

UNIVERSITÄT
BAYREUTH



DISSEMINATING INQUIRY-BASED SCIENCE
AND MATHEMATICS EDUCATION IN EUROPE

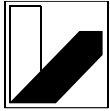
European Training Session
Deepening the Understanding of Inquiry in Mathematics

European Training Session

Deepening the Understanding of Inquiry in Mathematics

15 - 17 February 2012
Bayreuth, Germany





Deepening the Understanding of Inquiry in Mathematics

Schools must provide for more than just mere knowledge, they must provide education. Mathematical education consists, among other things, of the following elements:

- appreciation of mathematics
- confidence in one's own ability to be able to deal with mathematics
- application of mathematical knowledge to mathematical and non-mathematical tasks
- the ability to use mathematics as a form of communication and expression
- mathematical thinking.

A pedagogy using an inquiry-based approach establishes successful ways for realising these elements. There are certain fundamental guiding concepts that typify instruction of inquiry-based (respective problem-oriented) mathematics education at school.

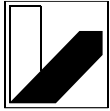
These include

- less knowledge acquisition, more problem-solving instruction,
- less orientation towards calculation, more focus on comprehension,
- learning mathematics in context ("storytelling", mathematics as a cultural asset),
- attention not only to results but also to the learning strategies and learning processes.

The seminar will cover manifold aspects of inquiry based mathematics education, taking into account the aims named above.

Structure and themes of the European Training Session

- Keynote presentations given by international experts on mathematics education
- General themes of the workshops
 - Rich learning tasks connecting mathematics and "the real world"
 - Inquiry based mathematics education in primary school
 - Hands-on mathematics
 - Dynamic mathematics as instrument to foster inquiry-based and problem oriented mathematics
 - Cross disciplinary approaches in mathematics education



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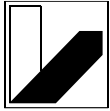
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Accomodation and Venue

Arvena Kongress Hotel
Eduard-Bayerlein-Straße 5a
95445 Bayreuth
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Telefax: + 49 (0) 921 / 727 - 115
Mail: info@arvenakongress.de
<http://www.arvena-kongress.de/en>





Travelling

By plane (airport Nuremberg)

Bayreuth is located about 90 km northeast of Flughafen Nürnberg (Nuremberg Airport).

The best way to get from Flughafen Nürnberg to Bayreuth is going by train.

- Buy a ticket of the VGN (Verkehrsverbund Großraum Nürnberg) at the airport in Nuremberg. Take the tariff 10+T (9,20€). This ticket is valid for the whole travel to Bayreuth (underground + train + bus).
- At the airport, take the Line 2 underground to Hauptbahnhof (Central railway station Nuremberg).
- The connection takes 12 minutes.
- From Nuremberg Hauptbahnhof a train departs to Bayreuth every hour between 06h00 and 24h00.
- At Bayreuth Hauptbahnhof, take bus 301 (direction Jakobshof, every 20min) to Berliner Platz

Be careful:

Some trains from Nürnberg Hauptbahnhof to Bayreuth are split at the stop Pegnitz. Please make sure in Nuremberg that you are in the part to Bayreuth. You will find information at the platform. At the windows and the doors of the waggons you can read the destination: Choose Bayreuth.

By car

The easiest way to reach the hotel is the A9 motorway "Bayreuth-Süd" exit. Drive towards "Stadtmitte" (town centre) and follow the brown hotel signs to the Arvena Kongress Hotel or "Arbeitsamt" (job centre).

The Ecological Botanical Gardens of the University of Bayreuth



The ecological-botanical garden was founded as a central institution of the University of Bayreuth in 1978. Within its boundaries it accommodates over 10 000 plant species from all over the world. They are mostly grown in environments closely resembling their natural habitats. Not only is the diversity of plants displayed but also their ecological relationships and functions to contribute to the important task of nature conservation.

The central task of the ÖBG is to support research and teaching of the university. It provides a range of facilities for educational and research purposes as extensive sample areas (8ha), a modern lysimeter, several ground water basins, a weather station, laboratories, a herbarium, a seed collection as well as an extensive library which forms part of the main university library. Every semester the scientific garden staff offers independent courses.

Apart from research and teaching the garden serves the public for education and recreation.

The Greenhouse of tropical high mountain plants – unique worldwide!

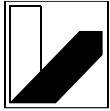
The alpine habitat of tropical high mountain regions (3500 to 5000 m above sea level) is characterised by extreme environmental conditions and a unique flora. It has been repeatedly tried to cultivate plants of these regions in botanical gardens. These trials remained unsuccessful apart from some species with very powerful competitive features.

