Continuous Professional Development for Raising Teachers' Self-sufficiency in IBSE

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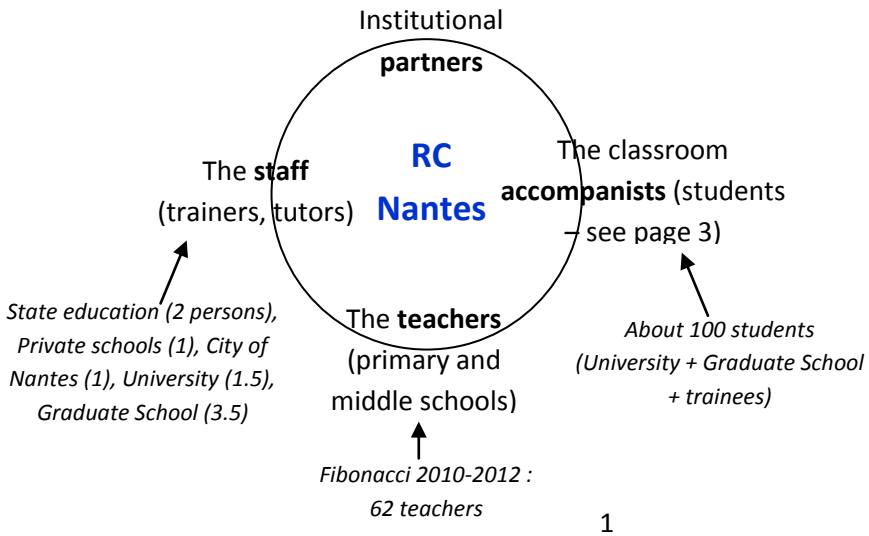
ABSTRACT : *The Fibonacci Reference Centre of Nantes (France) has designed a global 3 years process to increase teachers' self-sufficiency for using IBSE in primary and secondary schools. This process of* ***inquiry-based continuous professional development*** *(CPD) includes in-service training, classroom "accompaniment" by science students, and tutoring by senior scientist trainers. In this text, we present an overview of RC Nantes' activities and put specific emphasis on its most distinctive features: the training of teachers and their "accompaniment" in the classroom by students. We conclude by a few assessments and observations made by the staff.*

Key words : *Accompanist, autonomy, students, scientist trainer, CPD, primary school.*

CONTENTS

1. The Fibonacci Reference Centre of Nantes



RC Nantes is a network built for supporting science and technology teachers through their continuous professional development (CPD).

This Reference Centre is quite specific since most part of its trainers and staff are teachers who work at primary level or university level. No

education science expert is committed within the Reference Centre. This special feature doesn't come from a choice or a decision. It is the result of the former local development.

- The **City of Nantes** supports strongly the network through its Science Resource Centre, one of its science event organizers being part of the staff.
- A **science pilot centre**, affiliated to the French *La main à la pâte* foundation and located in the centre of the town, is a major partner of RC Nantes with its resource teacher.
- The **Science Faculty** of the University of Nantes is represented by a mathematics teacher and a nuclear research engineer who is also an expert science teacher, strongly involved in teachers' tutoring and training.
- The **Graduate School of Engineering** has been involved since 1996 in supporting primary schools for teaching science and technology. People from Graduate School are: an automatics engineer taking a PhD in science education; a nuclear physicist who has also taught physics and maths in secondary schools, an aeronautics engineer who chose to focus on hands-on, problem-based and project-based science teaching.

These people work daily in their research and teaching departments, and are allowed by their managers to devote a part of their work time to the partnership with primary and secondary schools.

All these local partners have been working together for many years before the Fibonacci Project, supporting primary school teachers' CPD. Fibonacci led them to strengthen their partnership and to build a much more consistent organization.

A major feature of RC Nantes is that **scientific students** (20-21 years old) **are an important part of the supporting operation**. This arrangement will be described further in the following pages.

