1st International Conference

INNOVATIONS AND CREATIVITY

PROGRAM

ABSTRACTS

June 30 – July 1, 2016
Liepāja, Latvia

1ST INTERNATIONAL CONFERENCE "INNOVATIONS AND CREATIVITY" ABSTRACTS
Liepāja University, Liepaja, Latvia

EDITORS

Dace Kūma, Dzintars Tomsons

LAYOUT

Dace Kūma

COVER DESIGN

Jānis Letinskis

CONFERENCE HOMEPAGE

http://mathart.liepu.lv/

Art and mathematics since ancient times have a close relationship. On the one hand its substantive areas, but on the other hand between them have developed close relationships. The aim of the conference is to update interdisciplinary link between math and art in the 21 century.

Conference is organized in four sections:

- Mathematics
- Computing
- Material sciences
- Art

Within the Conference, exhibition of artworks/creative projects "MATH and ART" is organized.

- "Mathematical Art". Author Raitis Ozols.

When Raitis Ozols learned at Liepaja Secondary School Nr.1 he was fascinated by mathematics and started to develop computer programs that drew function graphs and other mathematical objects. He understood – several of these objects may be considered as works of art. Afterwards he continued to collect knowledge and ideas how to create works of art with a computer and figured out how to get fractals.

These works of art are based on mathematical calculations performed by the computer. In creating them R.Ozols mainly used trigonometric functions, iterations, different curves equations and even ideas, borrowed from physics. Many works have been derived almost from experimenting with functions, so they are not only the result of work of mind but also the result of experiments.

It is his first exhibition in Liepaja.

- Art works, design projects and products of Liepaja University study program "Design" students in the field of interior design, product design, computer design.

Works – projects reveal how to provide acquisition of theoretical, research based knowledge in art and design in accordance with the requirements by conflating theoretical cultural, social and economic knowledge and artistic creativity. Artistic creativity goes side by side with discoveries, ideas and new treatment of things, objects and phenomena.

TABLE OF CONTENT

PROGRAM

THURSDAY, JUNE 30

10:00 – 11:00	Registration Welcome Coffe (Room 317)
Plenary session	**(Room 327)**
11:00 – 11:20	Opening of the conference
11:20 – 11:50	Vakaris Bernotas. Holistic approach in the training of the design
11:50 – 12:20	Raimonds Gabaliņš. Mathematic as art
12:20 – 12:50	Michael A. Radin. Applying mathematical ideas & patterns in landscape photography
12:50 – 14:00	**Lunch time**
Mathematics section	**(Room 303)**
14:00 – 14:30	Raitis Ozols. The use of functions and algorithms for creating works of art
14:30 – 15:00	Andrejs Cibulis. The art of problem solving
15:00 – 15:30	Vaira Karklina, Liene Bitlerjus. Functional relations between variables
15:30 – 16:00	Dace Kūma. Is it possible to teach art of solving math competitions' problems?
Computing section	**(Room 327)**
14:00 – 14:30	Ilze Kazaine. The improvement of electronic materials in the Distance Professional Learning Centre of Latvia
14:30 – 15:00	Dzintars Tomsons, Inta Znotiņa. Educational computer-based game as the first software development project for it students
15:00 – 15:30	Uldis Žaimis, Anita Jansone. Gold - section in interactive user interface development
15:30 – 16:00	Dzintars Tomsons, Inta Znotiņa, Sandra Anohina. Maze tasks for learning of basics of algorithms and programming
16:00 – 16:30	**Coffee break** **(Room 317)**

Mathematics section	**(Room 303)**
16:30 – 16:55	Indrė Kasulaitytė, Romualdas Kašuba. An attempt to compose an appealing book about problem solving by laying it out as a combination of several arts
16:55 – 17:20	Edmundas Mazėtis, Romualdas Kašuba. Some remarks concerning the role of visualization in the artistry and comprehension of geometrical problems and their beauty
17:20 – 17:45	Jānis Mencis. Spatial perception of the world
17:45 – 18:10	Agnese Šuste. Creativity in problems related to difference equations
18:10 – 18:35	Ingrīda Uļjane, Aleksandrs Šostaks. CATS appear everywhere in mathematics!
Computing and material science sections	**(Room 327)**
16:30 – 16:55	Vineta Tomsone, Dzintars Tomsons. Development of programming skills for in-service teachers of computing using MOODLE
16:55 – 17:20	Maksims Žigunovs. Graphene oxide production for further operations in Liepaja University within cooperation with "DITI"
17:20 – 17:45	Uldis Žaimis. Electrical energy storage design and parameter optimization
17:45 – 18:10	Viesturs Kalniņš. Air pollution synergistic effect problem in Latvia and potential solutions to detect and measure it
18:10 – 18:35	Armands Grickus. New insulation material
19:00 – …	**Welcome party on the beach**

FRIDAY, JULY 1

10:00 – 11:00	Excursion to the concert hall "Great Amber"
11:00 – 12:30	Interactive City tour
12:30 – …	Closing of the conference in restaurant "*Pastnieka māja*"

HOLISTIC APPROACH IN THE TRAINING OF THE DESIGN

Vakaris Bernotas
Vilniaus Academy of Art

How can we characterize the holistic approach to design? The Greek word "*holon*" is translated as "*wholeness*" and "*integrity*". According it, holism as the doctrine is based on the direct integral relationship of all that surrounds us. The concept of holistic design is based on the inseparability of essential integrity of all things.

