IBSME IN THE CZECH REPUBLIC

Libuse Samkova

Faculty of Education, University of South Bohemia, Ceske Budejovice

This text focuses on a work of a newly established Fibonacci Twin Centre Budweis. It provides an overview of the process of how the new centre identified the needs of their teachers, what action should then take place, and an evaluation of the initial 6 months of work. It also shows three interesting examples of implementing inquiry into financial literacy education. Final section offers one of the ways to positively motivate teachers for inquiry activities.

Keywords: IBME, inquiry, financial literacy, concept of education

Introduction

The University of South Bohemia in Ceske Budejovice (Budweis) joined the Fibonacci project very recently in September 2011, as a substitute for TC1 Santander. The staff of the Twin Centre Budweis is located at the Faculty of Education, at the Department of Mathematics.

As a subordinate to RC Bayreuth, the Centre focuses mainly on inquiry in mathematics.

The concept of Czech education

First of all we would like to acquaint you slightly with the concept of education in the Czech Republic. This concept is based on teachings of Comenius (the principle of illustrative nature of teaching), and on the John Dewey's logic of science (by practical work and active experimentation we create a theory of experience).

The obligatory document for teaching at primary and secondary schools in the Czech Republic is the Framework Education Programme (FEP). The FEP for primary and lower secondary education says:

*"An important part of mathematical education consists of **Non-standard application tasks and problems** that may be largely independent of the knowledge and skills of school mathematics, but in which logical thinking is required. These tasks should be present in all thematic areas throughout basic education.*

Pupils learn to deal with problem situations and tasks of daily life, to understand and analyze the problem, to organize data and conditions, to draw sketches of situations, to solve optimization problems." Research Institute of Education in Prague. (RIEP, 2007b)

The FEP for upper secondary education (grammar schools) says:

"Mathematical education helps cultivate abstract and analytical thinking, develops logical judgment, and teaches clear and factual reasoning aimed at finding objective truths rather than defending one's own opinion.

The focus of the instruction lies in mastering the ability to formulate a problem, along with a strategy to solve it, in actively mastering mathematical tools and skills, and in cultivating the capability of applying these skills." Research Institute of Education in Prague. (RIEP, 2007a)

So, the previous quotes show that IBME education is in accordance with the basic principles of mathematical education at Czech primary and secondary schools.

TC1 Budweis

Our Twin Centre decided to concentrate on lower and upper secondary schools. The reason is clear: we know well skilled secondary school teachers who cooperate with our university for a long time. The initial portfolio of our Fibonacci schools consists of two basic schools, a grammar school (gymnasium), an integrated technical and vocational school, and a secondary vocational school of mechanical engineering & construction.

Czech teachers know almost nothing about IBME, but some of them use the methods of IBME in their teaching for years. These 'natural IBME' teachers had priority in our Fibonacci team. The Fibonacci team was reinforced by selection of teachers who have worked with us continuously for a long time: six in-service teachers with best skills for IBME have been trained within the initial training session as mentor IBME teachers.

All our mentor Fibonacci teachers teach mathematics plus one or two other subjects such as biology, descriptive geometry, IT, chemistry, technical training. We want to take advantage of this interdisciplinary background, so that we prepared the following two fundamental tasks for them:

TASK No. 1:

The mentor teachers were asked to review their non-mathematical subjects to identify where mathematics is used as a tool. Then, they were guided to suggest how to link the two subjects.

The objective of this task is clear: The teachers (and therefore their students) will understand the mathematical ideas in a form and context that is useful for the non-mathematical subject.

TASK No. 2:

The mentor teachers should review their mathematical activities to identify where inquiry activities can be applied.

In both cases, the mentor Fibonacci teachers (with help of the TC staff) compose learning environments with appropriate methodological materials, and test them in their classes. The mentor teachers also help other teachers with the use of the learning environments in other classes.

Materials already debugged and tested are posted on our project web (Samkova, 2012). You may also find there some samples of students' completed worksheets.

