Refocusing Assessment

science

ssat the schools, students and teachers network

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Refocusing Assessment – science

Introduction

SSAT, ASCL and NFER have worked together to produce *Refocusing Assessment*, which is a resource to support schools in developing and reviewing their assessment practice. The resource identifies five key questions for all departments, which you will find below.

In the following pages you will also find some responses to each question. These are drawn from the expert panels that SSAT, ASCL and NFER convened, which were comprised of heads of department and representatives from subject associations. These are not intended to offer definitive answers to the key questions, but may help to support, challenge or structure your discussions.

For details about the references in this document, please refer to the *Refocusing Assessment* overview document.

How to use this resource

1. Spend time with your department discussing each of the five questions.
2. Record a summary of your discussion.
3. Look at the responses produced by the expert panels. How far do they reflect the thoughts of your team?
4. See if you can summarise the 'assessment requirements' for your subject on the template.
5. You may then be asked to share your responses with other departments to help identify the commonalities and differences between subjects in order to help establish a whole school approach. You may wish to consider the following questions:
   - How do the needs of different subject areas vary?
   - How can you apply best practice in different subject areas whilst also maintaining consistency across the whole school?
6. You may wish to produce an action plan to modify and shape your assessment policy and practice.
7. Set a time to review and evaluate the impact of the action plan on assessment.

Five key questions

1

What does it mean to be a successful student in science?

What is the purpose of our subject?

What does it mean to be a good scientist? Is this what we are preparing students for?

What are the core knowledge and skills required for success?

2

What is the purpose of assessment in science?

Why do we assess?

Who is assessment for?

3

What does progress look like in science?

How do we know when a student is making progress?

How might progress vary over time?

4

How can progress be assessed most effectively in science?

Which assessment techniques work best in science?

How successfully do we use formative assessment approaches?

How can formative and summative assessment work together to ensure effective assessment for learning?

How do we benchmark/ quality assure our assessment practices?

5

How do the assessment practices in our department contribute to/work with whole school policy?

Question 1: What does it mean to be a successful student in science?

Some thoughts from the expert panel discussion

The broad aim of science education is for students to be able to understand the natural world around them.

This requires a firm grounding in the key scientific concepts and content: the 'big ideas' of science. The current secondary science curriculum content areas broadly identify the core scientific knowledge and skills required of students. However, an expanded view has been developed in a significant publication on the 'big ideas' in science (Harlen, 2010) which may help to support your discussions. These 'big ideas' – for example, the cellular basis of life – represent the core science knowledge and are developed across all age ranges.

In addition to this grounding of subject specific knowledge, successful science students are able to apply their knowledge to new and varied situations and to utilise the methodologies of scientific enquiry and competency in practical skills in order to ask further questions about the natural world.

Our aim	How it prepares students for the future
To create scientifically literate citizens who can engage in an informed way with scientific issues that affect them and society.	Engagement at a personal level includes making informed decisions about health options or environmental impact. At the societal level, informed citizens can engage in debate about the future of science on topics as such as renewable energy or cloning.
To develop transferable skills for the future life chances of **all** students.	A full understanding of 'how science works' develops a wide range of skills including collaboration, analysis of information, objective reflection, and evaluation of outcomes. These skills are relevant to science and to a much wider range of careers.
To provide a grounding in the knowledge, understanding and skills that will be needed to pursue Science, Technology, Engineering and Maths (STEM) careers.	Pursuit of science and technology studies in higher education requires understanding of scientific knowledge, skills and methodologies. In addition, secondary school students can develop both an enthusiasm for, and knowledge of, the range of STEM career opportunities from medicine to engineering.
To prepare for examinations and qualifications.	The relevant scientific skills, knowledge and understanding need to be appropriately assessed and recognised in order to support further life and career opportunities.

Question 2: What is the purpose of assessment in science?

Some thoughts from the expert panel discussion

The key purpose of assessment should be to help students understand where they are in their learning - supporting them to know what they are secure with in terms of their knowledge, understanding and skills and helping them identify areas to develop.

