How are we doing with PROFILES in Copenhagen?

The University of Copenhagen joined the PROFILES project in November 2013. The scope for the Copenhagen team is to contribute to all work packages of the PROFILES project.

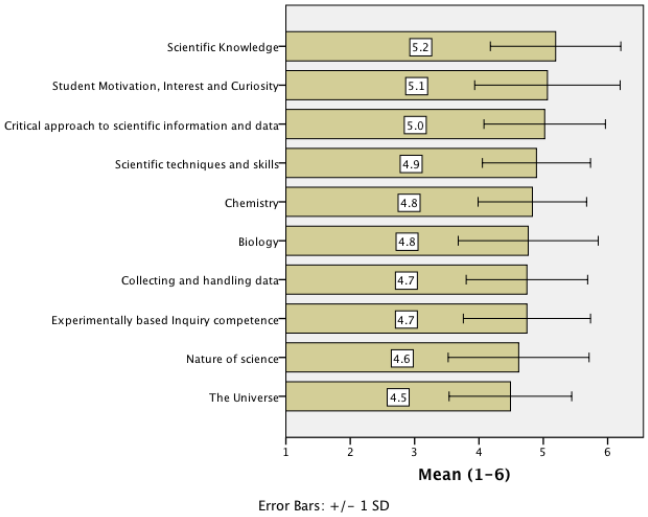
In this news brief we'll describe what we currently are doing for the WP3: Stakeholder Involvement and on the WP4: Learning Environments.

The Delphi Study

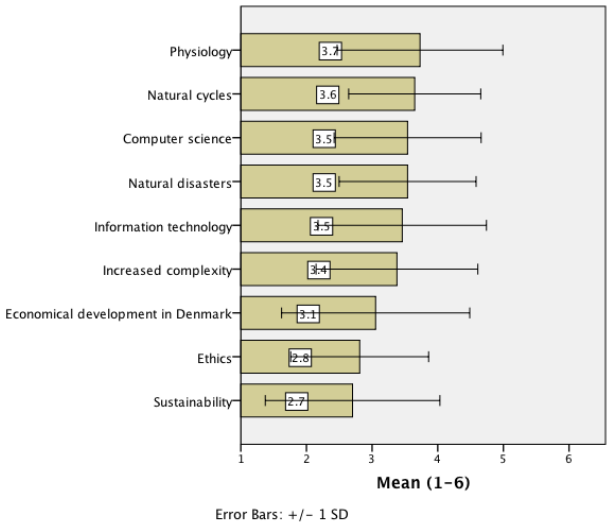
Currently we are in the process of finishing the second round of the Delphi study. Results are still coming in on the second round but we have some preliminary results that are quite interesting. Since more than 50% of the responses are from science teachers we believe that the results are relevant when related to topics taught in Danish upper secondary schools even though the sample is still very small.

	Students	Science teachers	Industry/ scientists	Scientific education researchers/ admin.	Total
1 Round					
# invitees	184 +	274 +	172	64	
2 Round					
# invitees	126	55	17	22	220
# respondents	12	38	8	11	69
%	10%	69%	47%	50%	31%

Below is the list of the top ten categories rated by the stakeholders for the second round of the Delphi study for the ideal teaching in science at Danish upper secondary schools (grade 10-12). It is interesting to notice that five of the ten categories listed as top priority clearly relates to Inquiry Based Science Education. These are: Critical approach to scientific information and data, Scientific techniques and skills, Collecting and handling data, Experimentally based science inquiry competence and finally Nature of Science. This supports the idea of the need for more focus on the skills and competences related to IBSE.



On this second chart the bottom ten categories rated by the stakeholders are listed. Again it is interesting to notice that traditional socio-scientific issues as Natural disasters, Increased complexity, Economical development in Denmark, Ethics and Sustainability are all rated as being among the least important categories for teaching. This puts an even more challenging focus on the Engage-phase of IBSE teaching since just having a socio-scientific focus does not alone ensure that the students engage in the learning process according to the stakeholders.



Learning environments

On the WP4 we have been running three courses for science teachers at the upper secondary level at Danish schools. The first two courses were due to time constraints integrated into already planned activities and the focus was not specifically on IBSE. The latest course specifically targeted teaching IBSE for the entire group of science teachers at a Danish upper secondary school.