RC Nantes includes primary school teachers (85% of the teachers involved in Fibonacci) as well as middle school science and technology teachers (15% of the teachers). Of course the actual needs of primary and secondary teachers are very different. In the middle schools, science teachers are keen on science but some of them don't practice IBSE so easily. In primary schools, most teachers feel more confident with literacy and they suppose they will not be able to teach science. **This text relates to primary school teachers, as well from private schools as from state schools**. Some specific supporting actions have been implemented for middle school science and technology teachers but it is not within the scope of this text.

2. Overview of activities

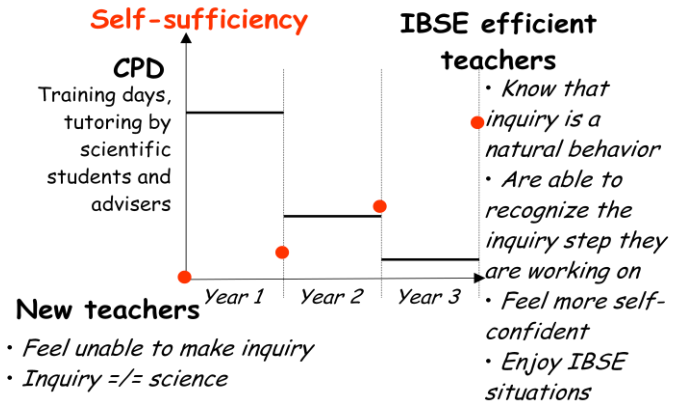
The organization of RC Nantes is dedicated to only this purpose : helping teachers to get self-sufficient for using IBSE in their classroom. The conditions for a teacher to become self-sufficient will be detailed in the last subsection of this text (§ **??**). The 3 main parts of RC Nantes' activities are :

- **In-service training days**: 2 or 3 days for the first year that teachers spend within Fibonacci (depending if they are in state or private schools), 1 day for the second year.

- "**Accompaniment**" by scientific students in the classroom (see below for the meaning of the word "accompaniment"), at a rate of *one lesson per week* : each teacher gets

support from a student for about 12 weeks during the first year, and for about 6 weeks during the second year.

- **Tutoring** by a senior teacher (4 among the 5 tutors are also scientists, i.e. engineers or researchers working in research departments). The tutor is in charge of coordinating training days and accompaniment, and supporting the twinned teachers and students. Indeed twinned work in the classroom is a fruitful but really special task ! Some teachers and most students feel quite uncomfortable at the beginning.



The global strategy for raising teachers' self-sufficiency may be described by the figure on the left. Supporting effort is much more intensive during the first year, because IBSE-starting teachers successively need to discover, test, analyse, discuss, test again with their class and hopefully finally understand what IBSE means.

The purpose of the training days is quite obvious. Tutoring is also a quite standard way of supporting teachers. These supporting activities will be described in the next subsections.

The purpose of accompaniment is to help teachers trying to apply what they learned during the training days. This special task proves to be a great help for teachers to understand really what IBSE means.

Supporting teachers	*Without training days*	*With training days*
Without accompaniment		Useful
With accompaniment	Totally useless	Very efficient

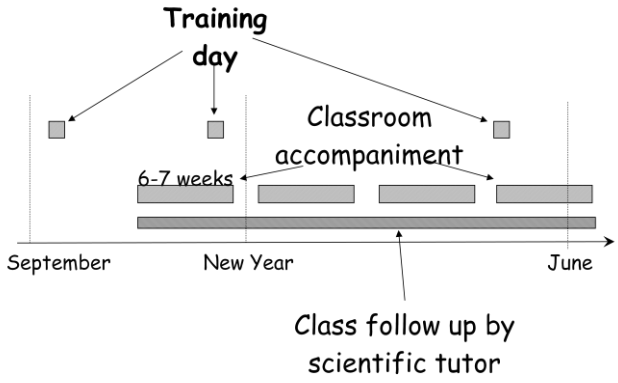
The table on the left shows that a **synergy** actually exists **between** IBSE **training and scientific accompaniment**. Indeed the three kinds of support were tested in RC Nantes. It's really clear that combining in-service training and classroom accompaniment gives the best results.

Why are the scientific students called "accompanists" ? The student **helps the teacher** to :

- **Prepare** the IBSE activities and the equipment or other resources needed,
- **Carry out** the activities in the classroom (debate, inquiry, experiment, with the whole class or with small pupils teams),
- **Analyse** afterwards what happened good or bad, and what steps of IBSE were experienced during the lesson.