THE ART OF PROBLEM SOLVING

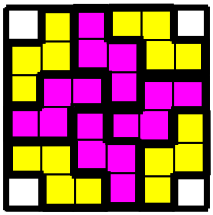
Andrejs Cibulis
University of Latvia

We focus our attention on elegant proofs, tilings and symmetrical patterns. As pointed out by Ian Stewart in [1]: *Mathematics and art have many points of contact, but none is more beautiful than the concept of symmetry*. We discuss some ideas of compatibility theory of polyforms which seem useful also for art. A lot of symmetrical compatibility patterns can be found in the beautiful webpages [2] created by George Sicherman.

Usually a path in searching "aha" solutions of problems or elegant proofs of theorems [3], [4] is not short and easy to find. A lot of unsuccessfully attempts as well as clumsy and long argumentations had been before such proofs were found. Elegance is frequently used as a standard of tastefulness particularly in the areas of visual design, decoration, the sciences, and the aesthetics of mathematics. The search for elegant solutions and proofs leads to what was called "mathematical power and attractiveness". Teaching mathematics, especially for gifted students, includes the search for "cool" or elegant solutions to problems, the nonstandard visualizations.

Here we mention only two examples: one from the recreational mathematics and one from the mathematical or functional analysis.

1. Densest packing. Let N(*s*) be the maximum number of N-tetrominoes covering the cells (without overlapping) of a square $s \times s$. Determine N(8) and N(9). Which task is more difficult? It turns out that it is more difficult to determine the smaller value N(8), moreover the elegant proof for determination N(9) as well as all numbers N(*s*) for odd *s* exists. The elegant solution immediately giving the number N(6) = 8 is shown below.



As to determination the number N(8) a short proof is not known and one can ask, "Did anyone find a shorter way to do this?" For a general even number *s* the problem of finding N(*s*) has not been solved.

2. Metric. Prove or disprove that $d(x, y) = \arctan|x - y|$ is the metric.

Students solve this task very rarely (if solve at all) in the elegant way.

Determine a class of functions f for which $f(|x-y|)$ is the metric on the set of real numbers.

References

[1] Stewart I., The Art of Elegant Tiling, Scientific American, July 1999. http://www.whydomath.org/Reading_Room_Material/ian_stewart/0799.html

[2] http://userpages.monmouth.com/~colonel/compatibility.html

[3] Aigner M., Ziegler G. M., Proofs from THE BOOK, (1998) Springer.

[4] Zeitz P., The Art and Craft of Problem Solving, (2007) Sec. Ed., John Wiley & Sons, Inc.

MATHEMATIC AS ART

Raimonds Gabaliņš
Liepaja University

Historically, arithmetic and geometry were included in the field of art. Historical development course of mathematics has evolved to a higher level. At present, we can say that the visual arts are mainly based on mathematical experience and has developed as one of the artistic languages.

NEW INSULATION MATERIAL

Armands Grickus
Liepaja University

In circumstances, when it is important to replace insulation materials with high content of emissions during production it is necessary to create new heat and sound insulation material, which eliminates CO_2 emissions, develop its production techniques and technological machinery – raw material chopper, pulp mixer, termopress, dryer chamber, formatting knifes, determine technical control parameters and control equipment, develop mathematical model of the material and calculation methods for design works. It is necessary to design, manufacture and experimentally test the respective technological equipment for insulation production pilot plant. To get exact physical parameters it is necessary design, manufacture and test unique laboratory equipment for determining the properties of insulation material.

AIR POLLUTION SYNERGISTIC EFFECT PROBLEM IN LATVIA AND POTENTIAL SOLUTIONS TO DETECT AND MEASURE IT

Viesturs Kalniņš
Liepaja University

Information on air pollution can be obtained with a variety of environmental parameter methods – automated measurements and pollution dispersion modelling. Current solutions fulfil their task – evaluate pollution level in compliance with environmental quality standards. However, recent studies have shown that there is a hidden, less obvious danger – synergistic effect – increased impact on living organisms caused by interactions of different pollutants and environmental factors. For example, ozone mixed with other pollutants, results in greater impact on human health than same substances in separate action (Mauderly and Samet, 2009). Such interactions are very complex and depends on a combination of many factors – weather, air temperature, humidity, exposure, etc. (Stylianou and Nicolich, 2009), hence they are not easy to assess.

Air pollution synergistic effect assessment methodologies are hindered by a lack of verified analytical framework (Callahan and Sexton, 2007) – synergistic effect most often is viewed only in a simplest form of interactions and mostly in laboratory conditions (Monosson, 2005; Meek et al., 2011). Therefore, with current knowledge on interactions between pollutants, environmental parameter methods alone cannot serve as an effective tool for synergistic pollution assessment.

This problem is also actual in Latvia. In year 2013, new synergistic effect evaluation method Cumulative Pollution Index (CPI) for the first time was tested in field research by doing synergistic air pollution evaluation in two cities of Latvia – Liepaja and Riga. Results show that there are interactions between pollutants and environmental factors all year long, especially in the summer months, and often in places where, according to pollution measurements, air is relatively clean (Kalniņš et al., 2014).

