The Fibonacci Project

DISSEMINATING INQUIRY-BASED SCIENCE
AND MATHEMATICS EDUCATION IN EUROPE

The Fibonacci Project – First European Conference

Raising Awareness about Inquiry Based Science and Mathematics Education in Europe

21-22 September 2010 , University of Bayreuth, Germany

SEVENTH FRAMEWORK PROGRAMME

This project has received funding from the European Union's Seventh Framework Programme.

Tuesday, 21 September 2010

08:30 Bus shuttle from Arvena and Ramada Hotel

09:00 Registration — Conference Office (Foyer)

Welcome

Peter Baptist
09:30 Welcome and presentation of the conference programme — H 18

Stefan Jablonski
09:40 Opening address — H 18

Peter Baptist (Chair)
Plenary session 1:
Science and mathematics education in Europe: a challenge and a proposal

Dusan Sidjanski
09:50 European cultural heritage and the role of science and mathematics — H 18

David Jasmin
10:20 Presentation of the Fibonacci project — H 18

10:40 Coffee break — Foyer

Michèle Artigue (Chair)
Plenary session 2: Relevance of mathematics and science education for society

Ulrich Trottenberg
11:00 Mathematical education meets reality and future — H 18

Pierre Léna
11:45 Science for all, a reasonable goal? — H 18

12:30 Lunch — Foyer

Parallel workshops

Peter Baptist, Petar Kenderov, Kenneth Ruthven
14:00 Deepening the specificities of scientific inquiry in mathematics — S 82

Tuesday, 21 September 2010

Wynne Harlen, David Jasmin
14:00 Deepening the specificities of scientific inquiry in natural sciences H 17

Ida Guldager, Phil Hingley, Petra Skiebe-Corrette
14:00 Implementing and expanding a reference centre S 80

Janet Ainley, Tina Jarvis
14:00 Cross disciplinary approaches H 19

Leo van den Bogaert, Konrad Krainer, Hannu Salmi
14:00 Using the external environment of the school H 20

16:00 Coffee break Foyer

Wynne Harlen (Chair)
Plenary session 3: Reports on the workshops

16:30 Short summaries of the five workshops H 18

17:15 Bus shuttle to Arvena and Ramada Hotel

18:45 Bus shuttle from Arvena and Ramada Hotel

Evening Event

19:30 Conference Dinner Thurnau Castle

23:00 Bus shuttle to Arvena and Ramada Hotel

Wednesday, 22 September 2010

09:00	Bus shuttle from Arvena and Ramada Hotel	
09:30	Poster session	Foyer
09:30	Arts exhibition	Foyer
09:30	Press conference	S 78

Peter Baptist (Chair)

Plenary session 4: Mathematics and science education – political goals

Ludwig Spaenle

10:00 Mathematics and science education – a key factor for our future — H 18

10:30	Coffee break	Foyer

Pierre Léna (Chair)

Plenary session 5: Inquiry-based science and mathematics education

Günter M. Ziegler

11:00 How can mathematics solve problems? — H 18

Wynne Harlen

11:45 Implementing inquiry-based learning in science education — H 18

Michèle Artigue

12:15 Science, mathematics and ICT — H 18

Agueda Gras-Velazquez

12:45 Presentation of Scientix — H 18

13:15	Lunch	Foyer

Parallel workshops

Ed van den Berg, Franz X. Bogner, Dan Sporea

14:30 ICT and virtual environment for science education — H 19

Peter Baptist, Paul Drijvers, Volker Ulm

14:30 ICT and virtual environment for mathematics education — H 20

Wednesday, 22 September 2010

Marie-Claire Certiat, Patricia Corieri, Wolfgang Gollub
14:30 Involving the private sector (foundations and companies) in science and mathematics education — S 80

Gerd Bergman, Martin Braund, Anders Jidesjö
14:30 Transition from primary to secondary school — H 17

György Darvas , Eugen Jost, Carsten Miller
14:30 Arts and inquiry-based science and mathematics education — S 82

16:00 Coffee break — Foyer

Closing session

Konrad Krainer
16:30 Summary of the conference — H 18

Peter Baptist
16:50 Conclusions and perspectives — H 18

17:30 Shuttle to the historic centre of Bayreuth

Closing ceremony — Government building of Upper Franconia

Wilhelm Wenning
18:00 Welcome address

18:15 *Peter Baptist*
Bayreuth impressions

18:30 Reception

Concert & guided tour — Margravial Opera House

19:30 Wooden Voices

21:00 Bus shuttle to Arvena and Ramada Hotel

Michèle Artigue

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After a PHD in Mathematical Logics and mathematical research in that area, Michèle Artigue progressively entered the field of research in mathematics education, thanks to her involvement in the activities of research, innovation and teacher training developed at the Institute of Research in Mathematics Education at the University Paris 7. Beyond theoretical contributions on the relationships between epistemology and didactics, her main research areas have been the teaching and learning of mathematics at university level. She is currently full professor at the Mathematics Department at the University Paris Diderot – Paris 7. She became President of the International Commission on Mathematics Instruction in January 2007.