Financial literacy topic

In addition to this multidisciplinary approach, the TC1 Budweis initiates the development of learning environments on a very needful topic: "Improving financial literacy".

From the perspective of the school curriculum in the Czech Republic, financial literacy is partly a component of mathematics lessons, and the other part is a component of social science lessons.

Because the topic is a slightly new component of the curriculum, Czech secondary teachers lack textbooks and learning environments.

Essentially, the financial literacy topic is very appropriate for IBME approach.

Members of our TC concentrate on the financial literacy topics for a longer time, as evidenced in (Hasek & Petraskova, 2010), (Dvorakova et al., 2011), (Hasek & Petraskova, 2011).

We want to share with you three nice examples of IBME approach to financial literacy issue.

The first and second examples have been successfully tested at a vocational school with lower performing students, with a very good response.

Example No. 1> "Where to fill the tank of our family car"

The first example deals with the real-life use of linear functions.

TASK FOR STUDENTS:

Check the price of gasoline (or diesel) around the place you live, and decide to which gas station it is worth going to fill up your family car (a full tank, 10 L, 20 L, 30 L ...).

Present the results of your investigation.

Students work out the task as an individual homework.

At the initial lesson the teacher discusses with students what input data are needed for proper grasping the problem, and writes down the list of questions raised:

- which kind of fuel their car needs (gasoline/diesel)
- how big is the tank of their car
- what is the average consumption of the car
- where are the nearest gas stations around their house
- what is the distance of each gas station from their house
- which gas station is regularly driven by (so that they don't need an extra drive to fill up the car)
- which amount of money has the family each month for buying the fuel
- …

Students should be able to analyze the costs associated with running a family car, and

- draw a graph (or a table) of a linear function expressing the dependence of price for 1 liter of fuel on the amount of fuel pumped, including the cost of the transport to a given gas station
- represent different gas stations in a common graph (or table)
- compare the gas stations, evaluate the results

- present the results
  - to the teacher and schoolmates at the next lesson: for getting a grade/mark,
  - to parents at home: for saving family money.

Example No. 2> "Home electricity costs and consumptions"

The second example deals with data and their collection in everyday reality. It is basically a light introduction to statistics.

TASKS FOR STUDENTS:

TASK 1 – Collecting the data

A. Monitor and write down data about electricity consumption of your home appliances: cooker, stove, jug kettle, refrigerator, TV, video, freezer, CD player, radio, microwave, lights. Find out their power input; observe how often and how long they are switched on during this week.

B. Find out the price of electricity in your house.

TASK 2 – Processing the data

A. Make the necessary calculations

B. Present the results of your investigation:

- compose a list of appliances ordered by the amount of consumption during the week,
- calculate the total weekly consumption of your home,
- determine the average daily consumption of every appliance,
- determine the average daily electricity costs of every appliance.

TASK 3 – Evaluation

A. Propose some electricity saving strategies for your home.

B. Compare your results with the results of your schoolmates.

C. Try to account which attributes of home appliances effect their consumption.

Again, students should be able to analyze the costs associated with electricity in their house, meet the factors affecting the consumption of electricity, and understand how to calculate the price of electricity.

As in the previous example, the value of the topic is not only curricular. Additionally, the topic is (financially) attractive for parents. It helps deepen the interest of parents about what is happening at school, at math lessons. The prospective domestic debate on electricity costs and consumptions can reinforce the relationship of children and parents, and foster the sense of shared responsibility for family finances.

Example No. 3> "Do we understand advertising?"

The third example shows the necessity of critical thinking and financial literacy in contact with advertisements.

The example is based on a detailed analysis of a flyer issued by a company that sells shoes.

Here is a scan of an original flyer:

Since you probably don't understand Czech, here is a translated imitation of the flyer:

We shall analyze the substantive content of the flyer. As usually, the most important pieces of information are hidden in small prints, and in colours that almost merge with the background. It needs several magnifications, several colour changes and several processes of looking for a star symbol (every star at the top of the paragraph refers to two different stars at two different locations in the flyer!) to get the complete information from the flyer:

There are two clues to identify items on sale:

- the sale applies only to items that have already been discounted,
- the sale does not apply to items with labels ‘permanent discount’ or ‘permanent low price’.

