The Fibonacci Project

DISSEMINATING INQUIRY-BASED SCIENCE AND MATHEMATICS EDUCATION IN EUROPE

Fibonacci Newsletter

Issue n° 05 - March 2013

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Beyond Fibonacci

Towards the emergence of a new generation of centres for science and mathematics education

It is in the final phase of the project, between June 2012 and February 2013, that the Fibonacci model genuinely came into its full dimension, with the Twin Centres 3 expanding the network to over 60 teacher support centers, thus demonstrating the multiplying power of the twinning process, and the structuring and catalytic effect of the systemic and holistic approach fostered by the project.

The substantive collaborative work done on the 5 common topics and during the 5 related training sessions also came into fruition with the publishing of 5 booklets, complementing the 3 background resources perfected by the scientific committee, which are now offering a consistent view of inquiry for science and mathematics. All these were presented in detail during the final project seminar that took place in December in Slovakia, which was a stimulating moment of sharing and interacting, and during which the Fibonacci outcomes and results were extensively discussed.

In this last newsletter, we chose to highlight the activities successfully carried out in four twinning groups, to illustrate the value and benefits of twinning as a key driver of change, peer learning and capacity building.

We also asked Educonsult, the external evaluator, to share a flavour of the analyses, conclusions and recommendations that will be part of their upcoming final evaluation report. These are essential indications about the challenges and achievements of the project, and we see them as formative rather than summative assessment elements. Indeed, by definition, there is no end to the Fibonacci sequence, where a generation always breeds a new and larger one.

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SEVENTH FRAMEWORK PROGRAMME

Twin Centres 3 and field visits 2

These field visits were organised by the Fibonacci Reference Centres and Twin Centres 1 for the 25 new twin centres (Twin Centres 3). They allowed RCs and TC1s to pass on their Fibonacci experience to the new centres.
The 22 field visits 2 took place between June 2012 and February 2013 and appeared very fruitful for the new Twin Centres 3.

Several aspects have been considered as useful by the new TC3 coordinators to implement a reference centre:
The importance to have a coordination centre, with a complete strategy and organisation framework (partnerships, contracts with local authorities...), and a well-structured website to share materials, to make pedagogical resources available, to build networks and good relationships with the teachers; the interest to make the leap from initial teacher education to continuing professional development was also highlighted. One key aspect appears to be the expertise of the educators and course leaders. Some coordinators have become aware of the importance to value the teachers as experts who know their students' learning and experimental needs.

Some resources (in science and/or mathematics) have been shared and will be adapted, translated, or transferred to the Twin Centre 3.
Other benefits of the visits were the exchange of information and advice on the IBSE approach, as well as the observation of possible connections between researchers and teachers in science and maths contents.
Contacts with experts able to guide them in the development of a strategy for the further implementation and dissemination of a project locally were appreciated by the TC3s, some of them even considering signing a cooperation agreement between the two centres.

Beyond Fibonacci: follow-up and feedback
It seems that these field visits are just the beginning of a longer cooperation for most of the TC3s: after Fibonacci, they plan to exchange material, and to ask the reference centre to follow and tutor their centre through participation to workshops, conferences, special events, the signing of cooperation agreements, etc.

Micro-projects
Some partners plan to start with a pilot project (10 schools), some others to add some new sequences and use Fibonacci resources in their teacher professional development sessions (pre- and in-service).

Top left: during the field visit organised by the Free University of Brussels for the Assessorato Istruzione e Cultura-Regione Autonoma Valle d'Aosta, 5-7 November 2012.

Top right: during the field visit organised by the University of Augsburg for the Pädagogische Hochschule Tirol, 30 January-1 February 2013.

Bottom left: during the field visit organised by the Vinca Institute of Serbia for the Organization for Reform and Development in Educational System in the Republic of Moldova, 12-14 February 2013.

Fibonacci final seminar – Slovakia 3-4 December 2012

The coordinators of the Fibonacci Reference Centres, Twin Centres 1 and Twin Centres 2 gathered for the last time in the project in the picturesque setting of the Smolenice Castle, Slovakia, on 3 and 4 December 2012, for a final seminar hosted by the University of Trnava.

It was the opportunity for the twinning groups to present their actions and projects to each other. The Fibonacci background and companion resources were presented in detail, while a round table with the scientific committee enabled to share views on the main achievements of Fibonacci and on the perspectives to come.