Abstract

Science, mathematics and ICT

Today information and communication technologies provide powerful tools to support the development of inquiry-based practices in mathematics and science education, and for their dissemination. Nevertheless, along the last decades we have also learnt that the actualization of the educational potential of ICT is not something easy. Thus the Fibonacci project faces important challenges regarding ICT. In this contribution, using some insightful examples, I will examine the lessons we can draw from the huge amount of existing research and innovative work for meeting these challenges.

Wynne Harlen

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Dr. Wynne Harlen has held several high ranking positions in scientific education and research in the United Kingdom, including Sidney Jones Professor of Scientific education at the University of Liverpool and Director of the Scottish Council for Research in Education. She has an honorary position as Visiting Professor at the University of Bristol, England, although working from her home in Scotland. She acts as consultant to several primary/elementary school science projects in various countries and is currently committed to the IAP Scientific education Programme on the development of inquiry-based scientific education. She is the author of 28 books and of many journal articles and reports on scientific education, evaluation and student assessment.

Abstract

Implementing inquiry-based learning in science education

The aim of inquiry-based education in science is for students to develop their understanding in science through their own mental and physical activity. Questions discussed will be: how is this to be done in practice? Must inquiry always involve first-hand investigation? How does it advance students' understanding? What are the roles of students and teacher in inquiry-based activities?

Honorary Chairman of the European Cultural Centre
Special adviser to the President of the European Commission – Switzerland
www.dusan-sidjanski.eu

Dusan Sidjanski

Founder of the Department of Political Science at the University of Geneva, Dusan Sidjanski is Professor emeritus at the Faculty of Economic and Social Sciences and at the European Institute in Geneva. From 1956, he worked in close collaboration with Denis de Rougemont at the European Cultural Centre (ECC). He is the author of works on federalism and European integration,among which Le dialogue des cultures à l'aube du XXIe siècle. Hommage à Denis de Rougemont par José Manuel Barroso (Editor in collaboration with F. Saint-Ouen), Bruxelles, Bruylant, 2007 ; Rôle de l'Union dans le dialogue des cultures et la participation citoyenne, Jean Monnet Conference, 2008 ; Jean Monnet Conferences on European culture and education, Madrid 25-26 January and Brussels 25-26 May 2010, with special emphasis on "Hands on" and "Pollen".

European cultural heritage and the role of science and mathematics

Abstract

European culture includes not only religion, philosophy and arts, but also science, mathematics (see Plato) and technology. Human resources are Europe's best asset. An introduction to science and mathematics has to take place at the early stages of child education, as conceived by the "Hands on" method (L. Lederman and G. Charpak) and spread by the European Commission's projects "Pollen" and "Fibonacci". Education in science and mathematics should always be presented as an integral part of European culture in connection with fundamental values.

Delegate for Education
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Pierre Léna

A member of Académie des sciences (Paris) since 1991, Pierre Léna has centred his scientific work on infrared astronomy. This work led him to organize the European Very Large Telescope as an interferometer. His interest in educational matters led him to become President of the Institut national de recherche pédagogique (1991–1997) and to be one of the 3 founder members of the La main à la pâte (Hands on) action renovating scientific education in schools since 1996. Until 2007, he has been President of the Comité d'éthique des sciences from Centre national de la recherche scientifique and vice-president of the Association Bernard-Grégory. Since 2005, he has been Delegate for Education at the French Académie des sciences.

Science for all, a reasonable goal?

Abstract

Fifteen years ago, the plea for a high quality science education for all pupils was an exercise done exclusively by specialists. Today, scientists, engineers, politicians, media are strongly arguing in favour of this, while in many places worldwide, pilot projects, reforms and reports express the will to make of science education one of the main avenues of XXI century schooling ambition. How is such a move justified? The economic and democratic needs, an intolerable decline in the quality of teaching, a better understanding of the cognitive process of learning in a child's brain, an urge for justice to better share the formidable advances of science, a blind trust in technology to save a future everybody more or less foresees as worrisome? Education is probably a good mirror of how a society sees itself, as education contains whatever we feel worthwhile transferring to the next generation. The presentation shall attempt to unfold the many reasons which are, more or less implicitly, contained in the choice of an inquiry-based science education.