Botanists of the University of Bayreuth have investigated the vegetation of the high mountain region of East Africa since 1979. In particular the adaptation of plants to this extreme habitat has received a lot of attention. From the results the climate and soil conditions for the greenhouse have been worked out together with staff of the TU Munich. Some very important factors are:

- an alternating day/night rhythm of 12 hours throughout the entire year
- the lowering of the night temperature down to the freezing point throughout the entire year and
- a high light intensity with high fractions of UV and red light.

The simulation of these climate factors as well as the cultivated plants make this greenhouse unique worldwide. Therefore it is of very high value for scientific research and experimental demonstration purposes.





Programme

Wednesday, February 15th, 2012

13:00 Registration

Plenary Session

13:30 Welcome by Peter Baptist and team

13:45 Paul Drijvers (Netherlands)
Experiences in Inquiry Based Mathematics Teaching

14:30 Peter Baptist (Germany)
Maths meets Art

15:15 Coffee Break

Workshops Session 1

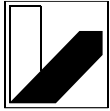
16:00 WS 1: Petra Ihn-Huber, Volker Ulm (Germany)
Inquiry Based Mathematics Education in Primary School

16:00 WS 2: Dagmar Raab (Germany)
Harmonic Oscillations: A Fascinating Theme for Exploring
Maths and Science in Realistic Situations

16:00 WS 3: Roman Hasek/ Vladimira Petraskova (Czech Republic)
The Necessity of Financial Literacy in Contact with
Advertisement

17:45 End of workshops

18:30 Dinner



Thursday, February 16th, 2012

Plenary Session

9:00 Albrecht Beutelspacher (Germany)
Mathematical Experiments

10:00 Coffee Break

Workshops Session 2

10:30 WS 4: Fibonacci Teacher Trainers (Germany)
Inquiry Based Mathematics in Teacher Training and Every
Day Classroom Teaching

10:30 WS 5: Liz Meenan (United Kingdom)
Be a Paper Mathemagician – 2D and 3D

10:30 WS 6: Jenny Sendova/Petar Kenderov (Bulgaria)
Dynamising the Mathematics Classes

12:15 Lunch

Workshops Session 3

13:30 WS 7: Petra Ihn-Huber, Volker Ulm (Germany)
Inquiry Based Mathematics Education in Primary School

13:30 WS 8: Libuse Samkova (Czech Republic)
Mathematics in a Lab

13:30 WS 9: Peter Gallin/ Mike Rohr/ Markus Jetzer (Switzerland)
How to Create Adequate Tasks for Everyone in IBME

15:15 End of workshops

15:45 Visit of the Green Houses (bus transport)

19:00 Dinner

Friday, February 17th, 2012

Plenary Session

9:00 Pavel Pech (Czech Republic)
On Inquiry Based Teaching Geometry with Computer in Pre-
Service Teacher Training

Workshops Session 4

9:45 WS 10, part 1: Liz Meenan (United Kingdom)
Be a Paper Mathematician – 2D and 3D

9:45 WS 11, part 1: Jenny Sendova/ Petar Kenderov (Bulgaria)
Stimulating Math Research at School Age

9:45 WS 12, part 1: Hana Mahnelova/ Libuse Samkova (Czech
Republic)
Czech Teachers and IBSME

10:45 Coffee Break

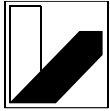
11:15 WS 10, part 2: Liz Meenan (United Kingdom)
Be a Paper Mathematician – 2D and 3D

11:15 WS 11, part 2: Jenny Sendova/ Petar Kenderov (Bulgaria)
Stimulating Math Research at School Age

11:15 WS 12, part 2: Hana Mahnelova/ Libuse Samkova (Czech
Republic)
Czech Teachers and IBSME

12:00 Final session: Results and perspectives

12:45 Lunch



Keynotes

Paul Drijvers

Freudenthal Institute, Utrecht University, the Netherlands

An Inquiry into Inquiry-Based Mathematics Education

Nowadays, inquiry based mathematics education (IBME) is a 'hot topic' amongst educators, teachers and researchers. But what is really meant by this notion? Which characteristics define it? What are the challenges of IBME for the learner as well as for the teacher? In this presentation, we will address these questions through examples and observations, and thus experience a first inquiry into IBME.

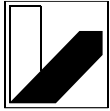
Peter Baptist

University of Bayreuth, Germany

Maths meets Art

The paintings have titles like "Hardy's Taxi", "A Walk with Mr. Euler", "Girasole" and "Sumer". Actually their style is different, but they all have a common background that one doesn't expect behind these titles: mathematics. They have been created by the Swiss artist Eugen Jost. His pictures tell stories, they stimulate interest for mathematical results and relationships just as for the persons who were engaged in these topics. They give opportunities to a lot of questions, and asking questions is the beginning of every scientific development.

A visit of our art gallery clearly shows: Mathematics is more than arithmetic and computational skills, mathematics is the study of patterns and relationships, a way of thinking and a science that is characterized by order and internal consistency, a language that uses carefully defined terms and symbols, a tool that helps to explain the world.