As an alternative bioindication can be used – pollution level determination by its impact on certain living organisms. It can't determine exact concentrations of substances, like with air quality measurements, but it is an effective tool to evaluate how much pollution caused damage living organism take in given pollution level (Tiwari, 2008). However, also bioindication alone cannot be used as an effective synergistic effect assessment tool, because it is impossible to determine whether damage to indicator organisms are caused by individual pollutants or the cause is a synergistic effect.

In case of synergistic impact, living organisms should receive more damage than it should be in measured pollution level. Therefore, by using chemical substances concentration measurements and bioindication together, as it was done in CPI method, would be possible to extract information about this extra damage from air quality measurement data, allowing to detect and evaluate synergistic effects more effectively than with current – statistical models based approaches.

Such integrated synergistic effect evaluation solutions could significantly improve efficiency of air quality monitoring, because in addition to the existing measurements, also synergistic effect can be detected and evaluated.

References

1. Callahan, M.A., Sexton, K. If cumulative risk assessment is the answer, what is the question? *Environmental Health Perspectives*. 2007, vol. 115, pp. 799-806.
2. Kalniņš, V., Straupe I., Sudārs R. Evaluation of cumulative air pollution in Riga and Liepaja with Cumulative Pollution Index method. *Research for Rural Development. Annual 20th International Scientific Conference Proceedings*, vol. 2, 2014, pp. 127-132.
3. Mauderly, J.L., Samet, J.M. Is there evidence for synergy among air pollutants in causing health effects? *Environmental Health Perspectives*. 2009, vol. 117, pp. 1-6.
4. Meek, M.E., Boobis, A.R., Crofton, K.M., Heinemeyer, G., Raaij, M.V., Vickers, C. Risk assessment of combined exposure to multiple chemicals: a WHO/IPCS framework. *Regulatory Toxicology and Pharmacology*. 2011, vol. 60, pp. 1-14.
5. Monosson, E. Chemical mixtures: Considering the evolution of toxicology and chemical assessment. *Environmental Health Perspectives*. 2005, vol. 113, pp. 383-390.
6. Stylianou, M., Nicolich, M.J. Cumulative effects and threshold levels in air pollution mortality: Data analysis of nine large US cities using the NMMAPS dataset. *Environmental Pollution*. 2009, vol. 157, pp. 2216-2223.
7. Tiwari, G.B.G.P.K. Lichens as an indicator for Air Pollution: A Review. *Indian Journal of Air Pollution Control*. 2008, vol. 8, pp. 8-17.

FUNCTIONAL RELATIONS BETWEEN VARIABLES

Vaira Karklina, Liene Bitlerjus
Liepaja University

Functional relation between the variables can be represented in four different ways – in a real-life situation or its description, in a table, in a graphic or a formula. Transition from one type to another potentially can take place in 12 different ways.

	a real-life situation	a table	a graphic	a formula
a real-life situation		Measure or determine corresponding values of variables	Create ordered pairs and display in the coordinate plane	Symbolize as equivalently
a table	Interpret table		Display values arranged in pairs in the coordinate plane	Formulate and test the hypotesis
a graphic	Interpret graph	Find out the coordinates of a point in the coordinate system		Compare with known function graphs
a formula	Interpret function rule	Calculate corresponding values of variables	Calculate and display corresponding values in the coordinate plane	

The report will analyse the transition from one type to another type.

AN ATTEMPT TO COMPOSE AN APPEALING BOOK ABOUT PROBLEM SOLVING BY LAYING IT OUT AS A COMBINATION OF SEVERAL ARTS

Indrė Kasulaitytė, Romualdas Kašuba
Vilnius University

It is a rather well-known fact that if you are lucky to make something of importance, essentially combining or applying several factors, then the result you will get might be astonishing even to those who are quite proficient in their field. Something similar happened to both authors of the book we are going to speak about, which is titled so: „Even (not so) serious book" (closest literal translation from Lithuanian). The book was edited by the Vilnius University Press in 2013.

The most common and natural way for a book to be born is probably that some sort of text appears or is otherwise produced. Frankly speaking, in our case the text was not so standard, because it was about problem solving in mathematics (the main part of most problems was arithmetical in its nature, although non-standard one). What is more, it was written by applying various elements of funny reasoning – and almost nothing more. Afterwards, about 50 illustrations (made by the first author) were added and the nature of the whole book changed, as did its quality. After that, the first draft was partly overwritten in such a manner that the problems were presented more as the fragments of some interconnected short stories. Also, an attempt to begin all the chapters with poetical epigraphs (usually consisting of 2 lines) was undertaken. Then the text was divided in two (again by the first author): one part containing theoretical or arithmetical (or mathematical, if you like to take things seriously) considerations and another, or so-called heuristically endowed part.

As a result of all that labour, you have a curious combination of several arts and styles which – as we hope – any potential reader will enjoy and which is worth seeing, discussing and considering.

THE IMPROVEMENT OF ELECTRONIC MATERIALS IN THE DISTANCE PROFESSIONAL LEARNING CENTRE OF LATVIA

Ilze Kazaine[1], Ilze Kalniņa[2]
[1]Latvia University of Agriculture,
[2]Distance Professional Learning Centre of Latvia

More and more educational establishments use some of the e-study systems in the studying process. Therefore, electronic teaching materials are offered to the students. These materials are one of the most important elements of the studying process and a lot of time and attention is paid to develop them. Nowadays e-study systems offer a great variety: HTML documents, video and audio materials, animations etc. The information presented must be in a format students can understand and acquire without a help of teachers.