As the student has **never** to bear alone full responsibility of the class, but has "only" to make things happen more easily for the teacher, his task is quite the same as the piano player who has to accompany a singer or a musician. Both accompanist and teacher have to build a **duo**.

The figure on the right sums up the organization scheme of the first year :



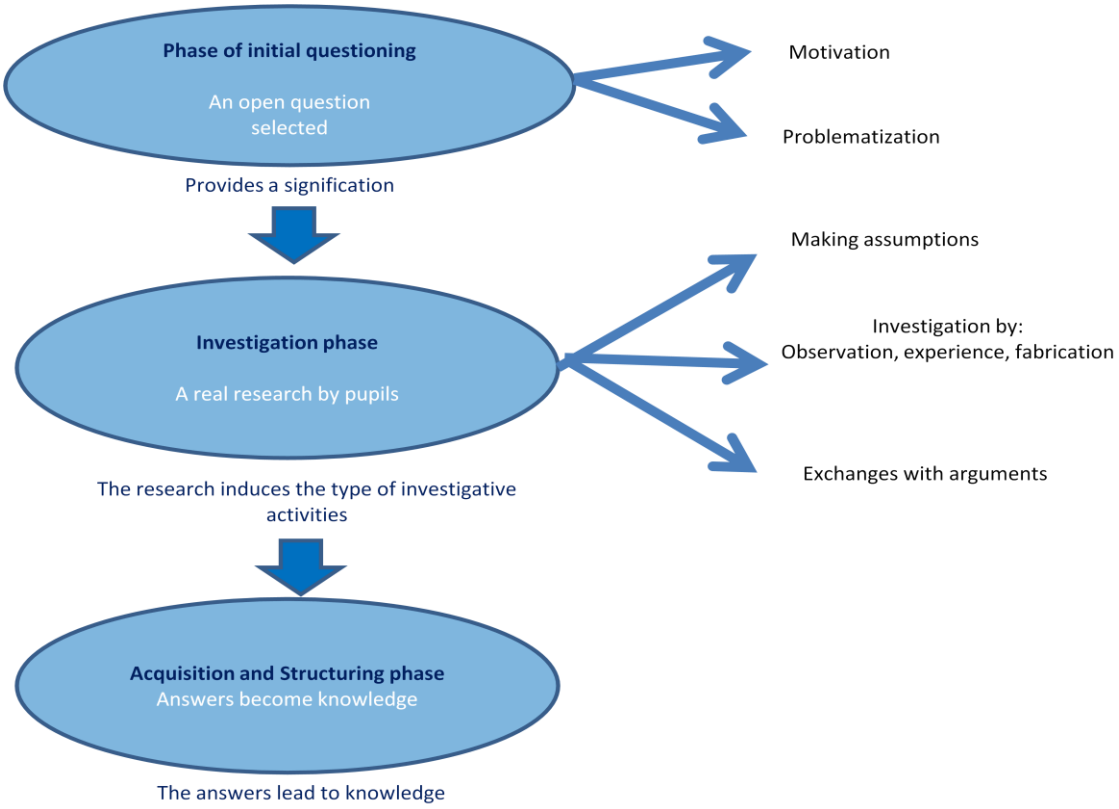
3. The training of teachers

Teacher training is done on three days at the beginning, middle, and end of the school year. This applies for teachers of the first year. For the teachers of the second year, the training is done in one day, in the middle of the school year.

3.1. The **program of the first day** (September) of training contains three parts.

- **Part 1 :** An introduction **to our vision of IBSE.**

Our field experience led us to outline an approach of IBSE like a three steps model. The following scheme represents this vision :



