

# TSG Agenda

## TSG Topic Study Group 59

### MATHEMATICS AND CREATIVITY

Class: A

a note: UTC+2 = CET, UTC+3 = Eastern Europe, UTC+8 = Beijing

## Session 1 Tuesday 13.7 06.30-08.30 UTC

Moderator: Roza Leikin

- Introduction      Different faces of creativity:  
on the program and participants of the TSG-59 ICME-14  
Roza Leikin (10 min)
- Opening            Individual vs social perspectives of mathematical creativity  
  
Chronis Kynigos (15 min)

Long paper Presentations

Each presentation takes 15 minutes, then a 25 minute discussion at the end of the session

### ***Collaborative Creativity: 6.55-07.45***

1. FOSTERING CREATIVITY IN A DIVERSE CLASSROOM OF A COMMUNITY COLLEGE

**Malgorzata Aneta Marciniak** - [mmarciniak@lagcc.cuny.edu](mailto:mmarciniak@lagcc.cuny.edu)

City University of New York, Long Island City, US

*Abstract: The diverse population of students of LaGuardia Community College, a large urban college in New York City, creates a challenging environment for introducing and assessing creativity in a mathematics classroom and outside. But at the same time, it is the diversity that supports the collective experience and enriches the individual learning of each student. Most students in upper-level undergraduate courses major in engineering or computer science, thus, creative activities were designed to address students' shortcomings and specifics of their future jobs. Fostering creativity includes brief creative assignments and 1-week long class projects, where students make an attempt to find their own topics. Students are encouraged to assess their skills of writing, speaking and mathematical exposition to create groups with complete skill sets. Since many LaGuardia students are non-native speakers, their skills of writing and speaking require additional practice. At the same time the nature of engineering jobs often focuses on group projects, where multiple specialists in various areas can exchange their experience, which is addressed in design of in-class and outside of class creative projects.*

2. COLLABORATIVE CREATION BETWEEN UNIVERSITY STUDENTS FROM MATHEMATICS AND MUSIC

**M. Alicia Venegas-Thayer**, [aliciavenegasth@gmail.com](mailto:aliciavenegasth@gmail.com)

Pontificia Universidad Catolica de Valparaiso, Valparaiso, Chile

*Abstract: In this investigation, we consider an interdisciplinary process as an opportunity for collaborative creation between specialists from different disciplinary areas. Supported by the Commognitive Theory, we planned a focus group with students of mathematics and music, who faced a task of musical creation using random experiments. During their interactions, we observe that the establishment of a procedure of musical-mathematical composition depended on the specialized practice of each participant, who resorted to routines typical of their discipline to talk about objects of the other discipline. From this, new interdisciplinary objects emerged to talk about the musical instruments for their composition.*

3. CREATIVE DESIGN OF DIGITAL TOOLS FOR TEACHING IN A MATHEMATICS' TEACHERS' COMMUNITY

Dimitris Diamantidis, **Chronis Kynigos** - [kynigos@ppp.uoa.gr](mailto:kynigos@ppp.uoa.gr)

National and Kapodistrian University of Athens, Athens, Greece

*Abstract: This paper aims to describe the collaboration in a community of Greek mathematics teachers, that took place in a realistic school context, where the common goal was to re-design digital tools for teaching mathematics. The original tools that were re-designed, are provided online, formally in the digital textbooks (<http://ebooks.edu.gr/new/>), by the Greek Ministry of Education, as suggestions to be used in teaching. Teachers in this community collaborated in successive cycles of re-designing the tools and then using them in classroom. These cycles constitute the body of a research intervention, adopting the approach of design-based research. From the analysis, that was conducted following the Strauss's & Corbin's paradigm of grounded theory, the characteristics of the collaboration and communication within the community emerged, hence the elements of a creative process and outcome, in line with Fischer's approach, were apparent. Moreover, several aspects of the process in the group evident the possibility of producing more data and analyzing them through integrated lenses of continuous professional development and creativity of mathematics teachers.*