Albrecht
Beutelspacher

University of Gießen and Mathematikum Gießen, Germany

Mathematical Experiments

Being amazed is the first step to get behind the mathematical secrets.

Albrecht Beutelspacher is an advocate of more imagination in maths teaching with a real "hands-on" approach to mathematical questions. He sees maths quite simply as the art of discovering things through independent thought. His interactive talk will show a playful access to the world of numbers – mathematics as an emotional experience.

Professor Beutelspacher has founded the Mathematikum in Giessen, a very big hands-on mathematics exhibition. But Mathematikum is much more than a mathematical museum or exhibition in the common or traditional sense. Under the motto "learning by doing" the visitors are invited to learn mathematics using their hands, to think about mathematical experiments and phenomena and to find out mathematical secrets.

Pavel Pech

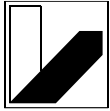
University of South Bohemia, Czech Republic

On Inquiry Based Teaching Geometry with Computer in Pre-Service Teacher Training

In the last four decades various computer algebra systems (CAS) appeared. At the same time dynamic geometry systems (DGS) were developed. For this reason the way we teach mathematics and the mathematical curriculum is changing.

In the talk experiences from a geometric seminar of pre-service teacher training which I lead for several years at the University of South Bohemia are presented.

New methods of proving, deriving and discovering geometric theorems including searching for loci of points are shown. With DGS we describe a problem and verify some related conjectures, with CAS we do rigorous proofs. We demonstrate it in a few examples from elementary geometry with the stress on inquiry based teaching.



Sessions and Workshops

Session 1

Workshop 1 **Inquiry Based Mathematics in Primary School**

Petra Ihn-Huber, Volker Ulm
University of Augsburg, Germany

The workshop will show what inquiry based mathematics education in primary school can be. The participants will work on topics like "Patterns of Fibonacci Numbers", "Mathematics in the City" or "How many are 10.000?".

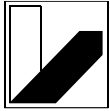
This will demonstrate how IBME can help pupils to acquire a variety of mathematical competences and to develop their mathematical thinking.

Workshop 2 **Harmonic Oscillations: A Fascinating Theme for Exploring Maths and Science in Realistic Situations**

Dagmar Raab
University of Bayreuth, Germany

Using mathematics for a deeper understanding of physical phenomena is a traditional approach in physics lessons at secondary schools. On the other hand real life examples can help to implement an inquiry approach in mathematics lessons.

The workshop will show that it is possible to find out physical laws and new mathematical aspects in parallel, based on the example of harmonic oscillations. Suggested real experiments will lead to a concept of cross-curricular inquiry.



Workshop 3 **The Necessity of Financial Literacy in Contact with Advertisement**

Roman Hasek/ Vladimira Petraskova
University of South Bohemia, Czech Republic

We face various forms of advertisements for goods, services, financial products etc. almost at every our step. Their formulations predominantly comply with the effort to give a consumer the impression of an extraordinariness of such offers. This purpose is often achieved by the use of unbalanced and ambiguous formulations that mostly allow variant interpretations. Therefore the attitude of a consumer towards advertisements should be based on a solid level of his/her financial literacy and critical thinking skills to enable him/her to consider the real advantages of their offers. In the workshop we will use several real-world advertisements to induce problem situations of graduated complexity. We will show that we can increase student's financial literacy and develop their critical thinking skills through the discussions on possible solutions of such situations.

Session 2

Workshop 4 **Inquiry Based Science and Mathematics Education in Teacher Training and Every Day Classroom Teaching**

Bernhard Sauermann, Ulf Gräber, Harald Haidl
Bavarian Fibonacci Teacher Trainer, Germany

How ist IBSME fostered in Bavarian secondary schools? We will give you a short overview of how our teacher training is organized and will present some examples, that have been successful in lessons. After that, the participants will have the opportunity to experience part of such teacher-training for themselves.



Workshop 5 **Be a Paper Mathemagician – 2D and 3D**

Liz Meenan

Leeds University, United Kingdom

Paper folding is a favourite pastime for both children and adults. However it is much more than just a creative hobby. It can be used in an entertaining and thought provoking way to learn mathematics especially its geometric aspects.

Can you fold a square from 'A' size paper and make a 7-piece tangram?

Can you make Islamic patterns using folded squares, triangles and other polygons?

Can you work out if 'A' size paper is an example of a golden rectangle?

Can you fold a pyramid from an envelope?

Can you pull-up a net and hold a cube, a pyramid or even an octahedron in your hand (all made without using any glue)?

Come along to this innovative and practical session to find out.

