage in activities which explore effective uses of the TI-84 Plus graphing calculator, at different stages of the problem-solving process, in solving a collection of mathematical problems suitable for upper secondary students.

ABSTRACT FOR 20603

AN OVERVIEW OF MATHEMATICA FOR EDUCATION

AUTHORS: PAUL ABBOTT, FARID PASHA

AFFILIATIONS: WOLFRAM RESEARCH INC, THE UNIVERSITY OF WESTERN AUSTRALIA

For over 20 years, faculty and staff worldwide have used Mathematica for everything from teaching simple concepts in the classroom to doing serious research using some of the world's largest clusters. Mathematica continues to provide faculty with interactive lessons to engage students, deepening their understanding and preparing them for the future across a wealth of disciplines. Academic researchers can utilize Mathematica to quickly and accurately analyze data, test hypotheses, and document results. And because Mathematica delivers more capabilities, taking the place of several specialized kinds of software, schools can utilize Mathematica at a lower cost across campus.

ABSTRACT FOR 20604

MAKE YOUR COURSE INTERACTIVE AND ENGAGING

AUTHORS: FARID PASHA, PAUL ABBOTT

AFFILIATIONS: WOLFRAM RESEARCH INC, THE UNIVERSITY OF WESTERN AUSTRALIA

Mathematica offers an interactive classroom experience that helps students explore and grasp concepts, and that gives teachers the tools they need to easily create supporting course materials, assignments, and presentations.

ABSTRACT FOR 20640

MATHEMATICAL MODELLING USING TI-NSPIRE

AUTHOR: THOMAS YEO

AFFILIATIONS: TEXAS INSTRUMENTS

Participants will try out a Mathematical modeling activity created by the speaker. This activity allows participants to model a real life scenario using scatter plots and regression functions. This activity

shows how the TI-Nspire CX capability to have cross-app collaborations help in better understanding and engagement of students. Hands-on guidance is given to create your very own modelling task during the session itself.

ABSTRACT FOR 20653

UNVEILING CASIO FX 991ES+ : MAXIMIZING ITS APPLICATION IN MATHEMATICS CLASSES

AUTHORS: MARIA AILYNN DIANSUY, ROMEO TOLENTINO

AFFILIATIONS: PAMANTASAN NG LUNGSOD NG MAYNILA, MATHEMATICS TEACHERS ASSOCIATION OF THE PHILIPPINES-TERTIARY LEVEL, NATIONAL UNIVERSITY

This workshop presents features of CASIO FX991es+ and its application to solving mathematics problems. However, it unveils the features through calculator techniques which facilitates problem solving process easier. It focuses on problems involving algebra, geometry, calculus and statistics. This workshop showcases the powerful functions of CASIO FX 991es+ in mathematics education.

ABSTRACT FOR 30005

DISCOVERING CONCEPT OF LIMIT FUNCTION IN TENTH GRADE SENIOR HIGH SCHOOL WITH SCIENTIFIC APPROACH ACCORDING TO 2013 CURRICULUM USING CALCULATOR CASIO FX-991 ID PLUS

AUTHOR: WIWORO

AFFILIATIONS: PPPPTK MATEMATIKA YOGYAKARTA, INDONESIA

Implementation of 2013 Curriculum use scientific approach in the classroom teaching and learning process. There are five activity steps that is done by students in using scientific approach to study based competency in mathematics, that is observing, questioning, information collecting, associating, and communicating. Teaching and learning process of limit function subject matter in tenth grade, senior high school in Indonesia, before the implementation of 2013 Curriculum is restricted to find the numerical value of limit from an arbitrary function, and do not focus on what the limit is. Scientific calculator Casio fx-991ID Plus can be used as a learning media to discover the concept of limit function using scientific approach.

ABSTRACT FOR 30007

CREATIVE MATHEMATICS ACTIVITIES IN A CLASSROOM

AUTHOR: JANCHAI YINGPRAYOON, DR.RER.NAT. DEPUTY DIRECTOR, INTERNATIONAL COLLEGE, (JANCHAI.YI@SSRU.AC.TH OR DR.JANCHAI@GMAIL.COM)

AFILIATIONS: SUAN SUNANDHA RAJABHAT UNIVERSITY, BANGKOK, THAILAND

This hands-on and mind triggering workshop focuses on the use of creative fun activities in mathematics lessons. This workshop will show how to make Mathematics lessons more meaningful, effective and interesting, how to cultivate intrinsic motivation for learning Mathematics, and how to develop thinking abilities, problem-solving skills and creativity. The topics of these activities are: Simple Balance, Magic Math cards, Reaction time test, Napier's Bone, Mathematics Crystal Structure. Each participating teacher will get a set of materials for these activities.

POSTER SESSIONS

ABSTRACT FOR 20618

LET'S EXPLORE THE FUNCTIONS OF COMPLEX VALUE.

AUTHORS: CHIEKO FUKUDA, KYOKO KAKIHANA

AFFILIATIONS: TEIKYO UNIVERSITY, JAPAN, TSUKUBA GAKUIN UNIVERSITY, JAPAN

Introduction to Complex Analysis, in which we treat the fundamental character of a complex numbers and functions, has been so far logically learned by a theorem and proof. In this material, functions of complex variable are visualized using technology, and it aims at helping students intuitive understanding of them.

A function of complex variable w=F(z) is considered as a kind of map from z=x+iy to w=u+iv.

While function y=f(x) of the real number can be expressed with one two-dimensional xy plane, F(z) needs 4 dimensional space. In this material, z and w are denoted by a two-dimensional plane respectively, and the correspondence relation between the point z0 on plane z and the point F(z0) on plane w is expressed by the line segment. If function F(z) =z^2 is investigated using it, we will understand that point F(z0) which is the mapping of z0 makes a whole circle on plane w, when point z0 moves on semicircle of plane z. In this way, some basic complex functions, quadratic function, exponential function, logarithm function and others are visualized. When students move a point z0 on plane z, they can explore correspondence with a point z0 and a point F(z0) on plane w.

The complex function theory is learned as a basic subject in a department of science-and-engineering. Such students'' intuitive understanding is important for the complex analysis.

ABSTRACT FOR 20619

PROBLEM SOLVING WITH CERTIFICATION

AUTHOR: SHIN WATANABE

AFFILIATIONS: THE MATHEMATICS CERTIFICATION INSTITUTE OF JAPAN

We want to solve given problem with technology. We have fore steps,(1)Activity with technology (2)Making the Hypothesis (3)Solving your hypothesis and(4)Development of given problem. This example is the foster of x^2n-x^n+1 and example the find out the general term of the series 1,4,10,20,35EEE.

ABSTRACT FOR 20635

AN APPLICATION OF CAS FOR DEFINING EQUATIONS OF SINGULARITIES WITH INDETERMINATE EXPONENTS

AUTHORS: TADASHI TAKAHASHI, FUMIYA IWAMA

AFFILIATIONS: KONAN UNIVERSITY

In classification of certain type singularities, the defining equations are polynomials with parameter coefficients and indeterminate exponents. The forms of Groebner bases of ideal generated by such polynomials depend on the values of parameters, and those calculations are not easy. In calculation process, we need to classify the conditions of coefficient parameters for the leading term. We can use a certain technic and get them by using Mathematica. We show that the calculation result for the defining equation of singularity gives the restriction of that series precisely and that it is effective method to get them.