4. CREATIVE ART PROCESSES TO DEEPEN GEOMETRICAL THINKING OF MIDDLE SCHOOL MATHEMATICS TEACHERS.

**Irina Lyublinskaya**<sup>1</sup>, Marta Cadral<sup>2</sup>  
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1. Teachers College, Columbia University, New York, US 2. CUNY College of Staten Island

*Abstract: This study focused on understanding the ways in which creative aspects of both mathematics and art could be combined to deepen middle school teachers' understandings of geometric concepts that are difficult to teach, and to improve their teaching of these topics. Despite a growing body of research showing the crucial role of creativity as foundational for our thinking, traditional mathematics teaching tends to focus more on cognitive understanding, while art tends to value an embodied knowledge that might not be expressed through words. Our study found that the art materials and processes provided a higher level of creative engagement that helped teachers appreciate and understand both pedagogy and mathematical content differently and more creatively. As these teachers learned through creative engagement, they made connections from learning mathematics content to pedagogy of teaching that same content.*

5. SOCIAL CREATIVITY IN A CONSTRUCTIONIST CLASSROOM CONTEXT

Chronis Kynigos, **Dimitris Diamantidis**  
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*Abstract: Social creativity is a theory addressing creative performance and outputs as they grow out from the interaction between individuals in collectives and computational media, technologies and artefacts, all of them providing aids to them in carrying out their work. Without neglecting or minimising the contribution of 'individual' creativities, the theory nevertheless treats them as sources and manifestations of a 'socio-cultural'*

capital in terms of educational and disciplinary background, life experience and professional expertise, as well as the cultural and epistemological antecedents of all these. Each individual brings such a capital with them, which is voiced in the individual's distinctive perspective towards addressing a particular problem or situation. Social creativity occurs also in a 'technical' context, apart from a 'social' one, human collectives and the interchange taking place within them. The students imposed redundant functional relationships on linear and angular elements of geometrical figures in order to program a computer to construct special kinds of figural models such as a parallelogram which can never become a square. The analysis of this design study approaches the generation of the students' creative ideas as a normal output emerging from a socio-technical environment where the teacher played a significant role to encourage playful creative posing and solving of problems.

**discussion: 08.05-08.30**

## **Session 2 Wednesday 11.30-13.00 UCT**

Short Oral presentations, each presentation takes 8 minutes, then a 18 minute discussion at the end of the session

### **Round table 1: 11.30-12.02 *Cognitive Perspective of Creativity***

Chair – Kynigos

#### 1. EXPLORING PRIMARY STUDENTS' CREATIVITY IN HANDS-ON MATHEMATICAL ACTIVITIES

**Jiali Xing<sup>1</sup>**, Qiaoping Zhang<sup>2</sup>, Xuanzhu Jin<sup>3</sup>  
[xingjiali904@163.com](mailto:xingjiali904@163.com)

1. Zhejiang New Thought Educational Science Academy, Hangzhou, China, 2. The Education University of Hong Kong, 3. Hong Kong SAR, China

*Abstract: Mathematical creativity is regarded as one desirable goal in mathematics education around the world. It is worth to know how to promote students' creativity through mathematical problem solving. This study explored students' creativity in collaborative hands-on mathematical activities. Three crucial characteristics of creativity (flexibility, fluency, and originality) have been identified in solving tasks together with students' positive affective factors. The elaboration and collaboration may need to be trained in the classroom and teachers' guidance are also crucial during their problem-solving process.*

#### 2. A LEAP FROM IN SCHOOL TO OUT SCHOOL - POSSIBILITY IS CREATIVITY DEVELOPMENT

**Shin Watanabe**, [longlifemath@gmail.com](mailto:longlifemath@gmail.com)

The Mathematics Certification Institute of Japan

*Abstract: The main purpose is that creativity is the bridge between In School and Out School. In School is an education given by teachers in mathematics learning, and is a passive learning place for students. As a lifelong learning, the place of learning that aims to enjoy mathematics is called Out School. The bridge between In School and Out School is creativity. This creativity development is the key to everyone enjoying Out School as lifelong learning. In School consists of "play", "inductive method" and "deductive thinking". And Out School is sublimated from "Inductive Thinking" to "Play". I want to think about how we can have a bridge that goes through these two stages. This creativity as a bridge makes it possible to find problems and to enjoy the mathematics by thinking for yourself.*