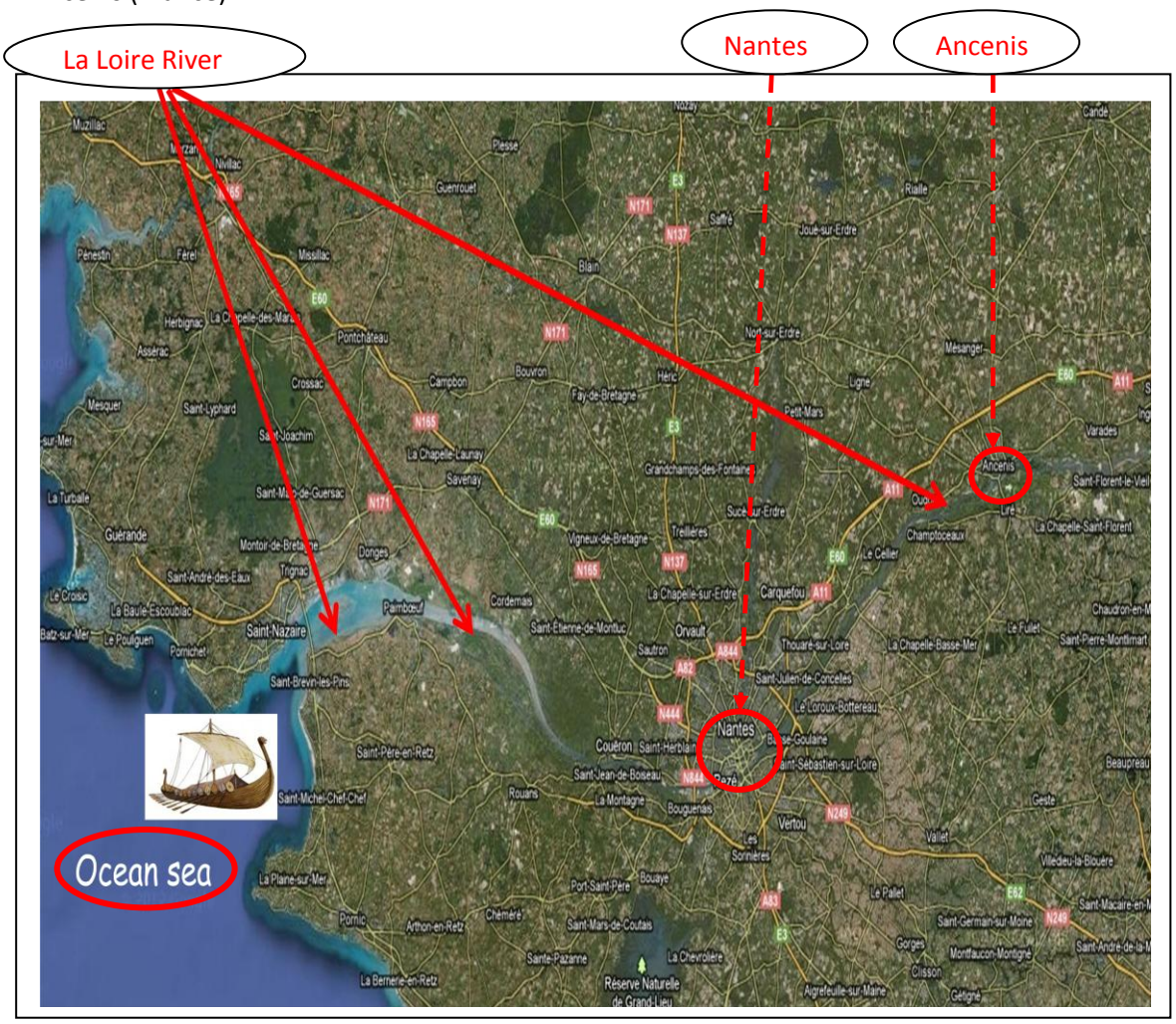
This scheme seems to suit the teachers. They fell pretty comfortable with it, because it corresponds to three key moments they encounter in other activities. As most of them are likely to teach literature, it is quite easier for them to discover IBSE as **following similar steps to writing an essay** :

- Step 1 = **Introduction** : Getting into a topic, asking questions.

- Step 2 = **Development** : Arguing about different opinions or situations, exploring thesis and antithesis.
- Step 3 = **Conclusion** : Summarizing the results, what was found, what should be kept.

- **Part 2 :** IBSE application by teachers who, being in position of pupils, have to **solve a problem** with a question in their level. This is aimed at **letting teachers experience IBSE as pupils**.