Network of new science teachers at upper secondary schools

In December 2013 we finalized the first of our activities focusing on disseminating IBSE. Since this was the first course we integrated the teaching on IBSE into another course that focused on creating a network of teachers to support the teachers in their first years of teaching so that they on the one hand, would get an easier start in the teaching profession and on the other hand, maintains the ideas and visions about the teaching in their subjects and at the same

time through exchanges of experience faster would become familiar with how to make the transition from being scientist to becoming a teachers of science.

The course had 20 participants from 10 different schools. 4 meetings were scheduled in the network, and the idea was that groups should be formed and these groups would meet between meetings. Each meeting had a special theme. The intension of the networking was that the groups were to continue meeting after the course.

The students assessed an overall need for networks of this type but at the same time they noted that there is "very little" or "little" time to participate in such a network. It confirms our belief that as a new teacher you are very busy and do not have the time to participate in further activities. The goal of the network is, of course, also to facilitate the everyday life of the participants, but it is probably not happened to any significant extent.

Danish Science Schools

A large number of Danish upper secondary schools are members of the organisation Danish Science Upper Secondary Schools (DASG). The purpose of this organisation is (among other things) to "*develop new teaching and learning methods and new teaching materials on the basis of didactic research and new professional educational ideas … and to support teachers' skills through courses, seminars and conferences*"[1].

In 2013-2014 this organisation ran a course on Inquiry Based Science Education and Green Technology. Approximately 25 teachers from the participating upper secondary schools attended the course. The scope of the course was to visit a range of green technology projects to offer some on-site experience to the teachers attending the course and secondly to develop teaching materials for teachers to use in their classes when teaching on green technology subjects using an IBSE approach. The University of Copenhagen was involved in planning and running the IBSE focus in this course.

Summary on teacher experiences from the first two courses

We have made interviews with some of the attending teachers on these courses on their experiences with the course and their experiences when working with the classes they teach at their home schools using the IBSE approach to science teaching.

This note is a summary from these interviews. The findings are categorised under four headings:

- What are the problems seen by the teachers when using the IBSE approach when teaching science in upper secondary?
- What are the challenges when teaching the IBSE way?
- What are the advantages obtained when teaching using the IBSE concept in science teaching?
- What do the teachers find are the keys to success of IBSE based science teaching?

Problems

Listed here are the problems mentioned by the science teachers in these interviews on IBSE based teaching:

- Teaching using the IBSE approach reduces science to inquiry. But science is more than just inquiry.
- The IBSE approach is very time consuming and takes time from other ways of teaching.
- Some topics in science are impossible for students to do experiments on. One example is Plate Tectonics.
- For some teachers it is hard to allow the students to take the lead in class and to let them design and carry out experiments not planned and tested by the teacher.

[1] http://science-gym.dk/

Challenges

Listed here are the challenges mentioned by the science teachers in these interviews on IBSE based teaching:

- When using the 6F (the Danish version of the 5E model) the "Fang" (equals Engage) step is hard. Furthermore it is critical to the success of the following phases and does not necessarily engage all students.
- IBSE is hard for the students. It requires a change in the contract between student and teacher regarding the role of the two parties. Who's responsible for what? The students expect the teacher to be responsible for teaching and making sure that the students are learning. It is not enough for the teacher just to facilitate.
- Students need to learn to do IBSE. It requires training.
- 6F (or 5E) and IBSE has a build in dilemma. To be successful IBSE requires to be practiced over and over again. But then again this may be boring for the students to do the same over and over again.
- In the first phases of an IBSE course the teacher will encourage the students to investigate to come up with an answer and suggest solution to their problems. However at the end of the course the teacher may need to tell the students that their conclusions to their experiments and their answers to their hypothesis are wrong. We – as teachers are forced to take on another role as "judges". This role differs from the role of guide and consultant in the first phases of the course. A new role that we have refused to fill during the entire course. It changes the role of the teacher.

