SAILS PROJECT **TEACHER EDUCATION PROGRAMME FIRST SESSION of four** Inquiry skills





1.3 Debating inquiry and

Strategies for Assessment of Inquiry Learning in Science



1.1 The aims

practical work

The difficulties of doing inquiry in the classroom at the present time were discussed.

In many schools teachers know how to run practical work well. However, often the distinction between practical work and inquiry is less clear. The teachers debated how inquiry is different from practical work, and how teachers could be helped to understand the distinctions.



SAILS aims to prepare science teachers, not only to be able to teach science through inquiry, but also to be confident and competent in the assessment of their students' learning through inquiry. www.sails-project.eu

1.2 Exploring what inquiry could mean

• Before the course started teachers were asked to write down what

1.4 Learning about inquiry skills

A range of open inquiries were presented to the teachers. An open inquiry is where the students take full responsibility for the direction of the lesson and pose the question to investigate, the process to take, and the means to explain the evidence. The teachers did these inquires and so were put in the position of pupil so they experienced what it felt like to learn inquiry skills through doing one. There were four inquiries:

- Floating Orange; any hypotheses about why oranges floated could be investigated
- Cooked and uncooked food; what happens to spaghetti when it is cooked?
- Cookie mining: how much of a biscuit is made up of chocolate?

they thought inquiry meant to them.

- The session started with a discussion of possible meanings of inquiry.
- The ASE booklet *It's not fair or is it?* was used to illustrate some meanings of inquiry and to move beyond the focus on fair testing. • Teachers were asked to look at the range of approaches, the suggested assessments, and how they could be used in their classrooms.

• Leaf temperature: how and why does it vary?

1.5 Planning for the classroom

Teachers discussed and planned how to run some inquiries in their classrooms with the pupils before they came to the second session. The inquiries that had been looked at in this session were to be used by the teachers as far as possible.



2.1 Teacher's feedback

2.4 Types of inquiry assessment

The main point highlighted was that the SAILS approach is to emphasise that formative assessment should be in the foreground, and summative in background. Formative assessment is primarily about learning and summative is primarily about checking learning at a stage, but is often about tracking and ranking. There was a discussion, with examples, of a range of assessment techniques such as teacher and peer observation, video and audio taping, observing writing, and how rubrics could be developed and used. The illustration below shows how pupils were asked to indicate what progression meant to them.

- The teachers reported back on the inquiries they had done with pupils. The reports backs included how pupils found the inquiry, and if it was challenging and engaging. The teachers also commented on:
 - their organisation and how important it was
 - if pupils of lower ability were involved and could produce good inquiries
 - if the teachers found out more about their pupils than they knew before.

2.2 Assessing inquiry.

The focus was on formative assessment, the processes involved in inquiry and also to think about what pupil progress would be like. The teachers were introduced to simple inquiry cycle: assessment of inquiry is formative and integrated with the tasks.

The participants were presented with a range of questions that had been developed by teachers who were experienced in inquiry methods. The questions aimed to be open to probe the pupils' thinking without leading them. The questions had been cut out so the participants could discuss at what stage of an inquiry they could be best used, see photograph below. The inquiry skills focused on in SAILS were planning, making an hypothesis, argumentation, working collaboratively along with reasoning and scientific literacy.





2.5 Inquiry as a social process

It is important for scientists to work in teams, form networks and be emotionally engaged in their research. They work in social and emotional ways to develop knowledge and an understanding of nature. The definition of inquiry usually focuses largely on the logical aspects and needs to be expanded, see diagram below for the range of activities and feeling a scientist may go through. The implications were flagged up to be discussed next session



Teachers actively explored inquiries that range from open (few instructions given and many paths) to guided (where some instructions are given and there are a few possibilities). There are three inquiries that were linked to subject concepts to varying degrees.

- The *Eggs inquiry* is the most open where dropping eggs and their landing are explored.
- The algae balls is a guided inquiry on plant nutrition.
- Exploring if sun creams work with Ultra violet light uses elements of being open and guided.

From: Matthews, B. (2015). The Elephant in the room: emotional literacy/intelligence, science education, and gender In D. Corrigan, J. Dillon, R. Gunstone & A. Jones (Eds.), The Future in Learning Science: What's in it for the learner? Dordrecht Springer.

2.6 Planning for the classroom

Tryout one or more of the inquiry activities from the session with one class over the next few weeks - or develop their own. Consider:

What inquiry questions will you ask the pupils? What does a good inquiry look like? How will the social and emotional aspects be integrated with the Logical?



3.4 Types of inquiry assessment

3.1 Teachers feedback

The feedback was on their classroom experiences doing inquiries with the pupils. The teachers were asked to feedback on questions such as:

- What were the main inquiry skills
- What evidence did you collect in order to assess it (them)
- how did you do it?

3.2 Inquiry and subject learning

In this part there was a focus on the way inquiry skills can be developed along with subject concepts. This is called *learning through inquiry*. Three inquiries were laid out for the teachers to explore and experience. These were on food labels, speed and reaction rates and were adapted from the SAILS units.