Ulrich Trottenberg

Director of the Fraunhofer Institute for Algorithms and Scientific Computing SCAI Germany
www.scai.fraunhofer.de

Trottenberg received his doctorate in 1972 from the University of Cologne. In 1977 and at the age of 32, he became a professor of Applied Mathematics at the University of Bonn. After his time in Bonn he became a professor of Mathematics in Engineering at the University of Essen. Since 1984 he holds the chair of Applied Mathematics & Scientific Computing at the University of Cologne. From 1995 to 1996 he was a visiting professor at the Courant Institute (NYU). Since 2001, he has been the director of the Fraunhofer Institute for Algorithms and Scientific Computing located in Sankt Augustin. From 2006 to 2009, he was the chairman for the board of directors of the Fraunhofer center located at the Schloss Birlinghoven.
In addition to these accomplishments, Trottenberg was also the initiator and scientific director of the SUPRENUM project and the European GENESIS project. He was the chairman for several initiatives and advisory boards, such as the initiative for the German High-Performance Computing Center, the scientific-technical advisory board of the PALLAS GmbH, and the advisory board of the Carl F. Gauss Center for Scientific Computing located at the Weizmann Institute in Israel. He also was an advisory board member of the Potsdam Institute for Climate Impact Research. In the early 2000s he was deputy chairman of the Fraunhofer Alliance for Information and Communication Technology and became director of the Simulation and Software Technology Institute of the German Aerospace Center (DLR). Furthermore, Trottenberg represented the Fraunhofer-Gesellschaft as a member of the coordination committee for the "Year of Mathematics 2008". Since 2008, he has also lead the supervisory board of scapos AG, and became president of the Association of Friends and Sponsors of the Forschungszentrum Jülich in 2009.
Among other honors, Ulrich Trottenberg received the Humboldt Award for the French-German Scientific Cooperation, the ECCO Award, and the SUPARCUP.

Abstract

Mathematical Education meets Reality and Future

The foundation of industries and economics increasingly depends on the so called "MINT" disciplines: mathematics, informatics & computer sciences, natural sciences, and technology. In real life, mathematical developments and their applications have progressed drastically, which includes computer-driven numerical simulations and other tools for modern problem solving. Today mathematical modeling and algorithms have a massive impact on the way we live and work – they are the basis of almost every technical improvement, and are fundamental for many industries, e. g. logistics, transport, traffic management, and sectors of financial management.
Unfortunately, these modern developments have been poorly integrated into school curriculums. Traditional mathematical education is often dominated by antiquated content and ways of thinking, coupled with rather formal teaching methodologies that stiffen creativity. Therefore, rethinking curricula and approaches is necessary in order to fully prepare the next generation for understanding the implication of mathematics for society and for each person. To improve mathematical education, an increase in the understanding is needed that mathematics is a critical tool for problem solving. A key towards realizing this goal is an intensive training in the use of algorithmic thinking that illustrate to students how mathematics is the foundation of modern technologies. Such technologies include everyday applications such as cell phones, navigation systems, mp3, and credit cards.

Ludwig Spaenle

President of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (KMK)
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Ludwig Spaenle was born in Munich in 1961. After graduation from high school in 1980 he took up his university studies in history and RC theology, which he completed with a PhD in 1989. From 1990 on he worked as a journalist for the Bavarian broadcasting. Since 1994 he has been a Member of the Bavarian Parliament.
From 2003 to 2008 he was chairman of the Standing Committee for University, Research and Culture in the Bavarian Parliament and chairman of the Bavarian Heritage Council.
In 2008 Dr. Ludwig Spaenle was appointed Bavarian Minister of Education and Cultural Affairs.
For the year 2010 he is the President of the Standing Conference of the Ministers of Education and Cultural Affairs of the States of the Federal Republic of Germany.
Furthermore he is member of several boards, among others the Advisory Board for the Munich Documentation Centre for the History of National Socialism, Board of Trustees of the Munich School of Philosophy, Board of Trustees of the German Christian Liebig Foundation, Board of Governors of the Alexander von Humboldt Foundation.

Mathematics and Science Education – a key factor for our future

The printed version of the speech will be distributed at the conference.