Advantages

Listed here are the advantages mentioned by the science teachers in these interviews on IBSE based teaching:

- Not all students possess the same skills. The IBSE approach allows students to form groups that reflect the skills and the level of ambitions of the students thus allowing for a differentiated teaching environment.
- Based on experience. If the students are actually engaged they can solve the challenges and successfully do IBSE.
- Also based on experience – there is time enough in science classed to do IBSE.
- One (additional) reason for doing IBSE is that the students will develop additional skills on top of their basic science training. They do develop the "meta-skills" side by side with their science knowledge.
- IBSE is not just about making experiments. IBSE is also searching for information in textbooks, in YouTube videos, Ted Talks, graphs, tables etc. It allows for a great deal of flexibility.
- IBSE does not mean that you as a teacher are not allowed to teach the students. The difference is that you teach the students when they experience that they have the need for it. And you answer their specific questions. But you do not hand them readymade guidelines for performing the experiments.
- When you manage to engage some students in class this will often "infect" other students to also participate and they involve themselves in performing the tasks required to perform experiments.
- Students are more willing to share their findings from their experiments with others following a more open and self-directed and self-guided course than students normally are following a traditional course.

Keys to success

Listed here are the keys to success mentioned by the science teachers in these interviews on IBSE based teaching:

- Teaching based on the IBSE approach often requires skills and knowledge on multidisciplinary subjects. Most teachers do not possess this knowledge. This challenge can be supported by setting up fora for teachers to exchange ideas, discuss problems, ask for help etc.
- Make sure that your focus on innovation and entrepreneurship goes hand in hand with your focus on IBSE.
- Obstructions may be one way to steer the students in the right direction or to rethink their experiments or their findings.
- "Traditional" problem and project based learning has the focus mostly on the role of the students. The 6F (or 5E) focusses on the role of the teacher. And the focus is on the teacher's role as a guide throughout the process. Hence not letting the students alone with their challenges but is setting up a scenario for the guidance to take place in each step of the model.

- If the students are not engaged the IBSE setup will die. The Engage phase is essential.

IBSE course at the Odsherred upper secondary school

In May 2014 we held the first course specifically focused on IBSE. We invited all science teachers at one selected school to participate. The learning objectives for the course were: *"After this course you will ...*

1. *... have knowledge and experience in Inquiry Based Science Education*
2. *... have experience of implementing IBSE with your students*
3. *... implement a language among the participating teachers on the main pedagogical / didactic terms when working with IBSE"*

The outline for the course was as follows:

Day 1	**Time**	**Subject**		
	9:00	1) **Welcome**		
	9: 25	2) Example of IBSE in practice: **Event 1: Physics**		
	10: 10	**Pause**		
	10: 20	3) **What happened?**		
	10: 50	4) Example of IBSE in practice: **Scenario 2: Mathematics**		
	11:35	**Lunch**		
	12:10	5) **Plenar debate** -> 5e teaching model		
	12:40	6) The teachers are divided into groups to develop **material** for IBSE based courses 12:40 Groups established 13:00 The groups choose a theme and groups working 13:30 Dating (share ideas) 13:45 The groups continues working 14:30 Voluntary presentation from a group of first stage		
	15:00 to 15:30	7) Status, new groups?		
Day 2	**Time**			
	9:00	8) **Today's plan**		
	9:10	9) **Testimonials and frustration:** How did it go? What can you achieve with students? Challenges? Learning outcomes? What is good and not good? How to comply with regulations? How do we evaluate?		
	10:00	1 0-1) Groups that did not finish yesterday **continues.**	1 0-2) Groups that are ready can either create new courses or **practice** how to use the material to another group.	10-3) Groups who will not practice prepares a plan for summative **evaluation** of both skills and core competences in their course
	11:35	**Lunch**		
	12:10	**Microteaching:** The groups (2 and 2) test their progress		
	13:10	Pause		
	13:25 to 14:00	**Plenary – final evaluations and plans for August activities**		

Day 3

The final day for the course will take place in September when teachers all have had a chance to meet with their classes and will have introduced the IBSE teaching approach to the classes. We will then gather the experiences and discuss experiences with the participating teachers.

Planned activities

Two more courses are planned similar to the one above but due to the summer vacation these will set off in early August. To accompany the courses we are writing on a compendium to support the participating teachers and to support their tast as leading teachers ahead.

Who's involved at Copenhagen University

At the University of Copenhagen Jan Alexis Nielsen (Assistant professor), Lærke Bag Jacobsen (Consultant of Research Activities), Klavs Frisdahl Jacobsen (Consultant of Research Activities), Claus Jessen Jacobsen (Consultant), and Fie Lykke Hansen (Student helper) are all working on the PROFILES project.