Since aspects of teamwork, collaboration and peer working are important then assessment methods that capture these as well as the logical aspects of inquiry need to be used.

A range of ways, including teacher observation – of groups and/or individuals – peer assessment, rubrics and learning landscapes were discussed and illustrative examples shown.

A focus was on how evidence of student learning to inform assessment judgments and feedback could be gathered. In the illustration below the pupils indicate in one colour which skills they are progressing in, and in another which skills they feel they should develop.

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As the inquiries were done it was important for the teachers to think what sort of questions would probe pupil's thinking without leading their ideas.

Questions for focus and feedback

- 1. Why do this as an inquiry?
- 2.What inquiry skills do you think would be best focused on in the inquiry?
- 3. Which inquiry skills would you focus on? Would you gather this pupils individually or as a group?
- 4. What would you be looking for if pupils were doing a good inquiry? In the centre of a piece of paper write down one inquiry skill you indentify. Then put around it as a spider diagram 4 or more characteristics you would look for evidence of learning.
- 5. Consider how, in this skill, you would look to the next stage in progression.
- *Possible tools: Teacher observation; notes; rubrics; learning landscapes; pupil self assessment; peer assessment; pupil notes and write-ups etc...

3.5 Planning for the classroom

The teachers planned out which inquiry skills they would they like to develop, along with how they would try to gain evidence of pupil learning to inform assessment judgements. The teachers were asked 'What methods of formative assessment' might you use?'

3.3 Inquiry as a social process

Building on the work in the last session, the concept of inquiry was deepened and broadened so that teachers could understand the importance of teamwork and collaboration, and that it should be integrated into inquiry. This is linked to group work and gender issues and how they can be part of inquiry skills. The logical aspects of inquiry are often focused on to the exclusion of other aspects, but being logical is often associated with being masculine, while femininity can be associated with being more emotional. If only the logical aspects of inquiry are emphasised then it tends to link science with male.

The implications for teaching inquiry is that it should be accepted as both a social as well as logical activity. These aspects were discussed and strategies for the classroom explored.



SAILS PROJECT TEACHER EDUCATION PROGRAMME

FOURTH SESSION



Strategies for Assessment of Inquiry Learning in Science Bringing it all together



4.1 Teachers feedback

This included:

- Which skills were focused on, and why?
- Range of evidence for assessments used to help develop pupil learning
- How pupils were grouped, and if gender issues were a factor?
 How was pupil progression being evidenced?

4.2 Review of inquiries used

The range of inquiries covered in the TEP included those that were *about* inquiry, *through* inquiry and *doing* inquiry. These varied from open to guided. The inquiries that had been done practically during the sessions were reviewed and discussed.

The teachers had also done a range of inquiries in the classrooms with pupils and they looked at what they had done so far.

4.4 Applying the model: Floating gardens

Teachers used the templates to plan an inquiry. The inquiry was based on the *Floating Garden* challenge where a platform had to built that would enable plants to grow even when flooding occurred.

When the inquiry was planned the foci included:
•type of inquiry planned for the pupils to do
•which inquiry skills were foregrounded?
•what science content was to be focused on?
•what assessment opportunities were there?
•what evidence of learning would be gathered?
•which questions would be used to probe the pupils?
•How would pupils be grouped and would gender issues arise?



Practical Action shows farmers how to make floating gardens so they can grow vegetables such as onions, okra and pumpkins even when it floods. This is an example of technology justice in action.

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4.3 Planning for inquiry

Two templates for developing a plan for an inquiry lesson, and how to integrate assessment, were shown and discussed. One was very detailed and illustrated how the flow of the lesson over time could be developed along with appropriate assessment opportunities.

The other was a grid to enable a focus on specific aspects and probing questions, see sample below.

Making Assessment of Inquiry More Explicit

ACTIVITY Floating Garden MS & VA.....

Inquiry Focus	Indicators of skill	Phase of Lesson	Collection Method	Probing Questions
	Sharing individual	Throughout the	Observingand	Why have you decided to do
	ideas	lesson, especially in	recording different	it that way?



Team work	Reaching a consensus on the method	the planning	groups using the tick sheet	
Planning	Deciding resources, evidence of the	Start and throughout the lesson	Photo/video	What would happen if? Why have you chosen that? Why not use this/that? Tell me why you have chosen this
Forming coherent arguments and ability to justify reasons	Verbal analysis supported by evidence	Throughout lesson and justification at the end of the lesson, why you have done it	Observing Questioning Rubric Learning landscape	Can you explain to me why?
Scientific literacy	Use of key words and terms e.g. capillary action,	Planning and practical	Observation, written proposal with reasoning, video blog/YouTube	What is the term for that? Where did we use this before in lessons?



4.5 Inquiry does not stand alone

To influence other teachers in the school it helps to realise that attitudes to inquiry are linked to how teachers believe that pupils learn. The constructivist view of learning supports inquiry as both stress the need for an active thinking pupil. Similarly, it helps if assessment is seen as a social process involving pupils.