Günter M. Ziegler Director of the Media Office of the German Mathematical Society and deputy chair of the Berlin Mathematical School, Germany
www.math.tu-berlin.de/~ziegler

Günter M. Ziegler was born in München, Germany, in 1963. He got a Ph.D. at M.I.T. with Anders Björner in 1987. Since 1995 he is a Professor of Mathematics at TU Berlin, a co-chair of the "Berlin Mathematical School", and a member of the DFG Research Center MATHEON.
His interests connect discrete and computational geometry (especially polytopes), algebraic and topological methods in combinatorics, discrete mathematics and the theory of linear and integer programming. He is the author of "Lectures on Polytopes" (Springer-Verlag 1995) and of „Proofs from THE BOOK" (with Martin Aigner, Springer-Verlag 1998), which has by now appeared in 14 languages.
His honors include a "Leibniz Prize" (2001) of the German Science Foundation DFG, the "Chauvenet Prize" (2004) of the Mathematical Association of America, and the "Communicator Award" of DFG and Stifterverband (2008).
He is a member of the executive board of the Berlin-Brandenburg Academy of Sciences, and a member of the German National Academy of Sciences Leopoldina. 2006-2007 he was the first chair of the "Berlin Mathematical School", a joint Graduate School of the three Berlin mathematics departments, funded in the framework of the German Excellence Initiative.
2006–2008 he was the President of the German Mathematical Society DMV, he initiated and co-organized the German National Science Year "Jahr der Mathematik 2008" and now directs the DMV Media Office and the DMV Network Office "Schools-Universities".

Abstract

How can mathematics solve problems?

If Mathematics Education at school is the answer, what was the question? What is the primary goal of Mathematics education at schools?
My claim will be that

A. it is not one goal but at least three, and
B. these goals are moving targets.

To name three primary goals:

1. To present Mathematics as a part of our culture, and as a basis for modern key technologies, which presents answers to very basic, very natural questions, history, present, future.
2. To present Mathematics as a field that equips everyone with the ability to give answers (himself/herself!) to important problems and questions that occur in daily life.
3. To introduce into Mathematics as a field of study – and to lay the foundations for possible (university or vocational) studies, in the Sciences, Engineering, or Mathematics itself.

All these goals change over time - so in shaping and designing the Mathematics school curricula we must be careful that the questions haven't changed fundamentally by the time our answers are being implemented.

Deepening the specificities of scientific inquiry in mathematics

Coordinator	Peter Baptist, University of Bayreuth, Germany
Speakers	Petar Kenderov, Academy of Sciences, Bulgaria
	Kenneth Ruthven, University of Cambridge, United Kingdom
Report	Volker Ulm, University of Augsburg, Germany

The goal of inquiry-based mathematics education is to teach students, among other things, how to deal with knowledge, apply knowledge and independently solve problems. These abilities are of a higher quality than simply checking off isolated elements of knowledge. In this workshop, various aspects of how to implement IBME successfully will be shown and discussed, e.g. experimental approaches, visualisation, fostering independent work and critical thinking.

Deepening the specificities of scientific inquiry in natural sciences

Coordinator	David Jasmin, La main à la pâte, France
Speaker	Wynne Harlen, University of Bristol, United Kingdom
Report	Susana Borda, La main à la pâte, France

In order to achieve the intended learning outcomes of inquiry-based science education – progress of students in understanding key scientific ideas, inquiry skills and attitudes towards science – students must experience certain processes of learning. In this workshop we will consider which learning processes are indicators of effective learning in science. These processes have consequences for teachers if they want to implement effective inquiry teaching. As a result we can express what teachers need to do in terms of standards to be attained, which can be used in formative evaluation of implementation and also by teachers in self-evaluation. Some examples of how this formative evaluation of practice can be carried out will be discussed.

Implementing and expanding a reference centre

Coordinator	Petra Skiebe-Corrette, Free University of Berlin, Germany
Speakers	Phil Hingley, University of Leicester, United Kingdom
	Ida Guldager, University College South Denmark
Report	Nicola Stollhoff, Free University of Berlin, Germany

Fibonacci reference centres play a role in professional development of teachers, material support, adapting to the existing curriculum, community involvement and evaluation. The workshop starts with three introductory talks discussing: 1) the requirements and problems that might occur when implementing a reference centre, 2) how Pollen changed the confidence and attitudes of primary teachers towards teaching science, and 3) how a material centre can service a large number of schools. In the workshop, participants will also discuss the problems they have in implementing a reference centre and try to find ideas to solve them.