Smolenice, Slovakia, December 2012. Photo by Yves Beernaert

The seminar focused largely on the project results and on its evaluation, with several insightful presentations by Educonsult, the external evaluator, on the various dimensions of the project, like the impact on teachers and teacher educators, the community boards, the twinning process or the impact on policy-makers (see below p. 8). Valuable recommendations were also made by Educonsult on how to further enhance the dissemination of the Fibonacci results and the sustainability of the network, especially by linking up with European lifelong learning programmes. The conclusions of the seminar stressed the importance and the originality of the work done and resources produced during Fibonacci, the positive spin-offs of the project and the need for further cooperation in the field of inquiry-based science and mathematics education. A strong desire emerged among the partners to carry on the network activities.

Teachers' award ceremony during the final seminar, Slovakia, December 2012

The Fibonacci Resources for Implementing Inquiry in Science and Mathematics at School

Resources for Implementing Inquiry in Science and Mathematics at School
Target readers: teachers, teacher educators, Centres for Science and/or Mathematics Education (CSME) coordinators, and other actors concerned with the implementation of inquiry-based pedagogy in science and mathematics at a local level

Background Resources

Companion Resources

The concept

The **Resources for Implementing Inquiry in Science and Mathematics at School** convey a coherent and consistent view of inquiry pedagogy in science and mathematics and provide some of the necessary tools and recommendations for its successful implementation in the classroom.

They are addressed to teachers, teacher educators and, more generally, local actors concerned with the practical implications of implementing inquiry-based science and/or mathematics education. They speak of the pedagogical and didactical implications of such an approach, both from the theoretical point of view and from the practical point of view at the classroom level, and help local actors to set up support networks for this pedagogy to become a reality in the classroom. These are documents designed to help bring about the desired reform in science and mathematics education on the field.

The **Background Resources** define the general principles of inquiry-based science education and inquiry-based mathematics education and their implementation. They include the following booklets:

- Learning Through Inquiry
- Inquiry in Science Education
- Inquiry in Mathematics Education.

The Companion Resources provide practical information, instructional ideas and activities, and assessment tools for the effective implementation of an inquiry-based approach in science and mathematics at school. They include the following booklets:

- Tools for Enhancing Inquiry in Science Education
- Implementing Inquiry in Mathematics Education
- Setting up, Developing and Expanding a Centre for Science and/or Mathematics Education
- Integrating Science Inquiry across the Curriculum
- Implementing Inquiry beyond the School.

Editorial process

An editorial process was led by the European Coordination to coordinate the work among the members of the Scientific Committee and the coordinators of the common topic groups, and thus ensure coherence and fruitful dialogue among all the different booklets. All the booklets were reviewed, commented, edited, and validated by at least one member of the Scientific Committee. The booklets are all cross-referenced where pertinent.

Diffusion

• Internet download: all booklets can be downloaded, free of charge, at the Fibonacci Project website, in the Resources section (both in the web version and the print version). http://www.fibonacci-project.eu/

• Printed copies: The Background Resources were printed in 100 copies each by the European Coordination which were distributed among partners. Each partner is free to print as many copies as required (printer versions are available on the Fibonacci website).

• Reprints, translations and adaptations: The Resources for Implementing Inquiry in Science and Mathematics at School are protected by a Creative Commons Licence. The Copyright holder is the Fibonacci Project, but all documents can be reproduced, distributed, and even modified (i.e. translated or complemented), as long as it is non-profit, as long as credit is given concerning the original document, and as long as the new document is licensed under the same conditions. Many reprints, translations and adaptations of the different booklets are already under way under the initiative of individual partners. Translations and adaptations will be uploaded on the Fibonacci website as soon as they are finished.

Publication: The Fibonacci Legacy: Disseminating inquiry pedagogy in science and mathematics throughout Europe

The "Fibonacci Book"

Provisional title:

The Fibonacci Legacy to Science and Mathematics Education. A systemic approach for the sustainable implementation of inquiry pedagogy tested in primary and middle schools throughout Europe (2010-2013)

Target readers:

Policy makers and decision-takers concerned with education at a national and European level

The "Fibonacci Book" will show how the Fibonacci Project responded to the needs identified in the 'Rocard Report': namely, massive dissemination of inquiry-based education in science and mathematics throughout the European Union.