To put teachers under investigation, we present a problem situation, for example: story of a Viking's ship which sails on the Loire River from Saint-Nazaire, Nantes, and sank near the city of Ancenis (France).



- One first question is asked to teachers: *why has it sunk?*

A discussion is launched to gather ideas from teachers and to work with them to bring out a problem in the form of **a clear and simple scientific question**: *how is it possible to show that the buoyancy of an object depends on the nature of water?*

The objective of this task is to sensitize teachers to **the importance of the first step of IBSE** to motivate pupils, support them in their questioning, and in the formalization of the problem. In other words, the matter is to train teachers **to move from the general question to one more productive question**.

- **Part 3 : Work on the teaching units.**

Ready-to-use teaching units dealing with different themes are proposed to teachers. We carefully choose these units as they are quite specific for beginning teachers. Activities within these units follow a very similar scheme to that of IBSE. While teaching this unit with their class afterwards, this will help greatly the teachers to identify the fundamental IBSE steps in what they are doing.

Each teacher can choose his/her first teaching theme. Forming a group for each theme, teachers then prepare the unit in a more detailed way, with the view of using it in their classrooms (during 6-7 weeks, 1h-1h30/week) within the following weeks.

3.2. The program's main objective of training of **mid and end term** is essentially to allow more freedom and autonomy for teachers.

Midterm (February):

- Going back on units tested in class, in order to identify clearly the steps of IBSE.
- Giving examples of written records from the classroom, and examples of skills developed.
- Preparing new units for the next period with documents less detailed, which leads the teachers to more individual reflection and leaves them a degree of autonomy.

End term (May):

Following the same principle as before, but with more and more personal input, the teachers have to prepare the next year with new units. We ask them to identify the parts they will be able to manage alone in their classroom – i.e. without accompaniment.

4. The accompaniment of teachers

Each first year teacher can benefit from the presence of an accompanying scientific student in its classroom during about **two periods** of 6 weeks (about 1h to 1h30 / week), to implement the units prepared during training. This accompaniment is done by accompanists, whom are scientific students at least in 2nd year (19-21 years old)**.** These activities are valued for the students and can be taken in account within their curriculum. Every second year teacher can benefit from this support for one period (**6 weeks, about 1h to 1h30 / week**).

4.1. The accompanists

- *Who are they ?*

  - **Engineering students** :

    Free involvement from 1996 to 2005: 25 – 30 students / year

    Accompaniment = social commitment (mandatory) since 2006: 5-15 students / year

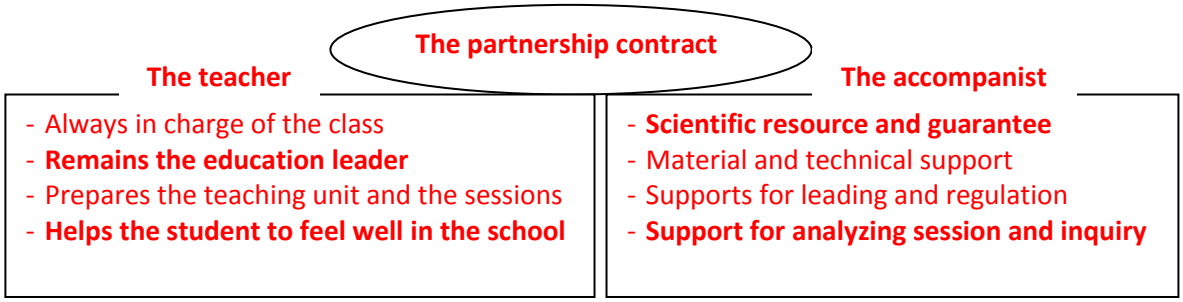
  - **Science Faculty students** :

    Part of a learning unit called "scientific accompaniment"

    75 students each year, working by pair (some intending to become science teachers).

- *What is their task ?*

  Their task is principally that of a scientific guarantee, but our field experience shows that the additional human input is much appreciated by teachers. Indeed, the **pair work** achieved by the **duo** during 6 to 15 h of collaborative teaching is fruitful for both the teacher and the student, and must be precisely defined in advance.



