

4.2 Case study 2 (CS2 Ireland)

Concept focus	Developing inquiry skills
Activities implemented	Activities A-D
Inquiry skills	Forming coherent arguments
Scientific reasoning and literacy	Scientific reasoning (argumentation) Scientific literacy (explaining concepts scientifically)
Assessment methods	Classroom dialogue Worksheets
Student group	Grade: 2 nd year (lower second level) Age: 13-14 years Group composition: single sex (male); 22 students Prior experience with inquiry: None

In this implementation, the focus of the lesson was on development of inquiry skills, as the students had no experience in inquiry-based learning. Assessment focused on students' *scientific literacy*, evidenced by their ability to explain the phenomena observed in a scientific way. This was achieved through classroom dialogue to review their prior knowledge, teacher observation, group discussion and evaluation of their investigation design. The teacher used worksheets to grade their level of understanding.

(i) How was the learning sequence adapted?

The **Light** SAILS inquiry and assessment unit was implemented in a single 80-minute lesson. Activities A-D were investigated, although limited time was available for the final activity. Students were put into groups of two for activities A and B. From Activity C onwards students were put into groups of 4 due to limited equipment available. The worksheet was photocopied and given out to students at the beginning of the lesson. There was no theory covered on the topic at the beginning of the class. This was the recommended strategy to follow from SAILS. Students were instructed to work through the worksheet with their partner and any confusion that arose could be directed to the teacher. The students had never taken part in any previous guided inquiry.

(ii) Which skills were to be assessed?

This was the students' first experience of IBSE, and the emphasis of the lesson was on developing inquiry skills. Students reported all their answers in the worksheet that was provided for them. Informal assessment took place as the teacher went from group to group. The teacher encouraged the students to discuss each question with their partner and spend time to discuss their observations from the experiments too. It was important to encourage students to take time going through the worksheet and discuss each part to allow new concepts and understanding to form (*scientific literacy*).

(iii) Criteria for judging assessment data

The teacher noted that the worksheet question encouraged interactive discussion amongst the students. The main criteria was assessing that students were developing clear scientific concepts (*scientific literacy*). This was achieved from their prior knowledge, observations, group discussion, teacher guidance and designing investigations. The worksheet was the official document for grading their level of understanding.

It was aimed for students to understand the following three concepts:

- Activity A: objects may be classified by their optical characteristics
- Activity B: light has physical properties such as colour and intensity
- Activity C: shadows are caused by the absence of light

(iv) Evidence collected

Teacher opinion

The students were engaged with the worksheet; it encouraged rich discussion amongst them. The question that caused the greatest amount of difficulty was question 5 in Activity A, in which they were asked to complete a table showing properties of some light sources. It seemed to be a huge jump from the previous questions that they were asked. The students did spend time discussing this and with guidance by the teacher they still found it difficult to fill in the table and understand what the question was really asking. It was hoped that as students continued on the experiments that they would develop a clearer picture on the different properties of light.

It was noted that students knew and understand concepts such as “reflection” and “shadows” but they still failed to see this as a property of light. Understandingly they had never covered this previously. The most common properties listed by students were, colour, source of energy and heat. One group noted that reflection was a property.

It was interesting to see what preconceptions students had about light. One question was “why can you see objects that are not sources of light?” to which a student replied “because of light shimmering on them.” Two students did note that it was due to reflection of light.

In Activity C: Understanding shadows, students investigated shadows. They followed the worksheet with little difficulty and needed less assistance and guidance from the teacher. Students came up quickly with three variables that could be changed to see if it affected the shadow. Some groups did require a small amount of guidance to come up with a third variable; commonly this was the intensity of the light. While carrying out the experiments students were developing clear concepts and understanding factors that affect shadows forming.

Students only had a short amount of time to work on Activity D: Exploring white light and filters. Some groups had difficulty forming the spectrum of light with the prism. The colours were difficult to see but with teacher guidance they were able to proceed. This was as far as the class got in the double class. The class ended with a brief discussion on the concepts covered today.

