

4.4 Case study 4 (CS4 Turkey)

Concept focus	Methods for collection of gases
Activities implemented	Activity A
Inquiry skills	Planning investigations Forming coherent arguments
Scientific reasoning and literacy	Not assessed
Assessment methods	Classroom dialogue Student devised materials (investigation plans)
Student group	Grade: 6 th grade, lower second level Age: 12-13 years Group composition: Co-ed; range of attainment and ability; 26 students Prior experience with inquiry: No prior experience

In this case study, the teacher evaluated student skills at the group level, focusing on *planning investigations* and *forming coherent arguments*. The teacher did not explicitly assess students' inquiry skills during the activity and instead focused on providing guidance and trouble-shooting where required. However, formative assessment was provided during the inquiry activity through question and answer sessions. The teacher also assessed the written student artefacts after the lesson.

(i) How was the learning sequence adapted?

Activity A: Design an investigation was implemented with students in the 6th grade. At this level students do not have knowledge of chemical reactions. However, they understand the concepts of physical and chemical changes in matter. Before the unit, the teacher divided students into research groups of five students.

The lesson sequence was modified to reflect the introductory nature of this topic. Where the lesson sequence suggests considering some reaction equations, this was not suitable for this grade. While students had prior learning about gases at this level, they had not gone into sufficient detail to consider the reaction equation. In addition, the students have not been introduced to methods for identification of gases. For this reason, the activity was modified, and the aim was to identify how to collect the gas formed during the reaction.

At the beginning of the lesson, the teacher carried out an experimental demonstration to engage the class and introduce the activity. After that, some questions related to the demonstration were asked, in order to elicit the students' observational data. For example:

- What is your first observation as soon as I drop a vitamin tablet into the water?
- Describe the motion of the tablet in the water?
- Why do bubbles occur after the tablet is added to water?

Students were interested in the experimental demonstration and these questions. Next, the teacher observed groups while they worked on the experiment. Every group carried out the reaction themselves. The class discussed some questions and then groups started to find an appropriate way to collect the gas that was formed during the chemical reaction.

(ii) How were the skills assessed?

The key skills to be assessed were *forming coherent arguments* and *planning investigations*. The teacher did not assess students' inquiry skills during the activity, instead focussing on providing guidance and trouble-shooting where required. The teacher's plan was to evaluate student artefacts

and their answers to set questions, preferring to evaluate a product (artefact) rather than a process. However, the teacher used questions and answer in-class for formative assessment, to enhance discussion and planning.

(iii) Criteria for judging assessment data

Assessment in this case study focused on students' skills in *forming coherent arguments* and *planning investigations*. Where groups formulated an appropriate hypothesis and conducted a process, the teacher accepted that the work was good. The teacher did not observe individual contributions, preferring to evaluate the group as a whole. It was assumed that every group succeeded in finding an appropriate way to collect the gas. However, they were not expected to answer all questions. The teacher's main expectation was that students would accomplish the task objectives, rather than have every question answered by every student. The teacher was not surprised at the end of the lesson, because everything met with their expectations.

(iv) Evidence collected

Teacher opinion

I was pleased with my students' work, because they were very attentive during the activity. Warm-up questions and demonstration were very useful to engage them (Figure 1). Moreover, I realised my student's misconception about gases during the discussion, whereby for instance they said that the bubbles would be acid. When I realised this problem, I asked extra questions to extend their reasoning for this observation. For instance I asked the question "What are the characteristics of the bubbles?" and students said it would be acid. After that, I asked, "What is your evidence to support your claim?" and they responded, "When we drink fizzy drinks, we observe bubbles due to acid. In the similar way we can say that source of bubbles would be acid." To assess inquiry skills and students' artefacts, I used assessment questions given in the SAILS unit. For example: Could they identify if CO_2 was produced? Were all members in the group involved and engaged in the task? Did they share ideas? I did not use any rubrics to evaluate students' answers.



Figure 1: Students and teacher engaged in dialogue during CS4 Turkey

Observer notes

The teacher started the lesson with an experimental demonstration. She asked students to take observation notes during the demonstration process. After the demonstration, students explained their observations and inferences relevant what occurred. Some groups mentioned that gases would cause the observed movement of the tablet. The teacher used this answer to introduce the aim of the lesson – an inquiry to plan how to collect the gas formed by chemical reaction. Students started to investigate the teacher's question. The teacher observed the students' work while they were studying in-group.