Now the first question occurs in our mind: "Are there any items on sale, which means items satisfying both previous conditions?" Hopefully.

For items on sale we have two discount possibilities:

- buy 3 items, and get the cheapest one gratis

- buy 2 items, and get the cheaper one at half price

The way how to present the topic to students may be as follows:

INITIAL SITUATION
Your parents send you to the shoe store from the red flyer, and give you 40 £ to buy a pair of shoes.
If you manage to get the shoes cheaper, you can keep the remaining money.

There are a lot of additional challenge questions that can be used in a given context (even if their particular choice depends on age of students):

- Can the sale action from the flyer help you to save money when buying a pair of shoes with an original price of 40 £ ?
- Consider a group of 2, 3, or 4 friends, all needing shoes with an original price of 40 £. Suggest them the most effective way to save the money.
- What changes if the price of each pair of shoes is different?
- Find the combination of prices of 3 (resp. 4) pairs of shoes on sale such that:
    a) the friends can save more money on '1 pair is free' than on '1/2 price' action,
    b) the friends can save more money on '1/2 price' than on '1 pair is free' action.

  Is there a combination of prices of 3 (resp. 4) pairs of shoes on sale such that:
    c) the friends can save the same money on '1 pair is free' as on '1/2 price' action?
- What is the maximum possible percentage of money saved, and how it is possible to reach it?
- What are the weak points of this sale action (from a customer perspective)?
- Is it easy to find a friend who wants to buy new shoes at the same time as you (and at the same store)?
- Is it easy to find in the store 3 or 4 appropriate pairs of shoes? Appropriate means that
    a) the customer is happy with design and quality of the shoes,
    b) the shoes are available in the customer's size,
    c) the shoes satisfy all the demanding conditions of the action (already discounted, but no 'permanent discount' nor 'permanent low price').

You may probably find other interesting questions related to the situation.

Similar analysis of various advertisements develops students' critical thinking, which is a very important component of inquiry activities.

Teachers and their experience

We have interviewed teachers involved in the Fibonacci project, and asked them about their experience with IBME teaching. Predominantly they see advantages of this way of learning in the fact that

- it supports activation methods of education, individual activities, and group cooperation;

- it can be implemented into various phases of the educational process (motivation, discovering new facts, deepening the knowledge, application of acquired knowledge, acquired knowledge in new contexts, etc.).

The teachers mostly see disadvantages of this way of learning in the fact that

- the examples of IBME which include an experimental component are time consuming: not only in terms of time needed for teacher preparation, but also in terms of time needed for their realization with pupils;
- these experimental examples often require appropriate lower number of pupils at the lesson, which can be achieved by dividing the classes – an arrangement which is not always feasible.

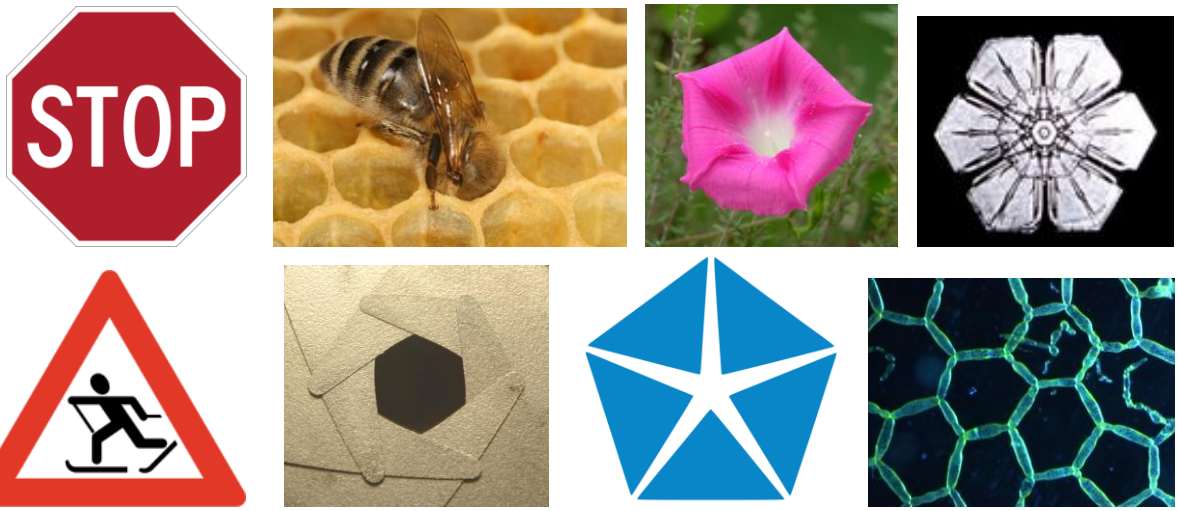
Summarized, the methods of IBME are very appropriate ways of education. But they must be properly included due to their big time demands. The use of IBME methods highly depends on the teacher's ability and willingness to use them.