- *Their commitment in the year :*
  The minimum commitment for students should be 20h in classroom. The mean actual commitment is 8h to 12h, thus students usually don't spend time enough within their duo to experience a very positive situation. Unfortunately it isn't possible for them to have more time free for accompaniment, thus it is of fundamental importance to support the students. This is the task of the senior scientist tutor.

- *How can we support them ?*
  - Pre-service training : The first aid we provide to students is a training time in IBSE. We begin with a presentation and explanation of the steps model. Then, in position of pupils, students must use this method to solve a problem with a question in their level.

  - Explain the respective position of students and teachers, showing some examples found in the previous years' reports, photos and videos.

  - Examples of units : We encourage and help students to familiarize themselves with the same modules they will use in class.

  - An early meeting is organized between the teacher, the accompanist and the tutor.

  - On the field coaching during the initial sessions : The tutor, who is himself a teacher and a trainer, is therefore legitimate to intervene in the classroom. He has to participate at least at the first session, and if possible at one other.

  - Monitoring and supervision by the tutor throughout the accompaniment : Teaching the accompanist how to analyze the activities after the session (real-time analysis).

4.2. Monitoring of the accompaniment

This important part of the partnership contract with teachers is done by three ways :

- *Exchanges teacher/ accompanist :*
  Assessments are made regularly at the end of each session (each lesson) in classroom. The accompanist fills, in conjunction with the teacher, a document prepared by the staff, which will be used in his exchanges with the tutor.

- *Exchanges accompanist – tutor :*
  Weekly exchanges are carried out to see what happens in the classroom. For its analysis, the duo uses the document mentioned above. The main idea of this exchange is whether IBSE is followed, and how the teacher appropriates the different phases of the 3 steps model. This time is designed for following up the development of teachers' autonomy.

- *Exchanges tutor – teacher :*
  The exchange starts at the first training day and then continues by mail, phone, and of course the classroom visits.

5. Major features and conclusion

As a matter of conclusion for this text, we give in the following subsection some of the assessments and observations that were made by the staff since the beginning of the Fibonacci project.

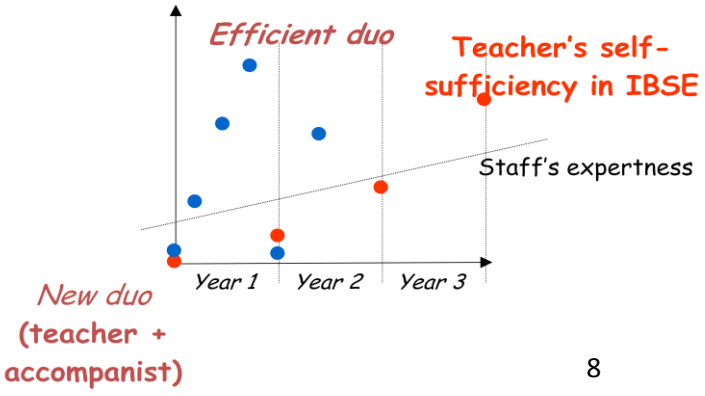
- **Concerning the supporting strategy developed for the teachers :**

For many teachers, IBSE proves to be a very difficult task to understand. One reason for this is very clear: mastering IBSE means having a good scientific background AND having achieved a positive experience of inquiry.

RC Nantes' strategy for reaching this goal is to have the teachers experiencing **INQUIRY-BASED CPD** during at least two years and more if possible. Referring to the three steps of IBSE as described page 4, the following table shows that **each teacher has to travel all over every step of inquiry**, thanks to the whole **integrated training and supporting operation** (= *in-service training* + *accompaniment* + *tutoring*) :

Step 1 - Initial questioning	*Discovering inquiry and teacher's tasks in IBSE* *Building the teacher's project for the year*
Step 2 - Investigation	*Discovering first a ready-to-use teaching unit* *Testing it in the classroom with an accompanist* *Real-time lesson post-analysis*
Step 3 - Acquisition and structuring knowledge	*Global post-analysis with the tutor* *Sharing experiences with other teachers* *Building together a new teaching unit*