Students performed very well in planning their investigation. Almost every group had a good plan for collecting the gas. However, their first attempt at the experiment failed because students didn't estimate experimental errors in their research plan. If the teacher had checked their plans before implementation, then the teacher could have led the students to reduce experimental errors.

One of the unit goals was to identify the gas that formed during the chemical reaction, but the teacher only focused on collecting gases. In the discussion time, students mentioned features of the gas and they said that it would be carbon dioxide. Unfortunately, they did not find any evidence to support their claim. This aim is in unit plan but teacher did not focus on which gas formed. At this school level, they don't know features of gases very well.

Sample of students' artefacts

Recording of observation data

Figure 2 shows how students recorded their observation data. It is a good task, because students usually don't record observational data, especially for teacher demonstrations.

Gözlemlerimiz

- 1- Kiborçuk çıkardı.
- 2- Rengi değişti.
- 3- Tablet suda çözündü.
- 4- Fiziksel ve kimyasal değişime uğradı.
- 5- Çözöldükten sonra yüze çıktı.
- 6- Eridi ve bitti.

Our observations

1. It was bubbled
2. Its color was changed
3. Tablet dissolved in water
4. Physical and chemical changes have occurred.
5. After dissolving, it rose to the surface
6. It melted and finished

Figure 2: Example of student observations during teacher demonstration

Presentation of the experimental process

Groups explained their experimental process with drawings. It is a very useful way to present their process. In Figure 3, we can see every stage of the experiment and we can understand the whole process. Moreover, teacher can use this artefact to assess students' skills.

6- Eridi ve bitti.

1. Aşama 2. Aşama 3. Aşama 4. Aşama 5. Aşama 6. Aşama

1. Phase
2. Phase
3. Phase
4. Phase
5. Phase
6. Phase

Figure 3: Drawing of the experiment process, example 1

Figure 4 features a drawing related to the students' experimental process, but has less detail than the previous example. This group's drawing shows only one stage of the process. However, it does feature a short explanation as well.

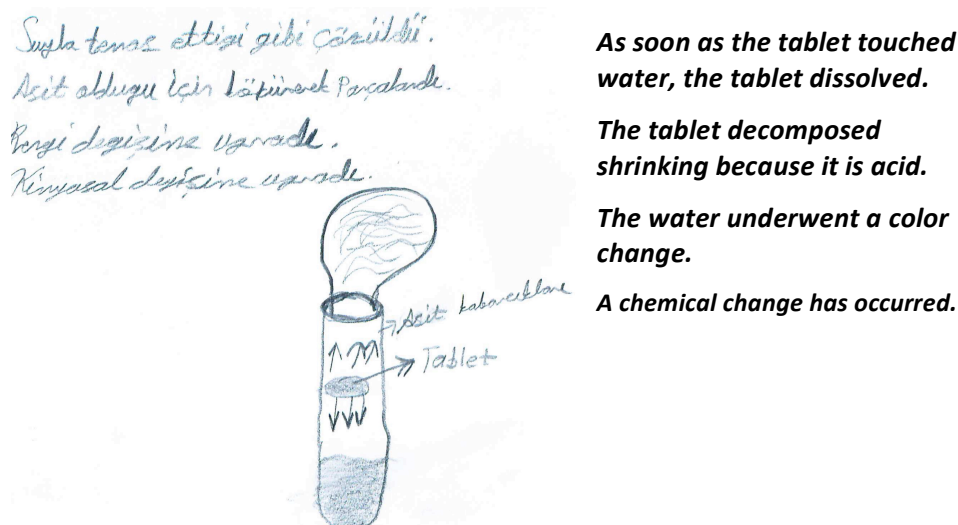


Figure 4: Drawing of the experiment process, example 2

(v) Use of assessment data

During a discussion after the lesson, the teacher gave some feedback based on her observations. The teacher observed group working in reaction rates activity and she realised some group members act a group's teacher or leader. Therefore different students engaged in the activity in a different manner to other group members. The teacher mentioned that students' personalities might be having an effect on this issue (leadership role, introverts), which she will observe carefully for the next group activity. The teacher used some display questions to check students' knowledge and some reference questions to elicit responses about interpretation and analysis of data. In particular, the teacher used questions to understand how students were working and to determine how she might guide the students. Some examples of such questions are: What is your plan? How will you reach end of your research? Do you have problem about anywhere?