It will show how the Fibonacci Project has built on and gone beyond the SinusTransfer and Pollen projects, promoting not just a renewed inquiry pedagogy for science and mathematics, the key feature of which is understanding, but also an efficient and successful dissemination strategy based on twinning, involving a transformational approach to change in education and, most importantly, forms of collaboration where learning from others was the key.

It will also show the challenges raised by the Fibonacci Project for science and mathematics education and emphasize the need for further research and funding of inquiry-based education research and implementation initiatives in the framework of Europe 2020.

Since its target readers will be political actors, the book will seek to convince the reader of the interest of inquiry pedagogy and of Fibonacci's dissemination strategies. It will be concrete, factual, and illustrative, but also solidly grounded on relevant research. The book will be short (45-60 pages) and include an executive summary.

The book will be available for on-line download to all partners in April 2013.

Beyond Fibonacci:
Feasibility study of a European Network of Reference Centres (ENRC)

The overall objective of the European Network of Reference Centres is to enhance the quality of IBSE/IBME by stimulating the development and the implementation of a network of IBSE/IBME Reference centres (RC) all across Europe. Such RCs are centres of excellence specialised on the one hand in IBSE/IBME and on the other hand in organising Continuing Professional Developments for school teachers or Pre-service teacher education courses for future teachers focusing on IBSE/IBME.

These RCs are also specialised in making available to teachers and schools creative resources to promote IBSE/IBME and in giving teachers support while implementing IBSE/IBME in the classroom. It is hoped that the activities of the RCs will result in more pupils and students interested and motivated to study mathematics and science, and hopefully more of them choosing scientific, technological or mathematical studies in upper secondary school and in higher education, and eventually scientific, technological or mathematical careers.

The ENRC would liaise with policy and decision makers at national and European levels to ensure integration of IBSE/IBME innovation in regional, national STEM policies as well as European strategies developed by the European Commission. It would enhance knowledge brokerage between researchers and research users focusing on IBSE/IBME. It would encourage networking between existing RCs to disseminate and valorise what has been achieved or to stimulate and support the creation of new RCs by transferring the expertise of existing RCs to new ones. The ENRC would organise specialised training for those who want to create a Reference Centre and those who want to act as expert trainers within those RCs.

Finally, the ENRC would promote European and international cooperation and innovation through partnerships in IBSE/IBME to the benefit of teacher education (CPD + Pre-service) and school education by supporting the creation of various types of projects. It would also stimulate research, applied research and comparative studies focusing on IBSE/IBME.

Focus on Twinnings

One of the cornerstones of the Fibonacci project's large scale dissemination of inquiry-based science and inquiry-based mathematics education process was the twinning. From the beginning of the project, 12 Reference Centres were twinned with 12 Twin Centres 1 and 13 twin centres 2, which received tutoring and support for 2 years, thus gaining expertise and, in the case of TC1s, becoming able to start tutoring another centre themselves. The twinning proved to be a very effective way to build the capacity of teacher training organisations in delivering quality continuing professional development in IBSE and IBME, and a powerful dissemination tool of good practice and peer-learning at European level. The level of satisfaction of the Fibonacci partners regarding the twinning is such that 80% of the Fibonacci centres have declared their willingness to continue collaborating with their twinned partners beyond the lifetime of the project. Here are 3 examples of successful twinnings.

Denmark (University College South Denmark - RC), Portugal (Ciencia Viva - TC1), Spain (University of Alicante - TC2):
Which boat sails the fastest?

In the beginning of the twinning process we decided to develop and implement units in cooperation. Searching for common and relevant contents that could inspire science and mathematics learning with an inquiry-based approach for our units, we found that all three countries, Portugal, Spain and Denmark, have long maritime traditions and that the schools in our networks are placed near harbors or coastlines. We therefore decided to develop a unit on sailing ships.

By developing a unit to be used both in CPD courses and by the teachers in their classes, we wanted to ensure that the teachers would find it relevant and would be working with genuine challenges or problems in the CPD courses, having to inquire themselves into how to design a sailing ship.

We also wanted a unit that would create possibilities for the teachers to adapt to his or her classes, or maybe even inspire them to develop their own unit using ours as an exemplary frame.

The unit on sailing ships was translated into Spanish, Portuguese and Danish and introduced to teachers in a number of workshops during the four twinning visits that took place from June 2011 until February 2012.