Cross disciplinary approaches

Coordinator	Tina Jarvis, University of Leicester, United Kingdom
Speaker	Janet Ainley, University of Leicester, United Kingdom
Report	Frankie McKeon, University of Leicester, United Kingdom

There will be four main parts to this workshop which will explore:

- what is a Cross-Disciplinary Approach and its advantages and disadvantages;
- what the term "inquiry" means to different subject specialists;
- what strategies can be used to include science investigations in different subject areas, including mathematics, within the context of real life problems;
- and what support is needed to enable teachers and schools to incorporate a cross-disciplinary approach within their teaching schemes ?

Using the external environment of the school

Coordinator	Hannu Salmi, University of Helsinki, Finland
Speakers	Leo van den Bogaert, The unschooled Mind Company, Netherlands
	Konrad Krainer, University of Klagenfurt, Austria
Report	Arja Kaasinen, University of Helsinki, Finland

Bridging the gap between formal education and informal learning is one of the main challenges of the education. The teacher students and in-service teachers should have more pedagogical opportunities and skills to apply it in their professional development. The session will handle the latest results on how to use science centres in benefit of classroom learning and especially teacher training. How to use ICT and other new technologies to form the link between formal education and informal learning? What is the role of the outdoor activities? How to involve scientific community in the classroom?

ICT and virtual environment for science education

Coordinator	Ed van den Berg, University of Amsterdam, Netherlands
Speakers	Franz X. Bogner , University of Bayreuth, Germany
	Dan Sporea, National Institute for Lasers, Plasma and Radiation, Serbia
Report	Bas Higler, pedagogical college PABO/Hogeschool van Amsterdam, Netherlands

Using computers in science research is a common place. In science education however, the use of digital information and communication technology needs a pedagogical rationale to justify investment and effort. This workshop discusses many successful (and some less successful) applications of ICT in secondary and primary science education in the perspective of inquiry-based science teaching. We plan to share our time evenly among presentation of interesting projects in schools, explanation of technical features, and engaging in a discussion about the added value of ICT in IBSE.

ICT and virtual environment for mathematics education

Coordinator	Peter Baptist, University of Bayreuth, Germany
Speakers	Volker Ulm, University of Augsburg, Germany
	Paul Drijvers, Freudenthal Institute Utrecht, Netherlands
Report	Jenny Sendova, Bulgarian Academy of Sciences, Bulgaria

New technologies lead to new ideas for visualising and learning. How do ICT and virtual environment help to improve students' understanding in mathematics? There are different design activities like dynamic worksheets, but also different ways of using them in classroom teaching. Different approaches, successfully tested in classroom teaching, will be shown and discussed in this workshop.

Involving the private sector (foundations and companies) in science and mathematics education

Coordinator	Patricia Corieri, Free University of Brussels, Belgium
Speaker	Marie-Claire Certiat, EADS Foundation, France
	Wolfgang Gollub, Gesamtmetall Berlin, Germany
Report	Philippe Leonard, Free University of Brussels, Belgium

The lack of interest of young people in science and mathematics is a concern for industry. While collaboration between universities and industry is common, more recently several actions have been aimed at primary and secondary schools in order to interest young children. Companies can provide internships and visits not just to children but also to teachers. They can also provide financial support to science projects, especially those linked with real life applications. This session will deal with interactions between industry, foundations, and science and mathematics education.

Transition from primary to secondary school

Coordinator	Gerd Bergman, Royal Swedish Academy of Sciences, Sweden
Speakers	Anders Jidesjö, University of Linköping, Sweden
	Martin Braund, University of York, United Kingdom
Report	Jan Schoultz, University of Linköping, Sweden

Progression and transition are key concepts in trying to adjust science content in relation to students' learning and their encountering of school science. Considering ways of working is one important part. Reflecting upon the content and understanding ways young people experience science in and outside school is equally important. This entails relating the work on progression and transition with concrete content from the perspective of the learners.

Arts and inquiry-based science and mathematics education

Coordinator	Carsten Miller, University of Bayreuth, Germany
Speakers	Eugen Jost, Artist and Teacher, Switzerland
	György Darvas, Institute for Research Organisation of the Hungarian Academy of Sciences, Hungary
Report	Doris Bocka, University of Bayreuth, Germany

Mathematical theories and problems are not only a matter of mind, they also have an effect on sensibilities and aesthetic feelings, comparable with artistic activities. The famous British number theorist G. H. Hardy (1877 – 1947) pointed out: "A mathematician, like a painter or poet, is a maker of patterns. If his patterns are more permanent than theirs, it is because they are made with ideas." Collaborative and interdisciplinary practice across the arts, mathematics and science can help to provide new perspectives on both fields. The workshop shows various ways how to find ways from visual art to mathematics and vice versa from mathematics and sciences to the arts.