The students enjoyed the process but at times found some of the questions tedious. Students were clearly motivated to complete the task and engaged with the process. The students worked with the equipment well. They were able to design the experiment structure themselves and decide on items such as deciding what to use for the screen etc. It is hoped by the teacher that at the end of the worksheet that the students would have a clearer picture on the properties of light, as this was the area that proved the greatest difficulty.

Sample student artefacts

In worksheet 1, the students completed a table with four different properties of light (example shown in Table 1). The teacher noted for one group that they had crossed the box out on their worksheet. The teacher had given them guidance earlier and returned to see their progress. The students still felt thought that they had not completed their work properly and were frustrated and had instead continued on with the worksheet.

Table 1: Example of a student answer to worksheet 1, question 5

Source of light	Property 1 <i>Visual</i>	Property 2 <i>Smell</i>	Property 3 <i>Heat</i>	Property 4 <i>Flame</i>
<i>Fire</i>				
<i>Torch</i>		X		X
<i>Sun</i>		X		
<i>Light bulb</i>		X		X
<i>LED</i>		X	X	X

Another group completed the same table with properties that included – electric, fuel, heat and colour. They had a wide selection of light sources but failed to tick off any of the boxes until instructed to do so by the teacher. It was interesting to see that further down the worksheet for question 8 “Why can you see objects that are not sources of light,” their response was “because the light reflects of the objects.” The students already had some concept of reflection.

For worksheet 2 the majority of groups had arrows coming out in all directions from the source of light. One group had an unusual way of completing the diagram in question 1, as shown in Figure 1. The teacher had asked them why they had drawn the picture that way. They had said that they didn’t know what they were meant to do and hadn’t talked about it much with each other. After some discussion with the teacher they drew it again and arrows drawn in with the second attempt were correct. For the rest of the questions they had already completed and had shown the direction of the light travelling from the source to the person in straight lines. However, when asked the question “how does the path change if the person closes their eyes?” despite their comments to the teacher they still responded in the worksheet that “they cannot see the light.”

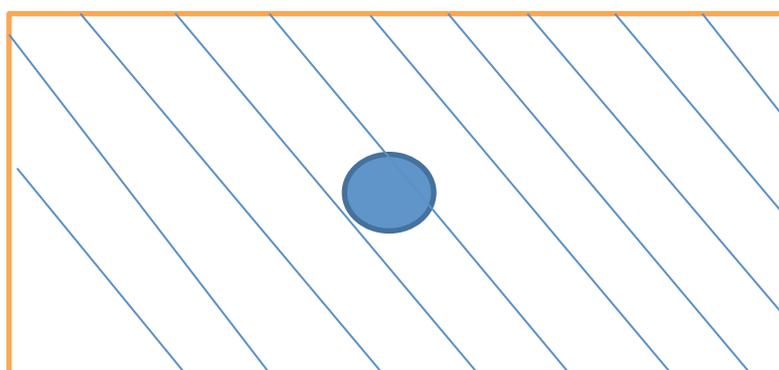


Figure 1: Example of student work for worksheet 2

(v) Use of assessment data

The worksheet was clearly laid out and easy for the teacher to scan through to ensure students were on the right path during the class. While the teacher was able to ask informal questions for assessment and understanding, the students’ worksheet provided concrete evidence for assessment. At the end of the class the teacher also asked a variety of questions to class to summarise the work covered in class while also providing further opportunities for assessment and allowing weaker students to listen again to new concepts developed.

The teacher plans to complete the worksheet with the students when they return in the next term. It was unfortunate that their following class was missed due to school activities taking place. While the teacher plans to give back the worksheets to the students corrected, the teacher does not plan to provide the students with a grade (formative assessment, no summative assessment). The overall aim is for students to be focused on what they have understood, and have developed clear concepts.

(vi) Advice for teachers implementing the unit

If the lesson was to be implemented again, it might be beneficial to have a class discussion at the end of each topic instead of at the end of the class. This would insure that the class as a whole were on the right track and also allow each group to feel confident in their approach by seeing how each group was progressing along the same route.