In the three countries there was also an ongoing process of adapting the unit to different age groups, to informal learning environments or for children with special needs, and we shared our experiences and ideas and used these for a joint presentation, 'An IBSME Approach to Teaching in In-Service Education' at the Leicester Conference in April 2012.

Our next aim is to create a community of practice involving teachers from the 3 countries starting by sharing experiences with IBSME units in their classes on a web blog: http://fibonacci-project-co-operation.blogspot.dk/

Classroom session with ships, Portugal

Teachers' workshop on ships, Spain

Germany (University of Bayreuth - RC), Bulgaria (IMIBAS - TC1), Czech Republic (University of South Bohemia - TC1), Germany (Thüringer Institut für Lehrerfortbildung):

Some highlights of the twinning actions and the scientific coordination in mathematics

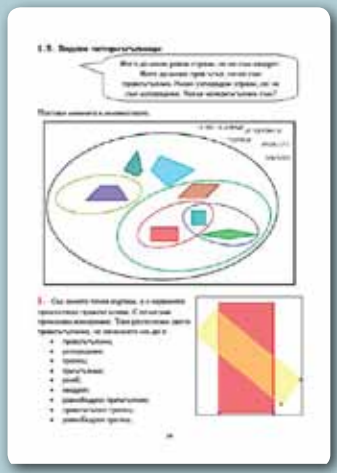
We were very lucky to get the chance to be twinned with very active and creative partners, all of them already experienced in inquiry-based learning methods. In our opinion this experience is needed to get sustainable effects on a larger scale in less than three years of common work.

We see the key elements of our twinning activities on several levels:

- Regular communication between the responsible actors of the centres: we had a good mixture of face to face meetings and digital contacts via e-mail and social media (e. g. virtual rooms for common work on materials).
- Exchange of materials, translation in the national language
- Training courses for teachers and teacher trainers of our twinned centres.
- Meetings between teachers, teacher trainers and teacher students of the twinned partners as well as between partners of the common topic group about Implementing inquiry in mathematics education.
- All twinned partners were involved very actively in the common topic group about Implementing inquiry in mathematics education.

The faithful and intensive cooperation made it possible to integrate the TC3 immediately in the whole team, as all partners of the common topic group joined the field visit 2 in Bayreuth. It was a great experience for all of us to have fun with inquiry-based mathematics and to learn a lot from each other.

All partners developed additional materials for inquiry based-mathematics education on their own in their national language, e.g.



A good overview about the positive results of this common work can be seen in the book Implementing inquiry in mathematics education.

Left : geometric figures (Bulgaria)

Digital worksheets (Czech Republic)

The math-bag, material for experimental mathematics

Maths Meets Art Exhibition, October 2012

Twinning, cooperating and developing: Slovenia (University of Ljubljana - RC), Serbia (Vinca Institute - TC1) and Poland (Jagiellonian University - TC2)

Cooperation between the University of Ljubljana, Vinca Institute of Nuclear Physics and Jagiellonian University from Krakow has been intense and fruitful for all partners. It included visiting CPD workshops, organized for Fibonacci teachers in all three countries, visits to Fibonacci schools and kindergartens and exchange on providing resources for teachers. Meetings offered time for discussions and exchange of experience.

Teachers in all three countries share enthusiasm for improving their science teaching and appreciate material support for experimental work of pupils. One of the key issues was therefore providing teachers with experimental kits and didactic materials prepared within the twinning group.

Appropriate topics were also shared and developed during the cooperation between the partners. The workshop "Fruits and vegetables" was initiated by Slovenian teachers, developed further in Poland and implemented in both countries in a new, richer version. This was also presented to a European audience at the Berlin cross-cutting topics group meeting.

The Serbia team was particularly active in providing teachers with translation of resources, which was beneficent for Slovenia too.

Cooperation exceeded the Fibonacci frame; there are exchanges of young researchers between University of Ljubljana and Jagiellonian University. The topic group for physics education in South-East Europe was initiated and its first meeting was held in Ljubljana in September 2012, with representatives from all three partners attending and contributing to raise awareness on the necessity and possibilities to implement IBSE also in physics education. This was a continuation of the activities of the Serbian partner institution, the Vinca Institute of Nuclear Physic, which has already organised five annual South-East European Workshops on Primary Science Education (2005-2010), which have contributed to raising awareness on IBSE also in the countries within the region that were not partners in the Fibonacci project.

