

## 4.6 Case study 6 (CS6 Germany)

<b>Concept focus</b>	Crash test investigations
<b>Inquiry skills</b>	Developing hypotheses Planning investigations (carrying out investigations) Working collaboratively (debating with peers)
<b>Scientific reasoning and literacy</b>	Not assessed
<b>Assessment methods</b>	Classroom dialogue Teacher observation Self-assessment Student devised materials (documentation of inquiry)
<b>Student group</b>	<b>Grade:</b> lower second level, physics class <b>Age:</b> 13-14 years <b>Group composition:</b> co-ed (30 students) <b>Prior experience with inquiry:</b> No prior experience in inquiry

In this case study, a cohort of lower second level students was introduced to inquiry by considering the collision of an egg as a model for crash test investigations. The skills chosen for assessment were *developing hypotheses*, *planning investigations* and *working collaboratively*, which were assessed formatively during the class. The teacher used observation and classroom dialogue to evaluate performance, and used the “traffic light cups” method for ensuring adequate support was provided, as needed.

### (i) How was the learning sequence adapted?

The **Collision of an egg** SAILS inquiry and assessment unit was implemented in full; the learning sequence followed the steps described in the unit with no modifications. The main idea of the lesson was that the students should plan and carry out their own crash-test investigations.

The teacher started the learning sequence with a picture of a car crash test and asked the students to describe the picture under energy aspects. The students were not in agreement if a hard or a deformable crash zone of a car would be a better protection for the passengers during a crash. Therefore the teacher described the use of eggs as objects for the crash test studies. After a discussion in classroom the students named two main variables in an experimental approach with egg crash test. First, the drop height of the egg and, second, variation of the ground on which the egg drops (e.g. a steel pot or a container with feathers) were mentioned. In the approach a variation of the ground was seen as an easy changeable equivalent to a variation of components of the crash zone of a car. In addition other variables in the experimental approach like the side of the egg that should point down were discussed. The research question that rose out of the initial part of the lesson was written at the white board: What is the maximum drop height before the egg breaks for different surfaces that the egg drops on?

### (ii) Which skills were to be assessed?

The following skills were assessed in this case study: *developing hypotheses*, *planning investigations* and *working collaboratively* (debating with peers). Assessment opportunities included teacher observation and feedback, evaluation of student artefacts and self-assessment.

The teacher used different formative assessment methods to provide feedback to the students. During the inquiry process the teacher used a method called “traffic light cups.” The methodological approach allows students to indicate their need for help during practical work by using different coloured cups (red cup: we need help urgently, yellow cup: we need help but have some time, green

cup: no problems). This method is intended to facilitate focused and purposeful feedback by the teacher.

In addition the teacher tried to give feedback on the observations he made during the lesson concerning difficulties in the experimental approach. At the end of the lesson a self-evaluation sheet was planned (Table 1). The teacher wanted to get information about students' perception of the inquiry. He wanted to know how each student valued his own role in the group work. Additionally the teacher planned six multiple-choice questions to get feedback about students' understanding about the physical concept of energy.

**Table 1: Self-assessment card for assessment of planning investigations**

Self-assessment card	I agree totally	I partly agree	I disagree
1. I was involved in the planning phase of the investigation			
2. I participated in realisation of the experiment			
3. I tried to keep focused on the discussion of the results			
4. I tried to refer to previous speakers in the discussion			
5. Now I have an idea of what to consider when I want to plan and carry out an investigation.			

### (iii) Criteria for judging assessment data

The teacher tried to get and to give feedback by the methods described previously. The assessment focused mainly on the inquiry skill *planning investigations*. The teacher described following learning goals as essential:

- Control of variables in their planning of the investigation
- Formulating testable hypothesis (*developing hypotheses*)
- Carrying out at least one experimental approach
- Communicate adequately in the groups (*working collaboratively*)
- Reflect about their individual working process.

### (iv) Evidence collected

#### Teacher opinion

The teacher described that the students had difficulties during the first phase of their investigations because many questions only arose while the students were doing their inquiry. For example some additional variables (e.g. "we have to make an agreement: when do we declare an egg broken?") appeared during the experiment and the students needed help in deciding how to proceed with their inquiry. The teacher described that he enjoyed seeing how students realised how complicated a simple investigation can get and how many decisions and agreements have to be made in the research community when comparison of different approaches is required.

He also found that the "traffic light cup" assessment tool did not work as planned. During the first part of the investigation too many students had questions, thus this specific method offered no advantage.

At the end of the investigation the teacher reported that all students managed to carry out their investigation but he had to give a lot of support. He reported that the students were not used to working in such an open inquiry situation and had many questions. As the inquiry was planned for 90

minutes he had no time left at the end of the lesson to discuss the multiple choice questions or do the self-evaluation with the students.

### **Observer notes**

A graduate student was observer at the lesson. He described that the initial part of the lesson where students discussed about the car crash test was fruitful in terms of the inquiry skill *planning investigations* but took a lot of time. The discussion raised many questions and difficulties that had to be discussed and as a result no other assessment tools could be included due to time constraints. At the end of the lesson the observer noted that a recap of the initial considerations of energy aspects at the car crash-test was not included. He reported that due to the lack of time the teacher decided to focus on a metacognitive discussion about the procedure of planning and carrying out an investigation. The control of variables was discussed intensively in the course of the inquiry activities.

### **(v) Use of assessment data**

The teacher planned to ask six multiple-choice questions to get feedback about students' understanding about the physical concept of energy (see example in Figure 1). This would be combined with the student self-assessment to evaluate their learning during this activity. However, teacher did not have sufficient time to carry out this further assessment.

*Choose the correct statement:*

- A) As the drop height of the egg gets higher, the kinetic energy of the egg at point of impact gets larger.
- B) The kinetic energy is independent of the drop height.
- C) The kinetic energy is independent of the potential energy.
- D) As the drop height gets smaller, the kinetic energy of the egg at point of impact gets larger.

**Figure 1: Example of a multiple-choice question for student feedback**

### **(vi) Advice for teachers implementing the unit**

Although the unit runs well, the teacher gave some advice for new teachers who want to do this unit with his adaptations:

- Do not underestimate the difficulties in the experimental set-ups
- It could be wise to give a bit more guidance in the phase planning of the experiments especially for bigger groups
- Spend a bit more time on implementation, especially for more theoretical issues.