The Distance Professional Learning Centre of Latvia offers and implements six long distance studying programs and provides an opportunity to receive a professional qualification at the end of the course. The educational institution has been operating since 2012. In the beginning all the teaching materials were published as e-books using PDF files.

The aim of the survey was to explore the development opportunities and the effectiveness of the electronic teaching materials in the Distance Professional Learning Centre of Latvia. In the period from 2014 till 2015 all the centre's students were questioned in order to evaluate the current situation, to understand the students' expectations and needs of electronic teaching materials. As a result of this survey all the original electronic teaching materials were improved, the special procedure to develop such materials was created, multimedia materials were added and suggestions for the development of the electronic materials were given. The survey proves that teaching materials in HTML format supplemented by audio and video elements can improve the outline of the theory and can provide an effective learning process.

IS IT POSSIBLE TO TEACH ART OF SOLVING MATH COMPETITIONS' PROBLEMS?

Dace Kūma
Liepāja University

Math competitions' problems usually are so called *non-standard* problems, because they are different from those ones considered during math classes. The difference mainly is in complexity of the solution:

- there are more steps until answer than in *standard* tasks;
- problem is formulated in non-standard way (vice versa);
- knowledge of various topics or branches of science should be combined.

Each competition's problem should be considered as unique one and needs its own approach, however there are also some general methods of thinking which should be taught to each participant of competitions (and not only those):

- Mean value method;
- Method of invariants;
- Method of extremal element;
- Method of mathematical induction;
- Method of interpretation.

In Liepaja there are organised regular lessons in solving math competitions' problems for school students. However, it is of great importance to increase competence of solving non-standard problems for math teachers.

In Liepaja University for preparation math teachers are carried out professional bachelor study program "Mathematics, Physics and Computer science" and professional master study program "General education teacher". Both these study programs contain also some courses having short insight in solving competitions' problems. In the report will be considered content of these courses.

SOME REMARKS CONCERNING THE ROLE OF VISUALIZATION IN THE ARTISTRY AND COMPREHENSION OF GEOMETRICAL PROBLEMS AND THEIR BEAUTY

Edmundas Mazėtis, Romualdas Kašuba
Vilnius University, Lithuania

The art of problem solving in geometry is rather specific and often regarded as remarkably complicated – all of us know the famous phrase about the non-existence of a royal way in geometry – "There is no royal road to geometry". (μή εἶναι βασιλικήν ἀτραπόν ἐπί γεωμετρίαν, *Non est regia [inquit Euclides] ad Geometriam via*) This was said in reply to the ruler Ptolemy I Soter, when he asked Euclid about a shorter road to mastering geometry than through Euclid's *Elements*.

On the other hand, any solving of geometrical problems is simply not possible without at least a little but always essential application of visual illustration and representation. Such elements seem to be crucially important in order to better imagine the essence of the whole geometrical reasoning and understanding the beauty in the challenging philosophical background that usually accompanies problem solving in geometry. During the lecture, these and other related matters as well as a natural geometrical reasoning will be looked into or at least mentioned.

SPATIAL PERCEPTION OF THE WORLD

Jānis Mencis (jun.)
University of Latvia

When a child begins to crawl, he tries to rise – we are the denizens of three dimensions! Things – toy building blocks, spoon, mommy – all there also are three dimensional objects. Playing hide and seek, we are looking for hiding place in the room rather than in the plane and let alone in a one-dimensional line. Mathematics teaching methods have seen attempts to work on increased introduction of spatial figures already in the first classes (Rein Kolde from Estonia), however, because of various reasons, for example, lack of teachers' preparedness, incomprehension – what should be done with these spatial figures, due to the traditions and other obstacles, and the like, nothing particularly good in this area has yet been achieved. Even more, in the 7th grade we cast the students out of the space back into 2-dimensional plane, as the systematic course in geometry begins. Things provided for grade 8 or 9 in relation to spatial figures do not greatly exceed the content already acquired in grade 6. Let us also note that already 100 years ago a student in elementary school knew how to calculate the numerical characteristic dimensions of the cube, parallelepiped, cylinder, cone, sphere – the surface area and volume. Thus, in this conference I would like to hear your views on the ideas how to change this situation for the benefit of strengthening the spatial – three-dimensional perception of the world already in the basic school.

Another issue I want to report at the conference is in connection with non-traditional polyhedral classification, which simultaneously serves to improve classification, analysis and synthesis, as well as evaluation skills (almost like Bloom's taxonomy!), and, of course, to develop the spatial perception. The question that we have studied in classrooms of different levels, of course, is nothing new in itself – how many tetrahedrons, pentahedrons, hexagonals are there, taking into account that the "topological" transformations do not constitute a new class of objects. Methodological aspect here can be seen both in creation of objects from natural materials, as well as in making drawings (paintings), and the use of appropriate computer applications (software).

Hopefully, the questions and their solutions will serve for a more interesting and purposeful mastering of the mathematics course.

THE USE OF FUNCTIONS AND ALGORITHMS FOR CREATING WORKS OF ART

Raitis Ozols
University of Latvia

In this work we consider ideas and algorithms that can be used for creating works of art using computer and programming. Author of this work uses such algorithms in computer programs that generates works of art as a pictures.