### 3. CREATIVITY IN LINEAR ALGEBRA THROUGH INTERACTIONS

**Aditya P. Adiredja**<sup>1</sup>, Michelle Zandieh<sup>2</sup>  
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1. The University of Arizona, US 2. Arizona State University, Polytechnic Campus, US

*Abstract: In this report we describe the co-construction of creative everyday examples to explain the concept of basis in linear algebra. Eighteen students participated in individual interviews during which they explained their understanding of the concept of basis: eight participants were undergraduate female minority students from the U.S., while ten were undergraduate and graduate students from Germany. During these interviews' students constructed everyday examples using diverse contexts, e.g., marine life, money, and religion to explain basis. This report focuses on the interaction between the participant and interviewers as part of the creative process. Students constructed a new example when the interviewers: 1) asked for another example without any specific guidance; 2) asked for an example for a specific context or audience; 3) suggested of a different structure or idea to think about basis; and 4) shared of an example from a different interview. Each instance highlights the role of collaboration in constructing the examples. This report documents creative acts in tertiary education outside of proofs and problem solving, and as an everyday co-construction with students.*

### 4. STUDENTS MAKE INTERACTIVE EXHIBITION "EXPERIMENTAL MATHEMATICS" FOR THE MUSEUM OF ENTERTAINING SCIENCES

**Mariia Pavlova**<sup>1</sup>, Maria Shabanova<sup>2</sup>  
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1. Northern (Arctic) Federal University, Arkhangelsk, Russia 2. Moscow Center of the Development of Human Resources for Education, Russia

*Abstract: Museums of entertaining sciences is one of the most interesting forms of popularization of scientific knowledge and scientific activity. The first museum of entertaining sciences was opened in 1906 in Germany. Today, there are numerous similar museums in many countries. The main advantage of such museums is the interactive nature of exhibits: everyone may touch the exhibits and experiment with them. We suggest going further by giving students an opportunity to create an exhibition themselves. The purpose of this article is to present our experience of realization of this idea. Students of universities and secondary schools have made a holistic interactive exposition "Experimental Mathematics" for a museum of entertaining sciences in Archangelsk. The students wanted to present mathematics in a new, unusual perspective of "experimental science", to tell them about the role of experiments in mathematical discoveries, and to make them feel themselves like real researchers and experimental mathematicians.*

## Round Table 2: 12.02-12.42 *Creativity in the World*

Chair – Leikin

### 5. MATHEMATICAL CREATIVITY OF FILIPINO AND JAPANESE STUDENTS: A COMPARATIVE STUDY

**Lady Angela Mico Rocena**<sup>1</sup>, Ma. Nympha B. Joaquin<sup>1</sup>, Manabu Sumida<sup>2</sup>, Naomichi Yoshimira<sup>2</sup>  
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1. University of the Philippines, Quezon City, Philippines 2. Ehime University

*Abstract: This study explored the mathematical creativity of Filipino and Japanese students by looking deep into student responses to open-ended problems on numbers and number sense. One-hundred forty Filipino and Japanese Grade 7 students participated by answering a researcher-made instrument which was content-validated, pilot-tested, and subjected to reliability testing. Then statistical tests were applied to analyze the results. Moreover, classroom observations were conducted and academic documents such teacher-made assessments and textbooks were analyzed to substantiate the statistical results. Results show that the mathematical creativity of these two groups are significantly different*

*with the Japanese students scoring higher. Qualitative analysis for these results were discussed, as is their usefulness for improving mathematics teaching and learning.*