Fruits and Vegetables workshop, Poland

Fruits and Vegetables workshop, Poland

Experimental kit and didactic materials, prepared for Serbian Fibonacci teachers

The Evaluators' point of view on the twinnings: twinnings between RC and TC as a successful means to enhance quality in IBSE/IBME

"The use of the twinnings between RC and TC as a means to disseminate IBSE/IBME has been very successful. Linking up very experienced RC with possibly less experienced TC1 or with TC2 with little experience of IBSE/IBME has proven to be very useful and stimulating. There has been a real transfer of expertise and knowledge, strong cooperation and cross-fertilisation between the clusters of RC, TC1 and TC2. Several clusters have developed jointly activities and materials which have enhanced IBSE/IBME within the clusters. The field visits organised by the RC have been a major element in stimulating the cooperation between the RC and the TC. The mentoring of the TC organised by the RC has also strengthened the quality of the work of the various partners of the RC-TC clusters.

All these activities have proven to be very inspiring peer learning activities. This cooperation has resulted in the fact that all the TC1 have reached the status of RC at the end of the project. It can even be stated that some of the TC2 have also reached this status already. The satisfaction of the cooperation between the RC and TC has resulted in other forms of cooperation between the members of the RC-TC cluster in the future. It is also important to state that cooperation has also developed gradually between the different RC-TC clusters which has had a positive effect on the development and the strengthening of the whole European network of RCs and TCs. This has also had an impact on the sustainability of the clusters and the network."

External evaluation

The external evaluation implemented throughout the three years of the project shows in its summative report that the Fibonacci project has been very successful and has even reached more than was expected and scheduled at the beginning of the project.

The external evaluators extended in their presentations in Smolenice on the key elements of the evaluation: relevance, efficiency, effectiveness, impact and sustainability. The larger part of one presentation was dedicated to a careful analysis of those elements.

Relevance

Concerning the Relevance they stressed that Fibonacci had been very relevant as to the objectives of FP7 and of the project itself: it has really been a dissemination project promoting IBSE and IBME across all Europe. It has made a major contribution to several of the EU 8 key competences adopted by the European Parliament and the Council of Ministers. Finally the activities of the Fibonacci project have definitely been relevant as to the objectives of the EU 2020 strategy and contributed to the creation of a SMART, SUSTAINABLE and INCLUSIVE Europe.

Efficiency

The evaluators stressed that the activities on the three pillars of the Fibonacci project have been implemented very efficiently: the core of the work has focused on improving and disseminating IBSE and IBME, the twinning between RC and TC has proven to be very effective and efficient and has shown to be a key element in disseminating IBSE and IBME across the 62 universities and other partners involved. However the evaluators note that the efficiency of some TC2 was less than could be expected. Finally the project has also been rather efficient in stimulating the local involvement by creating in various RC or TC community boards that support the implementation of IBSE and IBME. However, this last element still requires more attention towards the future.

The efficiency of the activities has been enhanced by the fact that most partners were very motivated and committed to the project and have invested themselves more than expected. This has also resulted in more schools, teachers and pupils reached than originally scheduled. Several partners have furthermore been very efficient in securing extra funding which enabled them to involve more schools and teachers. The efficiency has also been stimulated by the fact that several partners have linked up the Fibonacci activities with national IBSME initiatives which resulted in production cross-fertilization and amplification of the activities and their impact.

Effectiveness

Concerning the Effectiveness it has to be mentioned that all the objectives scheduled have been fully reached or even exceeded. Quality products have been produced such as the five guidelines to promote various aspects of IBSE and IBME, quality CPD has been developed and strategic partnerships have been concluded. However some challenges still remain: reaching new teachers and teacher educators for the European training seminars, strengthening or formalising the community board which is the basis for the local involvement, creating links with national or regional education policy-makers so as to strengthen the sustainability of the IBSE and IBME activities.

Although Fibonacci was originally meant to focus only on teacher CPD, in most cases activities were widened towards pre-service teacher education.

Furthermore, various mentoring models such as regional networks, multiplier or expert teachers have been experimented. Different CPD models have been developed and implemented involving teachers, future teachers and/or engineering students who may support teachers.