One of the simplest idea how to construct work of art with computer is to create an algorithm that generates a 3-tuples (x_{1k}, y_{1k}, c_{1k}), (x_2, y_2, c_2) of integers where k = 1, 2, 3, … and draw pixel with coordinates x_k and y_k, and colour c_k on screen for any k = 1, 2, 3, … In such a way can be constructed curves and different patterns. Second idea is to colour all pixels on computer screen such that pixel with coordinates x and y have colour c, where c is some function of x and y that takes integer values. Values of c can be obtained rounding some real-valued function f of x and y. $c = h(x, y)$

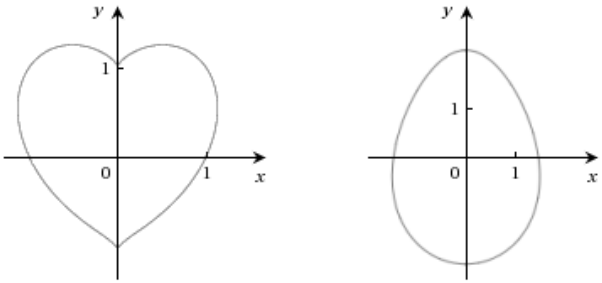


Figure 1.

Such functions *f* can be obtained making experiments with mathematical operations, using $f(x, y) = 0$ equations that gives interesting shapes and manipulating with them, making iterations etc. One can use equations that generates heart, egg etc. see Figure 1. These closed curves have equations $(x^2 + y^2 - 1)^3 - x^2 y^3 = 0$ and $y^2 + x^2 \cdot (1.2 + 1.5^y) - 5 = 0$.

There are many ideas how to obtain function using iterations. Author of this work often use such iteration algorithm: from the pixel coordinates x and y calculated some linear functions to obtain real numbers x_0 un y_0 and then making iterations. For example, this iteration can be made 10 times:

$$\begin{cases} x_{n+1} = f(x_n, y_n) \\ y_{n+1} = g(x_n, y_n) \end{cases}.$$

If 10 iterations in total will be made, then number c (which determine the colour of pixel with coordinates (x, y)) will be calculated depending on numbers x_{10} and y_{10}.

Iterative algorithms also allow to create fractals.

In this work we also consider a brief history of works of art creations by using computers and other electronic devices.

References

1. https://en.wikipedia.org/wiki/Software_art
2. https://en.wikipedia.org/wiki/Algorithmic_art

APPLYING MATHEMICAL IDEAS & PATTERNS IN LANDSCAPE PHOTOGRAPHY

Michael A. Radin
Rochester Institute of Technology

Photography is a Greek word and is translated as “Description of Light”. In particular, the purpose of each photograph is to portray how we interpret light and write an essay only in terms of light without words. Each photographer chooses his or her own theme in describing light; landscape photography, portrait photography, artitecture photography, and action photography. The first fundamental question to address: what is so unique about each photograph? Furthermore, what does a photographer see that nobody else sees? Moreover, how do we apply mathematical ideas and patterns in landscape photograhy to capture these unique moments and describe these unique moments in terms of light.

Keywords: *Reflection, Symmetry, Fractals, Patterns, Repetition of Patterns*.

Acknowledgements:
- American Mathematical Society.
- American Mathematics Teachers of Rochester Association
- Rochester Institute of Technology Faculty Institute on Teaching and Learning.
- Rochester Institute of Technology Faculty Learning Community.
- Liepaja University.
- University of Latvia.

CREATIVITY IN PROBLEMS RELATED TO DIFFERENCE EQUATIONS

Agnese Šuste
University of Latvia

Equation $x_{n+1} = f(x_n, x_{n-1}, \dots, x_{n-k})$, where n and k are nonnegative integers, is $(k+1)$st order difference equation with initial conditions $x_0, x_{-1}, \dots, x_{-k}$, whose solution is a sequence $\{x_n\}_{n=-k}^{\infty}$. The term *difference equation* is frequently used to refer to any recurrence relation.

Topics about recurrence relations are included in the school curricula, for example, students learn about arithmetic and geometric progressions, a little about other recursively defined sequences, Fibonacci numbers and fractals (see [1]). Problems about recurrence relations also are included in mathematical competitions (see collection of problems used in various contests and Olympiads in Latvia [2]).

There is a variety of views and studies on creativity. Mathematical creativity in school mathematics is usually connected with problem solving or problem posing (for example see [3]). Students can develop their creativity, for example, by generating multiple answers to a problem (if they exist), by generating multiple solutions to a given problem, by exploring several solutions to a problem and generating a new one, by generating multiple problems from a given situation. The elegance of a solution also is an indication of mathematical creativity.

Can problems related to difference equations be creative? See [4] about mathematical classroom problem posing from the perspective of mathematical creativity with examples of difference equations. Students performance when solving some problems related to recurrence equations are analyzed in [5].

Examples about recurrence relations in mathematical competitions and in mathematical circles, student solutions and results will be presented.

References

1. *Mācību priekšmetu programmu paraugi.* Available: http://visc.gov.lv/vispizglitiba/saturs/programmas.shtml
2. *Uzdevumu arhīvs.* Available: http://nms.lu.lv/uzdevumu-arhivs/latvijas-olimpiades/
3. Silver, E. A. *Fostering Creativity through Instruction Rich in Mathematical Problem Solving and Problem Posing.* ZDM, Volume 29, Issue 3, 1997, pp 75-80.