6. AN EXPLORATION INTO CHINESE HIGH SCHOOL STUDENTS' CONSCIOUSNESS OF ENQUIRING AND INNOVATION

**Yi Chu** , [852834229@qq.com](mailto:852834229@qq.com)

JIN Haiyue, Nanjing Normal University, Nanjing, China

*Abstract: This study investigates the consciousness of enquiring and innovation of Chinese Grade 10 students (n=483) with a self-designed questionnaire. It reports the results of a survey with high school students from two typical high schools in Nanjing. One of the high schools ranks first in the city, and the other high school ranks slightly inferior. The results showed that great imbalance between students' exploring spirits and creative practice ability did exist even if students from the top high school showed a deeper interest in the exploration of new things and the resolution of problems.*

7. PROMOTING CREATIVITY IN THE INTERNATIONAL BACCALAUREATE DIPLOMA PROGRAMME MATHEMATICS

**Deborah Sarah Sutch**, Helen Thomas  
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*Abstract: The aim of all International Baccalaureate (IB) programmes is to develop internationally minded people who, recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world through educational programmes that are broad, balanced, conceptual and connected. Creativity is central to this desire and as such there are a number of strategies in place which create space and time for the development of creativity both across the IB programmes and within the Diploma Programme (DP) mathematics courses. This paper aims to illustrate the strategies and conditions that have been deliberately put in place to provide opportunities for IB DP students to develop and demonstrate their mathematical creativity. It seeks to add to the discussion about whether creativity is purely the domain of the truly gifted in mathematics using Usiskin's (2000) eight-tiered hierarchy of creativity and what Sririman (2005) describes as "the butterfly effect".*

8. ESTABLISHMENT OF EVALUATION INDEX SYSTEM FOR PRIMARY SCHOOL STUDENTS' MATHEMATICAL INNOVATION COMPETENCY: INVESTIGATION AND ANALYSIS BASED ON DELPHI METHOD

**Anzhi Wang** , [201931010006@mail.bnu.edu.cn](mailto:201931010006@mail.bnu.edu.cn)

Beijing Normal University, China

*Abstract: In this study, the Delphi method was used to collect three rounds of opinions from 19 experts from universities and scientific research institutes on the constituent elements, connotation and weight of the evaluation index system of pupils' mathematical innovation competency. Five first-level indicators and 13 second-level indicators were formed: knowledge acquisition (mathematical basic knowledge level, acquisition of new knowledge, knowledge). Knowledge organization, thinking ability (divergent thinking, aggregated thinking), self-monitoring (evaluation, reflection, regulation), practical ability (discovery and proposal of mathematical problems, design and implementation of problem solutions, resource utilization and management), communication and communication (acquisition of views, expression of views). It provides standards and tools for the cultivation and evaluation of pupils' mathematical innovation competency.*

9. BRAIN EXERCISES FOR IMPROVING MATH CREATIVITY AND PHYSICAL HEALTH

**Valentina Gogovska,**

University "Ss. Cyril and Methodius", Institute of Mathematics, 1000 Skopje, N. Macedonia

*Abstract: Textual tasks, magic squares, mathematical riddles, puzzles and rebuses can be used as a tool for motivating and encouraging students' interest in mathematics. The aim of this paper is to*

*suggest several such tasks that increase students' interest in mathematics and mathematical challenges, deepen their knowledge and encourage creativity and the process of acquiring long-lasting and structural knowledge among students. Simultaneously, by pointing and discussing solutions we can increase not only creativity but also students' mathematical thinking and encourage them to think about formulating new tasks that will have similar or different solutions. That means that we can foster their ability to be successful and to work and think more and further than others.*

**Discussion: 12.42-13.00**

## **Session 3– Saturday 17.7 06.30-08.30 UTC**

### ***Cognitive abilities and development of Creativity***

Each presentation lasts 15 minutes followed by 15 minute discussion at the end of the session

Session chair: Kynigos

1. DESIGNING GAMES TO FOSTER CREATIVITY THINKING ABOUT RANDOMNESS

**Theodosia Prodromou**<sup>1</sup>, Chronis Kynigos<sup>2</sup>  
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University of New England, Armidale, Australia 2. National and Kapodistrian University of Athens, Greece

