



# PROFILES



Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science

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### Case Studies (1<sup>st</sup> Period)

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Interim Report on Case Studies First Round of the UCPH Working Group

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## 1. Introduction

A large number of Danish high schools are members of the organisation Danish Science High Schools (Danske Science Gymnasier, 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”* .

In 2013-2014 this organisation ran a course on Inquiry Based Science Education (IBSE) and Green Technology. Approximately 25 teachers from the participating high 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.

On the last day at the course – when groups were finalising their projects and finishing developing their materials Lærke Bang Jacobsen and Klavs Frisdahl from the Department of Science Education - a part of the Faculty of Science at the University of Copenhagen (Institut for Naturfagenes Didaktik på Københavns Universitet) interviewed 7 of the attending teachers 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 case study presents 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 high school?
- 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?

## 2. Danish Case Study - Example 1 - Summary results

### 2.1. Problems

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

1. Teaching using the IBSE approach reduces science to inquiry. But science is more than just inquiry.
2. The IBSE approach is very time consuming and takes time from other ways of teaching.
3. Some topics in science are impossible for students to do experiments on. One example is Plate Tectonics.
4. 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.

### 2.2. Challenges

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

1. 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.
2. 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.
3. Students need to learn to do IBSE. It requires training.
4. 5E and IBSE have 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.
5. 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.

### 2.3. Advantages

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

1. 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.

2. Based on experience. If the students are actually engaged they can solve the challenges and successfully do IBSE.
3. Also based on experience – there is time enough in science classed to do IBSE.
4. 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.
5. 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.
6. 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.
7. 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.
8. 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.

#### **2.4. Keys to success**

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

1. 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.
2. Make sure that your focus on innovation and entrepreneurship goes hand in hand with your focus on IBSE.
3. Obstructions may be one way to steer the students in the right direction or to rethink their experiments or their findings.
4. “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 teachers’ 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.
5. If the students are not engaged the IBSE setup will die. The Engage phase is essential.