Impact

Concerning the Impact it can be strongly stated that there has been a clear impact on the schools, the teachers and the pupils as shown by the analysis of the statistical data gathered. Teachers state that their motivation and confidence in teaching IBSE/IBME has been greatly enhanced by the CPD organized by Fibonacci. They also greatly appreciated the mentoring and support they received from the Fibonacci mentors. The teachers also consider that their CPD has had a major impact on the interest and motivation of their pupils and students to study IBSE/IBME. The analysis shows that especially the younger teachers and the older group of teachers benefited from the CPD organised by Fibonacci. It was also clear that the impact was greatest on primary school teachers and lower secondary teachers.

There has possibly been less impact on national or regional policy and strategy as to STEM and this is why links with and contribution to national policies/strategies have to be strengthened.

The RC-TC model was successfully tested and has definitely had an impact on spreading IBSE and IBME across Europe, involving at the end of the project over 60 universities and other partners.

Sustainability

Concerning the Sustainability, the strong cooperation within the RC-TC twinning is the first key element to guarantee sustainability. In several cases national coordination teams will try to broaden their support basis to other higher education institutions and partners and more focus will be given to IBSE/IBME pre-service teacher education. New European projects are being developed and partners have been invited to create European Comenius training courses making use of the expertise, tools and guidelines developed within Fibonacci. Finally, the different dissemination initiatives set up at European and national level by all the RCs and TCs should also enhance the sustainability.

As an overall conclusion, the external evaluators consider the project to have been implemented in a very efficient and effective way, its activities have been very relevant, there is definitely an impact on the key target group – the teachers – and there are many elements that show that sustainability of what has been achieved is secured. The strong motivation, the commitment and active involvement of both the European coordination team and the national teams running the RC and TC have generated the many positive results Fibonacci can be proud of.

Some facts and figures

The most innovative elements of the Fibonacci project

- ★ The twinning process: development and implementation of the RC-TC clusters to transfer innovation in IBSE/IBME from experienced RC to the TC. The exchange of knowledge and expertise and the cross-fertilisation between the RC and TC has definitely been useful to all the members of the cluster and to the whole network.
- ★ The organization of Field visits for all RC and TC which have proven to be real peer learning activities stimulating cross-fertilization between all the members of the networks. In this way, the networking across the project was also strengthened.
- ★ The creation of a Community Board to promote the local involvement in innovation in science and mathematics education and support the sustainability of what was started up during the project. Even if not all partners have set up a real Community Board, yet the foundations have been laid to further develop this in the near future.
- ★ The development and the implementation of the activities in the five cross-cutting working groups which have enabled all partners to share specific expertise. The European training workshops and the companion resources developed by these 5 groups will prove to be very useful for all those who want to promote IBSE/IBME and set up and implement reference centres.
- ★ The activities of the scientific committee which has clearly defined the framework of key principles which were the basis for the Fibonacci project. The three background resources developed by the scientific committee have been useful while implementing the project and will offer valuable theoretical background to others starting to work on IBSE/IBME.
- ★ The development of various forms and models of continuing professional development (CPD) ranging from short CPD of one day to CPD of 40, 70 and even 120 hours resulting in some cases in credits being given to the teachers involved. Furthermore also the fact that in CPD not only teachers were involved but in some cases future teachers and even engineering students who support primary school teachers.
- ★ The fact that most of the RCs and TCs have not only focused on CPD but have also made efforts to set up courses or modules for pre-service teacher education to enhance continuity in innovation in science education through IBSE/IBME.

Fibonacci in numbers

- ★ The Fibonacci network = 12 References centres, 12 Twin centres 1, 13 Twin centres 2, 25 Twin centres 3, i.e. 63 partners in total with the European Coodination, in 31 countries.
- ★ Number of teachers involved: 5908
- ★ Number of pupils involved: 306618 = twice the minimum number of teachers set at the beginning of the project, and 7 times the minimum number of pupils
- ★ 19 centres in both science & mathematics
- ★ 16 centres in science only
- ★ 2 centres in Mathematics only

New resources

University of Klagenfurt, Austria

Austrian teachers participating in the Fibonacci project wrote a short documentation on their projects answering the following five questions: What did you do? How did it go - what was surprising? What materials did you use and how do you see them now? What did you observe with your students? What would you recommend another teacher doing «your project» to have in mind?

All the teacher reports were assembled into one booklet (for each year), which can be downloaded at http://ius.aau.at/fibonacci/articles/view/7. Many of the reports exceeded the expectations of a short documentation, and proved to be detailed accounts of individual experi-

ments, their sequencing and student reactions. They demonstrate the enthusiasm with which the teachers started to engage in inquiry based science.