*Abstract: This study focuses on teachers' experimentation in a constructionist setting that induces mathematical creativity allowing students to experiment with randomness which is embedded in wider socio-scientific issues that call for decision making under uncertainty. The game modding - versioning process is addressed through collectives of diverse teachers. The analysis of the modding - versioning process shows that the interactions fostered by the socio-technical environment allowed these diverse practitioners to use their deterministic meanings in a productive way while modifying the game or designing new games that simulate a realist situation where people make decisions about their daily diet. The end-product of this social creative process were 39 different mods created by means of a game authoring 'choices with consequences' tool we call ChoiCo. These mods evolved through participants discussions about the realism of the games and the randomness embedded and generated in the target context.*

2. CREATIVITY VARIES FROM TASK TO TASK, DOESN'T IT? - A QUALITATIVE VIEW ON FIRST GRADERS' INDIVIDUAL CREATIVITY

**Svenja Bruhn** - [svenja.bruhn@uni-bielefeld.de](mailto:svenja.bruhn@uni-bielefeld.de)

Bielefeld University, Germany

*Abstract: Working individually on a mathematical open task, which facilitates primary school children to be creative, leads to very personal and unique creative processes and products. The observation and illustration of this creativity at primary school level is valuable for deepening our understanding of creative behavior in mathematics of younger students. This study takes a first glance on individual creativity of ten first graders working on two arithmetic open tasks. It determines, whether the individual creativity varies between two tasks. The qualitative analysis reveals different creativity types, which are deducted from the individual creativity patterns of the first graders. As a result, the individual creativity varies from task to task for only seven out of ten children.*

3. "RETHINKING THE WORLD" WITH MATHEMATICS: THE GEOMETRIC CHESS FROM BAUHAUS AS A BASIS FOR CREATING MATHEMATICAL IDEAS AND MATERIALS

**Torsten Fritzlar**, Karin Richter  
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*Abstract: "Rethinking the World." The 100th birthday of the Bauhaus was celebrated under this motto. The legendary art school only existed for 14 years. Nevertheless, the break with traditional ideas and old certainties, a new way of thinking in art, architecture, design and education made the Bauhaus one of the most influential art schools in the 20th century. The article presents a project on the Bauhaus chess game for pupils and teacher students that not only takes up a design example but also the Bauhaus methodological approach and thus enables creative activity within and beyond mathematics.*

4. INVENTING GROWING PATTERNS BY PRIMARY SCHOOL STUDENTS - A CREATIVITY PROVOKING TASK

**Daniela Assmus**, Torsten Fritzlar  
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Martin Luther University of Halle-Wittenberg, Germany

*Abstract: Even though there are numerous studies on how primary school students work on sequences of growing patterns, so far there has been little research on how successful these children are in inventing their own growing patterns with consistent regularities. The presented case study with 14 mathematically gifted and 29 not mathematically gifted children combines two aspects regarding this content. First, it examines the extent to which the invented growing patterns of mathematically gifted third-graders differ from those of heterogeneous school classes. Second, it addresses the question of whether the presented task is suitable for provoking mathematical creativity in primary school age. Results of the case study show that the mathematically gifted children invented more and in a larger proportion consistently regular growing patterns than the children in the comparison group. In addition, the patterns of gifted children are characterized by a greater diversity than in the school classes, which could indicate a special creativity of the mathematically gifted children.*

5. THE RELATION BETWEEN SPATIAL ABILITY AND CREATIVITY IN GEOMETRY IN PRIMARY SCHOOL

**Anastasia Datsogianni**<sup>1</sup>, Pantelitsa Eleftheriou<sup>3</sup>, Nektaria Panagi-Louka<sup>2</sup>, Athanasios Gagatsis<sup>2</sup>  
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1.University of Munich (LMU)<sup>1</sup>, Munich, Germany 2.University of Cyprus<sup>2</sup> 3.Cyprus Ministry of Education and Culture<sup>3</sup>