4. Pelczer, I. *Problem posing in the classroom and its relation to mathematical creativity and giftedness.* 11th International Congress on Mathematics Education. TG6: Activities and Programs for Gifted Students, 2008. Available: http://tsg.icme11.org/document/get/582
5. Barbosa, A. *Developing students' flexibility on pattern generalization.* In: Proceedings of 6th International conference on Creativity in Mathematics Education and the Education of Gifted Students, 2011, pp 18-25.

DEVELOPMENT OF PROGRAMMING SKILLS FOR IN-SERVICE TEACHERS OF COMPUTING USING MOODLE

Vineta Tomsone, Dzintars Tomsons
Liepāja University

The current paper describes and analyses the professional development course for in-service teachers of Computing of elementary and primary schools. The course consists both of face-to-face lessons in classroom, participants' independents learning between the classes, distance learning by videoconferences, and learning activities in virtual learning environment Moodle. The Moodle was designed as repository of teaching materials accessible also after the completion of the learning course.

Information and Communication Technology (ICT) is increasingly having pervasive role and presence in the educational milieu as it continues to shape all aspects of our lives (Abuhmaid, 2011). There is wide agreement that it is often the teachers who make decisions as to whether and how to use Information Computer Technology (ICT) in their teaching, and that when they do, they can act as change agents for technology integration (Liu & Kleinsasser, 2015). Educators of pre-service and in-service teachers should assist their decision making providing them with knowledge about the variety of the ICT tools and train them how to use these tools.

The necessity to develop teachers ICT competencies has been directed also by the fact that, in the recent years, the most of children are familiar with computer at the beginning of their primary school education (Zaharija, et al., 2013). Due to the mentioned reason, the pilot project has been implemented in several Latvian elementary and primary schools introducing the enhanced training of ICT skills in early age. The essential role is defined for algorithms and programming. Computer programing is an important process consisting verbal and numeral skills together (Kert & Erkoc, 2011). (Zaharija, et al., 2013) suggests that adopting programming concepts should help them in their further education in areas that require logical thinking and problem solving.

In 2015, academic staff members of Liepāja University trained about 180 in-service teachers by 160 hours program. The full paper and presentation is going to describe and analyse their experience.

References

Abuhmaid, A. (2011). ICT training courses for teacher professional development in Jordan. The Turkish Online Journal of Educational Technology, October, Vol. 10, Issue 4. Available: www.tojet.net/articles/v10i4/10420.pdf

Kert, S.B., Erkoc, M.F. (2011). Computer Games as Programmıng Educatıon Tools. Proceedings of the International Conference "The Future of Education", Florence, Italy, Available: http://conference.pixel-online.net/edu_future/common/download/Paper_pdf/ LGA07-Kert.pdf

Liu, M. H., Kleinsasser, R. C. (2015). Exploring EFL teachers' CALL knowledge and competencies: In-service program perspectives. Language Learning & Technology, No.19 (1), pp. 119–138.

Zaharija, G., Mladenivic, S., Boljat, I. (2013). Introducing basic programming concepts to elementary schoolchildren. Social and Behavioral Sciences, No. 106, pp. 1576 – 1584.

EDUCATIONAL COMPUTER-BASED GAME AS THE FIRST SOFTWARE DEVELOPMENT PROJECT FOR IT STUDENTS

Dzintars Tomsons, Inta Znotiņa
Liepāja University

The current paper describes the application of game development as a learning tool in software engineering for the first year Computer Science students. In higher education institutions, the games are used in various ways to promote the engagement of students in learning process and provide them with the working experience. "Digital games are seen as excellent tools for facilitating and supporting situated learning of students" (Admiraal, et/al., 2011).

There are several reasons to include the game development project into Computer Science curriculum. (1) The growing popularity of the computer-based (or video) games. Global video game market expenditure has grown from 75 billion US dollars in 2011 to 112 billion US dollars in 2015 (Statista, 2016). The age of players becomes older; in 2015, 29% of games are under 18; average age of US gamers is 31. (Lofgren, 2015). (2) Most of students are familiar with games and game-playing. "76% of students (82% of full-time and 69% of part-time students) report playing games" (Lenhart, et al., 2008). Thus, they do not need to study the scope of the project, but they can put more effort on creativity and development. (3) Computer-based game is an example of complicated interactive software system. "Interactive computing focuses on real-time interaction ("dialog") between computers and people, and the technologies that enable this." (Grinter, 2011). That includes most popular programs, such as word processors, spreadsheets, etc. The interactivity is the most essential feature of the game by definition; otherwise - non-interactive game would be animated movie. (4) Computer-based game serves as integrative platform for applying knowledge and skills of programming, design of user graphic interface, identification of software use cases, development of computer animation and multimedia applications, and writing of user documentation. At the Liepāja University, these competencies the first year students have been training in the courses of Programming, Introduction to Computing, Development of Web-based Software, Computer Graphics and Animation, and Laws and Standards of ICT industry. (5) Due to complicity of computer-based game, it is suitable for students' teamwork.

The full paper and presentation is going to describe and analyse the experience of managing computer-based game development projects by the academic staff of Liepāja University. The case study involves annual projects of the first year undergraduate students since 2011.