Hogeschool van Amsterdam, Netherlands

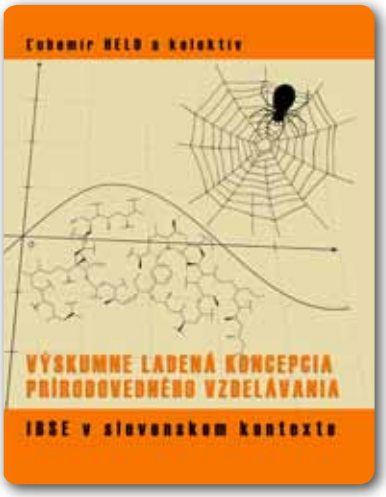
Amsterdam Fibonacci will publish a Dutch and an English language booklet on pre-service teacher education describing two different approaches to strengthen the IBSE component of pre-service. Amsterdam Fibonacci also contributed to the content and publication of a Dutch language book (150 p) on Learning by Inquiry and Design with Students Age 4 - 14 which will be published by the Dutch Science Teachers Association in March with a recommendation of the President of the Royal Academy of Sciences. The book contains 40 articles on successful IBSE classroom activities ranging from easy to implement to more complex, and emphasizing different aspects of the spectrum of inquiry and technological design skills and methods to develop them in children.

University of Trnava, Slovakia

A new book about Inquiry Based Science Education was published in Slovak:

Held, Ľubomír, et al. (2012): *Výskumne ladená koncepcia prírodovedného vzdelávania - IBSE v slovenskom kontexte (Inquiry Based Science Education in Slovak Context).* Trnava: Typi Universitatis Tyrnaviensis, 2012. ISBN 978-80-8082-486-0

During the three years of the project, the local Fibonacci team established and continuously developed specific CPD courses dedicated to inquiry-based science education in ISCED 0, ISCED 1 and ISCED 2 levels of science education. According to previous experiences with different kinds of courses for in-service teachers we realized that if we wanted to bring a change to science teaching practice we needed to bring a change to teachers' inner concepts of teaching (teachers' beliefs). This is why we decided to prepare a very intense course focusing on the principles of inquiry-based activities as we wanted to lead the teachers not only to use the already prepared IBSE activities, but to understand inner principles of the activities anchored in the development of specific science process skills. What we lacked was a textbook for teachers where all the principles would be explained. We decided to use our rich experience in implementing IBSE activities in the teaching practice and we prepared a book about inquiry in elementary education to help the teachers with studying this specific topic.



The book explains the core ideas of IBSE in relation to the specific conditions of the Slovak education system. The main ideas of the book are based on the theory of constructivism. The pedagogical effect of IBSE activities is explained by a process of cognitive conflict and the modification of pupils' naive ideas about investigated phenomena. The work with pupils' preconceptions is explained as a vivid part of scientific literacy development. Step by step, specific examples of teacher's interventions are analyzed according to the development of science process skills. All the mentioned content is supplemented by recommendations for teacher's practice. Finally, a specific algorithm of scientific thinking used during an inductive thinking process is explained and methodological notes for effective application are listed.

The book consists of following chapters:

- Global tendencies in European education
- Level of science literacy as a starting point for rebuilding science education
- Initial conditions for implementation of IBSE into the Slovak educational system
- Constructivism as a theoretical basis for IBSE
- Dealing with a crisis of science education by the implementation of IBSE
- Actual design of IBSE
- Pedagogical principles of IBSE
- Supporting the implementation of IBSE via the involvement of the scientific community

The book is dedicated to those teachers who would like to become familiar with inquiry-based science education and its practical application into teaching practice.

St Patrick's College, Dublin, Ireland

Fibonacci Ireland: Resources and Future Developments

For the past two years of the Fibonacci project, members of the Irish Fibonacci professional development team have been collaborating with the Irish National Teachers Organisation (INTO) www.into.ie to develop a National programme for Continuing Professional Development (CPD) on teaching Nature of Science in primary schools. As part of this collaboration the INTO co-funded the making and publication of a DVD on teaching Nature of Science in primary schools. Two of the Dublin Fibonacci teachers (Siobhan Ni Threasaigh, Bayside Senior School, and Sinead Lally, St Pius' Boys' School) were videoed teaching about different aspects of Nature of Science using innovative inquiry-based approaches. These lessons exemplified some of the innovative methodologies for teaching about Nature of Science in primary classrooms that were developed over the course of the Fibonacci project. The DVD is going to be used as a teaching resource for a National CPD programme. Dr Cliona Murphy (principal CPD facilitator) and Siobhan Ni Threasaigh and Emer O Connor (two of the Dublin Fibonacci teachers) are currently developing this 20 hour National CPD programme, which is going to be piloted in July 2013. Siobhan and Emer are going to be the programme facilitators on the pilot.