*Abstract: The current study aims at investigating the spatial ability and creativity skills of 192 fifth and sixth graders from Cyprus and Greece as well as the relation between these two concepts. Firstly, students' performance in the three dimensions of spatial ability (form board, card rotation, and orientation) was examined, with students' success rates being low. The creativity characteristics, fluency, flexibility, and originality, were investigated through multiple solutions tasks based on the context of area and perimeter. Fluency and flexibility were strongly and consistently related, appearing as a dipole, while originality was observed among very few students. Finally, the relationship between spatial ability and creativity was examined and the two concepts seem to be related. Implications and limitations of the study are discussed.*

6. STRATEGY-RELATED AND OUTCOME-RELATED MATHEMATICAL CREATIVITY IN ALL AS COMPARED TO THAT IN GIFTED

Haim Elgrably, **Roza Leikin** - [rozal@edu.haifa.ac.il](mailto:rozal@edu.haifa.ac.il)

University of Haifa, Haifa, Israel

*Abstract: The contrast between relative creativity and absolute creativity is central when comparing creativity-in-all and creativity in gifted individuals. We first will devise a theoretical framework for the*

*analysis of creative processes and creative products associated with problem solving and problem posing. Second, we will exemplify posing mathematical problems through solving investigation tasks in Geometry. We will draw a distinction between outcome-related creativity and strategy-related creativity, thereby demonstrating differences in mathematical creativity-in-all and mathematical creativity in gifted individuals. Focusing on the fluency, flexibility and originality of the problem solving and problem posing strategies and products, we argue that major characteristics of mathematical creativity in gifted individuals is a high level of strategy-related flexibility and product-related originality.*

## **Discussion: 08.15-08.30**

### **Session 4– Saturday 17.7 13.30-15.00 UCT**

Paper presentations: Each presentation - 8 minutes and then 25' discussion at the end

Session Chair: Suhy

Round Table 3: *Collaborative and Interactive creativity*  
Chair - Prodromou

1. A SURVEY OF MATHEMATICS TEACHERS' PERCEPTIONS ON MATHEMATICALLY GIFTED LEARNERS IN THABA NCHU PRIMARY SCHOOLS IN SOUTH AFRICA

**Motshidisi Gertrude van Wyk**

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Central University of Technology –Free State, SOUTH AFRICA

*Abstract: South African teachers conduct their lesson through inclusive education, but empirical evidence shows that the interpretation of inclusive education is that of meeting the needs of learners who are academically falling behind. The researcher of this study therefore investigated and analysed foundation phase teachers' preparedness in terms of catering for the needs of mathematically gifted learners. Data were collected from teachers and principals of the selected 10 primary schools in Thaba Nchu through questionnaires and structured interviews, respectively. The results show that 64% of teachers were competent to teach the gifted learners and, 88% expressed the need for higher education institutions to include content on gifted education in their courses. The results further show that, 70% of principals encourage teachers to attend AMESA congress and workshops to meet the needs of these precocious learners. However, the needs of gifted learners in inclusive classrooms are still not met due to lack of teacher training particularly in gifted education.*

2. INQUIRY DIALOGUES IN MATHEMATICS CLASSROOM AND MATHEMATICAL REPRESENTATIONS AND THEIR ROLE IN LEARNING MATHEMATICS

**Hanna Zdziarska Slabikowska**

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University South-Eastern Norway, Solbergmoen, Norway

*Abstract: Inquiry-based learning in mathematics invite students to work in ways similar to how mathematicians and scientists' work. The purpose of this poster is to discuss how connections between inquiry-based mathematics dialogues, reasoning, and mathematical representations, in a practical*

*context, can contribute to students' conceptual understanding of The Pythagorean theorem. The students in the study explore mathematical problems and discuss mathematical concepts.*

3. MATHEMATICAL CREATIVITY WORKSHOP TO REVIEW ELEMENTS OF GEOMETRY WITH HIGH SCHOOL STUDENTS

**Matheus Delaine Teixeira Zanetti<sup>1</sup>**, Mateus G. Fonseca<sup>2</sup>, Cleyton H. Gontijo<sup>1</sup>

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1. University of Brasilia, Brasilia, Brazil 2. Federal Institute of Brasilia