References

Admiraal, W., Huizenga, J., Akkerman, S., ten Dam, G. (2011). The concept of flow in collaborative game-based learning. *Computers in Human Behavior*, 27, 1185-1194.

Grinter, B. (2011) What is Interactive Computing? Retrieved from: https://beki70.wordpress.com/2011/01/27/what-is-interactive-computing/

Lenhart, A., Jones, S., Macgill, A. (2008) Adults and Video Games. Retrieved from: http://www.pewinternet.org/2008/12/07/adults-and-video-games/

Lofgren, K. (2015). 2015 Video Game Statistics & Trends. Who's Playing What & Why?Retrieved from: http://www.bigfishgames.com/blog/2015-global-video-game-stats-whos-playing-what-and-why/

Statista (2016). Global video game market expenditure from 2011 to 2015, by segment Retrieved from: http://www.statista.com/statistics/273597/global-video-game-market-expenditure/

MAZE TASKS FOR LEARNING OF BASICS OF ALGORITHMS AND PROGRAMMING

Dzintars Tomsons, Inta Znotiņa, Sandra Anohina
Liepāja University

The current paper describes an approach to teaching algorithms and programming for pupils of elementary school. (Zaharija, et al., 2013) suggests that adopting programming concepts should help them in their further education in areas that require logical thinking and problem solving. Due to advancement of technologies, more equipment, requiring at least minimal programming skills, appears in labour market and daily life.

Labyrinth is very grateful playground for different problems to be solved writing sequence of simple instructions in order to lead robot, animal, of another creation to target place. There is a lot of software applications available solving such exercises. Most of them provide built-in set of tasks that must be solves, e.g., LightBot, RobotMind, etc. Teachers and students of Liepāja University also have developed several software applications for solving of maze problems. In order to lead the creation through the maze, the child usually must write the instruction "go forward" or "turn right / left". Depending on the specific software application, the player has possibility to apply the standard constructions of algorithm, such as, loops, branching, sub-algorithms, etc.

The additional advantages have been provided by the educational robots. "Robots can be an entertaining platform to learn about computers, electronics, mechanical engineering" (Mubin, et al., 2013). Robots and computers provide powerful motivational forces in the classroom (Meyer, 2010). Maze is subject for developing both simple algorithms, and advanced ones to be completed by the robots.

The full paper and presentation is going to describe and analyse the experience of the academic staff of Liepāja University. The case study involves both development computer-based learning applications, their use for training of in-service teachers of Computing, and extra-curricular activities for schoolchildren of grades 2 to 6.

References

Mubin, O., Stevens, C.J., Shahid, S. Mahmud, A., Dong, J.J. (2013). A review of the applicability of robots in education. Technology for Education and Learning. Available: http://roila.org/wp-content/uploads/2013/07/209-0015.pdf

Meyer, D. (2010). Math class needs a makeover. Available: http://www.ted.com/talks/dan_meyer_math_curriculum_makeover.html

Zaharija, G., Mladenivic, S., Boljat, I. (2013). Introducing basic programming concepts to elementary schoolchildren. Social and Behavioral Sciences, No. 106, pp. 1576 – 1584.

CATS APPEAR EVERYWHERE IN MATHEMATICS!

Ingrīda Uļjane, Aleksandrs Šostaks
University of Latvia

Category theory, or the *theory of cats*, as it was nicknamed by one of the main contributors to this theory and a passionate cat-fancier Horst Herrlich [1,2], originates from the famous paper by S. Elenberg and S. Maclane [3]. The notion of a category was first invented as a tool to deal with complicated mathematical problems of algebraic classification of topological manifolds. However, after some decades, it turned out to become a universal mathematical concept, which successfully serves as a foundation, both theoretical and philosophical, for the whole body of modern mathematics. And indeed, special and natural examples of cats can be found, everywhere, in all branches and areas of mathematics!

It is the aim of this talk to explain the meaning of the notion of a category and of some closely connected with it notions by several simple examples related to arithmetic, algebra and geometry. We expect that all these examples will be clear for interested senior pupils and, all the more, for the first year students in mathematics. We also hope that these examples will promote a more creative attitude of pupils and students to the study of mathematics and help to get them a sense of mathematics as a whole body and a unique science and not only as, say, separately existing arithmetic, algebra, and plane geometry.

References

1. J. Adamek, H. Herrlich, G.E. Strecker, Abstract and Concrete Categories: The Joy of Cats. Wiley-Interscience Publ. New York, 1990. Internet version http://katmat.math.uni-bremen.de/acc
2. H. Herrlich, G.E. Strecker, Category Theory, Heldermann Verlag, 1979.
3. S. Elenberg, S.Mac Lane, General theory of natural equivalences, Trans. Amer. Math. Soc., vol. 38 (1945) 231-294.

ELECTRICAL ENERGY STORAGE DESIGN AND PARAMETER OPTIMIZATION

Uldis Žaimis
Liepāja University

The development of non-traditional forms of electrical energy generation is becoming increasingly crucial in the energy storage problem. Multiple uses of existing solutions (Ni-Cd, NiMH, Li-Ion, Li-Pol, etc.) have a number of disadvantages, such as high costs, lack of raw materials, environmentally unfriendly production, and a recirculation problem at a relatively high energy density.