Workshop 6 **Dynamising the Mathematics Classes**

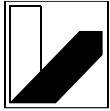
Jenny Sendova/ Petar Kenderov

Bulgarian Academy of Sciences, Bulgaria

The workshop will demonstrate two aspects of "Dynamising" – using dynamic mathematics software and making the teaching process more interactive and more involving for the students.

The participants will receive a disk with learning environments for different age groups the Bulgarian Fibonacci team has developed for teacher training courses and for direct implementation in a class setting. They will have "hands-on" experience on several topics including:

- New formulations of classical problems – try with parallelograms
- In the style of the ancient Egyptians – can we complain about operations with common fractions?
- Harnessing informatics for the design of tessellations
- Making extremal problems not so extremal - inscribing two circles in a rectangle



Session 3

Workshop 7 **Inquiry Based Mathematics in Primary School**

Petra Ihn-Huber, Volker Ulm
University of Bayreuth, Germany

See workshop 1

Workshop 8 **Mathematics in a Lab**

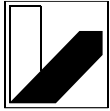
Libuse Samkova
University of South Bohemia, Czech Republic

Have you visited recently a chemical or biological lab lesson? Do you know what students are doing there? Are they prepared properly for these lessons from mathematical point of view, from mathematics lessons? And what about you, can you correctly estimate volume ratios of essential solids? We shall invite GeoGebra to help us with this uncommon matter.

Workshop 9 **How to Create Adequate Tasks for Everyone in IBME**

Peter Gallin, Mike Rohr, Markus Jetzer
University of Zurich, Switzerland

Central to the idea of IBME in Switzerland is an approach called Dialogic Learning. Within this framework, it is essential for children and students to receive precise instructions with regards to writing their journal. To this end, the tasks need to satisfy three conditions:
They refer to a relevant, interesting, rather large and yet untreated subject within the ordinary mathematical curriculum. (Concept of a core idea)



Although they focus on one particular theme, they must allow various levels of treatment. (Concept of fruitful use of heterogeneity) The instructions are clear, yet no single correct answer is expected. (Concept of openness)

Session 4

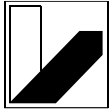
Workshop 10

Be a Paper Mathemagician – 2D and 3D

Liz Meenan

Leeds University, United Kingdom

See Workshop 5



Workshop 11 **Stimulating math research at school age**

Jenny Sendova/ Petar Kenderov
Bulgarian Academy of Sciences, Bulgaria

The workshop focuses on a special kind of inquiry based mathematics education, viz. mentoring highly achieving pupils from the secondary school to work on research projects in mathematics and informatics.

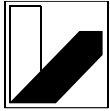
Yanitsa (a representative of the Bulgarian High School Institute of Mathematics and Informatics) will discuss the experience she gained when working on two research projects:

As different as they may be, any two mathematical projects have a few things in common – inquiry, exploration, experimentation and generalisation. For example, could a purely geometrical project, done with no more than angles, parallel lines, similarities, etc. relate to a project about algorithms, formulae, numbers in various numerical systems, inequalities, linear functions and more? Of course it could.

The projects I'm talking about are "Pompeiu's Triangle", which I did when I was in 10th grade, and "Mad Elevators" – my most recent one, when I'm 12th grade.

Pompeiu's theorem states that for every point in the plane of an equilateral triangle the distances from the point to its vertices always can form a triangle. Through generalisation both regarding the triangle's type (through isosceles to a random one) and the number of sides/vertices (through a quadrilateral to a polygon) this at first sight simple theorem got morphed into a similar one about a point and a polygon. Of course, a lot of failures were an unfortunate part of the process but failure goes along with experimentation.

On the contrary, mad elevators are numbers, functions and nothing else. But as every such elevator is characterised by an odd number K , the inquiry starts by seeing what happens when $K=3$ and $K=5$, and only after that pursuing a general conclusion. These elevators had to be explored: on the basis of a simple algorithm, a mathematical explanation and a model had to be found and proved. Moreover, the project spread like the branches of a young tree – posing many different questions on already found facts and looking for the answers, which then were questioned again in a different direction.



The participants will discuss possible ways for stimulating students to see a math problem/project not just as a task that has to be done in order to receive an excellent mark or a diploma, or even a scholarship but rather as an adventure. And to enhance students' understanding that whether it's geometry, graph theory, algebra, topology, or number theory, all math projects have several things in common – inquiry, experimentation, exploration, studying special cases and generalisation.

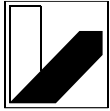
Workshop 12

Czech Teachers and IBSME

Hana Mahnelova/Libuse Samkova

University of South Bohemia, Czech Republic

Hana and Libuse will show IBSME from the perspective of a Czech secondary school teacher, the teacher involved in the Fibonacci project. Observations, comments, opinions, suggestions and examples of learning environments will be starting points for discussion as well as the role of in-service teacher training.



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Local organisation and contact

Dagmar Raab

If there are any questions please contact me:

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