*Abstract: Improving critical and creative thinking in mathematics is a subject that has been studied by different researchers around the world. In this paper it is reported an activity carried out with a group of 18 Brazilian students from the last year of high school, whose purpose was to review geometric figures properties.*

4. COMPARING SOCIAL CREATIVITY AMONG DESIGNERS WITH CREATIVITY OF MATHEMATICAL DIGITAL RESOURCES PRODUCED

**Nataly Essonnier<sup>1</sup>**, Mohamed El-Demerdash<sup>2</sup>, Jana Trgalová<sup>3</sup>

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1. University of Geneva, Switzerland 2. Menoufia University, Egypt 3. University of Lyon, France

*Abstract: In this paper, we bring to the fore social creativity in the design of digital resources with creative mathematical thinking (CMT) affordances, called 'c-books' ('c' for creative). We look for correlations between social creativity occurred during the design process and the CMT affordances of the c-books produced. Our analysis shows that CMT affordances are linked with SC.*

5. EXPANDING POSSIBILITIES: A METAPHOR FOR THE CO-CONSTRUCTION OF STUDENTS' CREATIVE ACTS

**Ayman Eleyan Aljarrah<sup>1</sup>**, Jo Towers<sup>2</sup>

[ajarrah74@yahoo.com](mailto:ajarrah74@yahoo.com)

1. Acadia University, Wolfville, Canada 2. University of Calgary

*Abstract: The study described herein is part of a broader research study exploring collective creativity in elementary mathematics learning environments. While creativity is being encouraged in mathematics classrooms (Leikin & Pitta-Pantazi, 2013; Levenson, 2013), teachers have few tools to recognize, observe, and foster students' acts of collective mathematical creativity as they work together in groups in classroom. In this paper, we adopt the metaphor "expanding possibilities" to describe the creative actions of a group of sixth grade students while they are working together on a mathematical task and we offer the metaphor as a way to highlight the creativity inherent in children's doing of mathematics.*

Round Table 4: Evaluation of Creativity  
Chair – Fritzlar

6. MATHEMATICAL CREATIVITY WORKSHOPS TO HIGH SCHOOL BRAZILIAN STUDENTS AND THEIR EFFECTS ON MOTIVATION AND PERFORMANCE IN MATHEMATICS

**Mateus Gianni Fonseca<sup>1</sup>**, Cleyton H. Gontijo<sup>2</sup>

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1. Federal Institute of Education, Science and Technology of Brasilia 2. University of Brasilia

*Abstract: This research aims to investigate whether the use of creativity techniques in math classes can be effective in improving mathematical creativity. It also aims to verify its effects on motivation and performance in mathematics. For this, an experimental research was designed. Eight workshops were offered to two groups of students from the last year of the Brazilian high school: control group and*

*experimental group. To the first group, the classes were based in a conventional approach, while to the second one, the classes were based on open-ended problems and creativity techniques. As a result, although both groups had improved their scores on mathematical creativity, motivation, and performance after the workshops were completed, only the experimental group achieved significant results.*

#### 7. RESEARCH PROBLEMS AND ASSESSMENT BY STUDENTS

**Noriko Tanaka**, [norikotanaka91@gmail.com](mailto:norikotanaka91@gmail.com)

Asahigaoka Senior High School, Japan

*Abstract: Research Problems (Asking students to make up and research problems) increases interest in mathematics, encourages creativity, and helps students appreciate the usefulness of mathematics. This method has been used and tested in two different settings: students in classroom and students in mathematical circle. Students not only present their research but also assess each other at oral session and poster session. I describe the method used for the research and assessment by students. Then I will share some examples of students' actual work at my senior high school.*

## **Discussion: 14.26-14.51**

### **Closing SUMMARY AND FUTURE PLANS**

Chronis Kynigos (9 min)