Often, especially in the stationary conditions, it is advantageous to use energy storage (accumulators, batteries, supercapacitors) made from inexpensive, affordable, environmentally friendly materials, although with a lower density of stored energy. Such devices can be manufactured with MnO_2 and are C-based, making the processing of the substance surface area increase significantly for current collectors using metal (Zn, Cu) electrodes or graphene coatings. Experiments have been conducted finding optimal electrolyte on the basis of pure sodium sulphite or sodium chloride impurities.

Keywords: *Energy Storage, Battery, Accumulator*

GOLD - SECTION IN INTERACTIVE USER INTERFACE DEVELOPMENT

Uldis Žaimis, Anita Jansone
Liepāja University

The days when only specialists worked with programs and the functionality was the most important have long passed. In today's competitive environment, an important marketing component is reliability in which the only tangible part of the program, the interface, plays a large role. Purely psychological, it is important for the users' visibility, correctness and can even be argued, friendliness. This is determined by the elements of visibility and components' location in intuitively expected places, design integrity, tone and choice of characteristic elements which, together, create a feeling of sympathy or antipathy from the software user. Regularities, which ultimately determine the user's subconscious reactions, are found in natural formations - from the most basic proportions of plants to more sophisticated self-arranged compositions.

The harmony of the structures of natural systems, that is, their internal organization, is subject to certain mathematical laws. Objective world stable stationary states corresponding to particular figures, called generalized gold sections. These figures are all the structure of the invariant, which are embodied by the dialectic structure of the world and the different variations that can be observed at every step of nature. It is important to note that with the generalized Golden Section, not only is the well-known ratio of 0.618 understood, but a whole line of relationships, where like in music, a single major or minor note can be played, and another can stand out from the whole ensemble.

The main golden section applications in interface design are space division, caption-font size ratios, restrictive areas (buttons), title queue length, color tone saturation ratio, and cell location coordinates.

In this paper, we propose a certain recomendations for develop of user - friendly interface.

Keywords: *Gold Section, Design, Interface, Computer Software*

GRAPHENE OXIDE PRODUCTION FOR FURTHER OPERATIONS IN LIEPAJA UNIVERSITY WITHIN COOPERATION WITH "DITI"

Maksims Žigunovs
Liepāja University

Graphene and approach to produce grapheme oxide was used

The graphene is a one layer regular net of graphite entities. This kind of net has several conditions can be used by humankind quite wisely.

These conditions are:

•) High electron mobility
•) High thermal conductivity
•) High tensile strength

By using this material the high capacity batteries can be developed to store more electricity than nowadays batteries do.

The production of the graphene oxide is tightly connected to pure grapheme production as the result of the grapheme oxide enhancement.

The difference between the graphene and graphene oxide is several graphite elements connected with another elements such as OH and O elements making oxides inside the graphene net.

Figure 1 demonstrates the graphene net and figure 2 demonstrates the graphene oxide net.

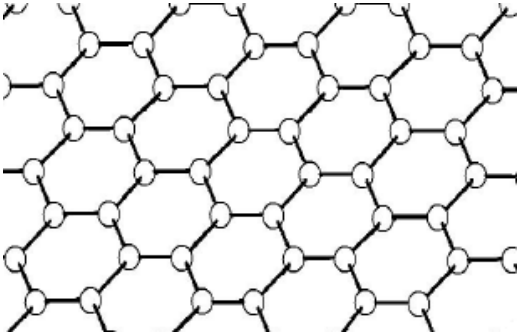


Fig 1: Graphene net example.

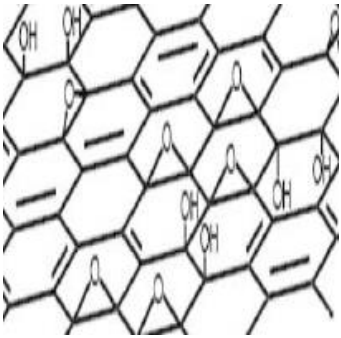


Fig 2: Graphene oxide net example.

The use approach is commonly known as a low cost high approach. For the base of grapheme oxide the graphite powder was taken.

The main direction of the reaction was made to produce graphene from graphite was hydro thermal effect within oxygen source and acidic environment to make aggressive OH and O elements integration inside graphite layers.

There were several experiments oriented on the concentrations of the acids and oxygen source values and it was found that as more the acidic is the environment and as bigger the oxygen source as more aggressive the OH and O integrations in the graphite layers.

Figure 3 is the possible graphene layers picture taken using the optical microscope.

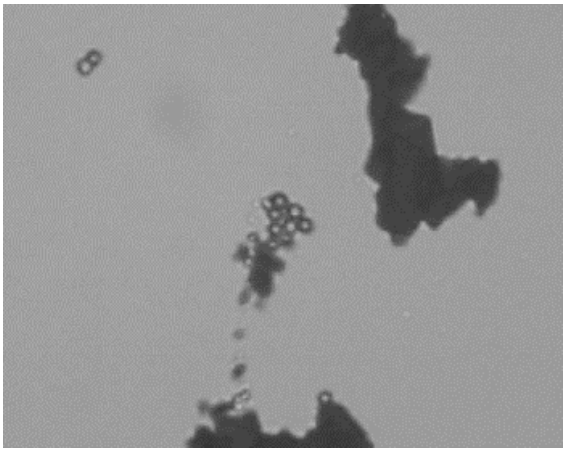


Fig 3: Possible grapheme oxide parts small group almost in the middle of the Figure.