- **Concerning the whole network (teachers + trainers + scientists) :**



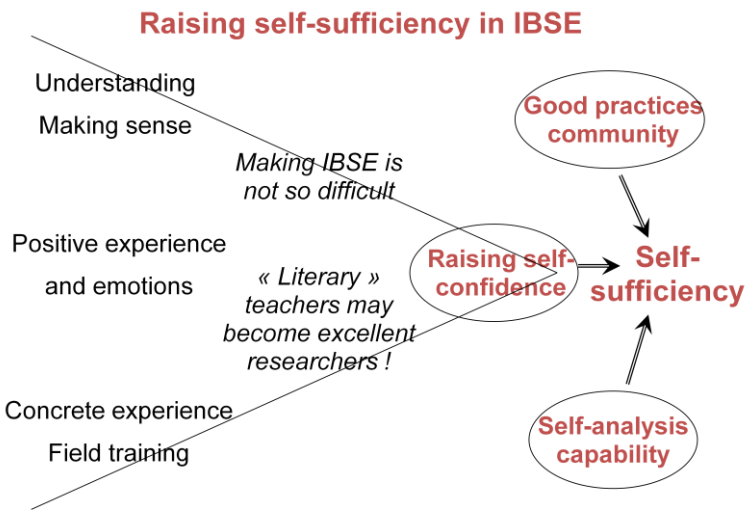
Collective working situations within the partnership are in permanent move. For teachers and accompanists, each time a new duo meets, it has to invent its own way of working together. Thus the tutor's support is very useful. Although the duo's efficiency starts each year at nearly 0, the teacher's

understanding of IBSE increases from one year to the other. From the staff's point of view, there is a lot to learn from these situations.

- **Concerning the assumption of raising teachers' self-sufficiency in IBSE :**

The following figure shows, from left to right, how **inquiry-based CPD** may give the teachers good experience simultaneously **in the 3 basic areas of human activity** :

1°) *thinking* (understanding) 2°) *emotions* 3°) *action*



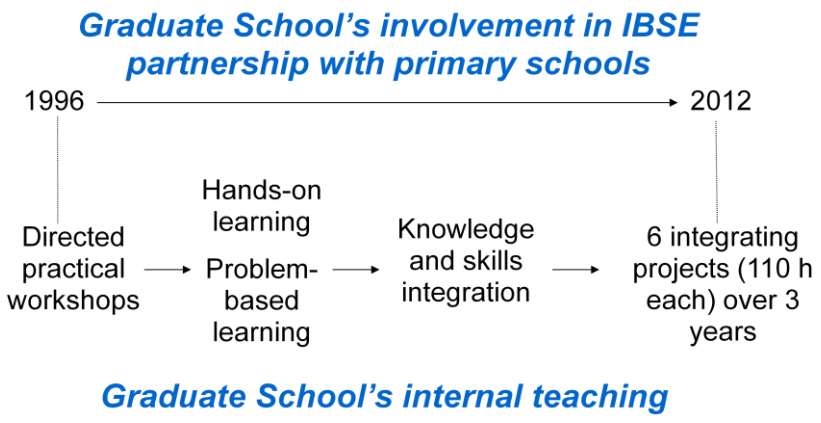
➢ We assume that **the key** of the improvement of teachers' capabilities is **to raise their self-confidence**.

➢ Besides this, the RC's network is **a community of (quite good) practices** that may encourage teachers to share and to experiment.

➢ As a last feature, the main goal for the senior tutors is that the teachers will get quite autonomous in **self-analysing their own practice**.

- **Connection between teaching in primary schools and teaching for engineering students :**

There is an interesting connection between these two teaching levels that usually work together very rarely. The figure on the left shows how the teaching methods changed during the last 16 years in our **School of Engineering**. The teachers and scientists involved in IBSE partnership simultaneously had to teach physics and engineering for their 20 years old students. They thus developed very similar teaching methods, implementing IBSME and changing progressively from directed experimental teaching to project-based skills development.



This shows that **building bridges between different educative and scientific communities is a win-win strategy**. Obviously it had a quite heavy cost for our Graduate School, but thanks to these choices it has developed an open-minded concept of teaching and training. This is without any doubt very beneficial for our engineering students.