École des Mines of Saint-Etienne, France

Documentary: "Ice cubes drifting with the current" (original French title: "des fils et des glaçons")

The film "Ice cubes drifting with the current" was made in a French school (école de Veüe de Saint-Etienne). It shows pupils between 6 and 8 years old working on two different topics: electricity and water.

In this film, you will witness a science learning session where two teachers mix their classes to promote mutual support among their pupils. In these sessions, the teachers are working with boxes of material and learning resources from the Fibonacci project.

The first theme is electricity and pupils must find a way to light the nose of a clown. The second theme is water. Pupils experiment with the different states of water (liquid and solid) by completing a series of challenges.

The teachers were also accompanied by a science student from a technical school as part of the ASTEP program, which provides support to school teachers, involving in-class support by science and engineering students.

Overall, there are 40 different science themes available for free at http://www.ccsti-larotonde.com/Programmation,343.

If you want to receive a DVD, please contact Emmanuel Baroux : baroux@emse.fr

In the press

The Fibonacci sequence: multiplying IBSE teacher training across Europe, an article by Wynne Harlen in Roots, November 2012

In this article, Wynne Harlen introduces the Fibonacci Project, and explains why the promotion of inquiry-based science and maths education in primary and secondary schools is fundamental to Fibonacci's development of teacher training centres around Europe.

Acknowledgements

It is somehow paradoxical that a project based on the indefinite expansion of the Fibonacci sequence would stop only after the third generation of Fibonacci centres. Intellectually seducive on paper, the Fibonacci model also passed the test of the field and, through its twinning mechanism and associated support system for teachers and teacher educators, proved to be very effective in disseminating IBSE and IBME across Europe.

Of course, this could not have been done without a constant and careful steering from all the partners involved, starting with the scientific committee (Michèle Artigue, Peter Baptist, Justin Dillon, Wynne Harlen, Pierre Léna), whose devoted and demanding attention to the project, and acute expertise in the area, enabled to maintain a high standard in the activities developed, while producing some truly reference documents on inquiry-based learning in science and mathematics.

As a learning process, the project also owes a lot to the sharp scrutiny of Educonsult, the external evaluator, to Yves Beernaert and Magda Kirsch, whose experience and recommendations always came as precious and inspiring formative assessment for the project as a whole.

As based as it may be on a mathematical model, Fibonacci was above all a very concrete project, grounded in the realities of multiple local contexts and situations. Critical for a successful implementation on the field was the role of all the coordinators of the Fibonacci centres. It is not possible to name them all here, but they certainly deserve the bulk of the credit for making an attractive idea come true, and, overcoming all the difficulties, stimulatingly engaging with teacher educators, teachers and pupils, who, as the end-targets and essential players of the project, should be warmly thanked for enthusiastically taking part in all the Fibonacci activities.

Last but not least, our gratitude goes to the European Commission, whose trust and meaningful support deserve rightful recognition, as they simply made the project possible, as much as its continued investment in inquiry-based science and mathematics education must be saluted and encouraged. This way, one can hope that the Fibonacci sequence of centres for science and mathematics education can be deployed further on the educational map of Europe, and that more research and development can be done in effective teacher professional development, teaching and learning models, thus contributing to reaching the long-term objective of successfully renewing science and mathematics education.

What is the Fibonacci Project?

The ambition of the Fibonacci Project is to contribute to the dissemination of inquiry-based science and mathematics education throughout the European Union, in ways that fit with national or local specificities. It defines a process of dissemination from 12 Reference Centres to 25 Twin Centres, based on quality and a global approach. This is done through the pairing of Reference Centres selected for their extensive school coverage and capacities for transfer of IBSME with 12 Twin Centres 1 and 13 Twin Centres 2, considered as Reference Centres-in-progress.

Started on 1st January 2010 for a duration of 3 years, the project is coordinated by the French *La main à la pâte* programme, with a shared scientific coordination with the University of Bayreuth (Germany).

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