An atmospheric appendix

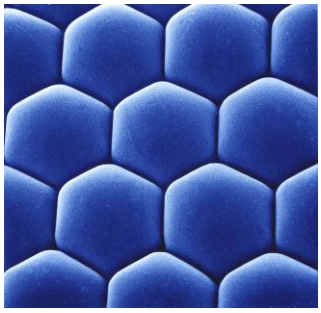
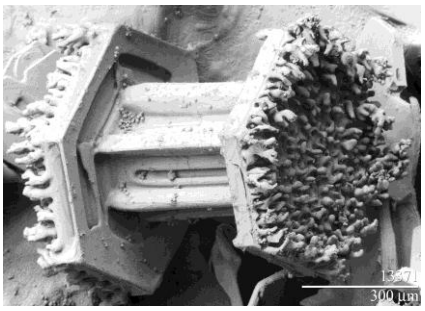
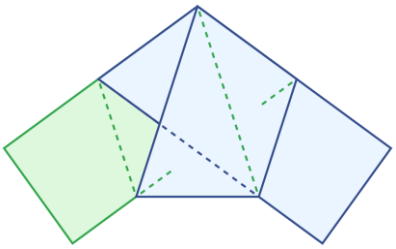
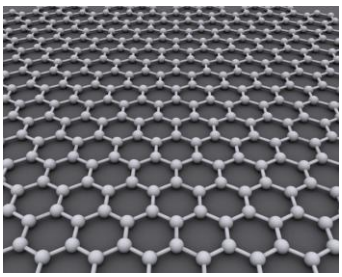
Since the IBME way of teaching is demanding for teachers, we must motivate them positively, stimulate their IBME activities, encourage them in their work, and offer them new ideas and approaches.

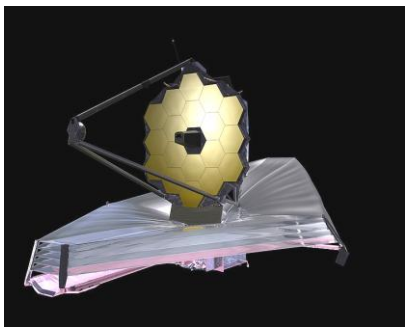
Sometimes we offer them an atmospheric impulse. For example, in the form of mathematically tuned video promotion. These videos are concentrated on mathematics around us, in our everyday life. They monitor the occurrence of mathematical shapes in nature, architecture, art, mechanics, geomorphology, microcosms, etc. Some instances are obvious, some are thought-provoking.

One of the videos is called "Regular polygons around us". It contains images of various traffic signs, buildings, technical equipment, animals, flowers, coins, magnified details of snowflakes or eyes and things of everyday reality:





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Such video presentations encourage teachers to look for new approaches to their mathematics lessons, as well as suggest different places where mathematics can be found. It offers topics for discussion on the importance of mathematics and on the presence of mathematics in everyday reality.

Some teachers take the inspiration and create similar presentations themselves. It really helps to better awareness and understanding of mathematics in an interdisciplinary context.

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