However, assessment can also:

- allow learners to reflect on learning over time
- be used to find out where students are before they start something new
- help teachers reflect on their pedagogy
- help teachers to develop a better understanding of the student as a learner
- help to identify learning issues to support the planning of strategic interventions
- provide a basis for a meaningful dialogue with students, parents/carers and other stakeholders, such as school leaders, governors and Ofsted, about students' progress.

Formative assessment can provide helpful insights into learning and take a range of forms, for example: from informal discussions, to the use of 'hinge questions' in lessons, to assessing extended tasks that can be used to tease out more complex and deeper levels of understanding. Formative assessment should address the totality of a student's performance, not just the easily measurable.

In developing formative assessment, it is vital to consider what information the assessment is aiming to collect. Effective formative assessment helps to identify strengths and areas for development and can also help to demonstrate progress over time.

Assessment information is needed for a variety of stakeholders and purposes but, fundamentally, assessment should be focused ***on*** the student and ***for*** the student.

Whilst each subject is unique in its own right, the purposes of assessing students are broadly the same in all subjects:

- to allow students to know where they are in their learning
- to help to inform future teaching and learning activities
- to help identify specific learning issues and to provide additional support/intervention where needed
- to track and monitor students' progress and to identify underachievement.

Formative assessment is integral to everyday teaching and is part of good pedagogy. It should be embedded into teaching activities, with regular opportunities for assessment and feedback within each lesson. There is already some excellent formative assessment practice occurring in schools. However, this is not necessarily consistently good across schools or between different subjects or between teachers within departments within the same school. This inconsistency can be due to a number of factors including varying levels of expertise, confidence and experience amongst teachers.

The challenge is in developing staff expertise in formative assessment practices and in assessment literacy more generally. This is a challenge that is relevant to all (Carter, 2015) not just to trainee teachers and newly qualified teachers (NQTs). To make formative assessment even more successful:

- teachers must understand formative assessment and be confident in integrating it fully into their teaching
- there needs to be a supportive and collaborative climate in which staff are encouraged to share good practice and try out new assessment approaches
- there needs to be strategic, long term planning in order to ensure that sufficient time is factored into teaching a topic to allow for feedback to students and for students to review and respond to the feedback given
- the leadership team need to promote a culture of Assessment for Learning (AfL) both within departments and across departments in a school and encourage moderation of assessment practices within and across departments.

Question 3: What does progress look like in science?

Some thoughts from the expert panel discussion

Science is uniquely complex because it is made up from multiple distinct subjects (biology, chemistry, physics, earth science, applied science, etc.) with a common thread of practical and investigative skills. Accurate science content knowledge forms the base from which progress develops. Indicators of progress that might be common to all science disciplines include:

Practical and investigative skills
Improving skills in planning, practical data collection, analysis and evaluation that are independent of the topic area.

Explanations
Developing the ability to use existing knowledge and understanding to explain and make sense of unfamiliar situations and contexts.

Independence
Increasing independence can be demonstrated when teacher support and scaffolding are reduced or removed. For example, less reliance on verbal help during practical tasks.

Questioning
Students reveal a lot about their understanding and misconceptions from the questions they ask of their teachers and peers. Progress may be evidenced by increasingly searching and complex questions which reflect current understanding and attempt to further develop and refine thinking.

Scientific literacy
Increasing use of appropriate specialist scientific vocabulary and terminology in written and verbal communications.

Making links
Identifying commonalities from different topics within a subject, or between different subjects, and using these to develop explanations.

Modelling
Moving from concrete observations to more abstract representations, generalisations and models is an important stage in the development of scientific thought. Increasing confidence in understanding and communicating abstract models is indicative of progress.

Open-ended tasks (with or without scaffolding) are likely to provide a richer source of assessment information than closed-response questions or tasks. Students are much more likely to reveal how far their understanding has progressed through probing discussion that allows for on-going development and reframing of ideas than through a written assessment. This is especially true where scientific literacy skills are still developing.

Progress in science is likely to be far from linear. Even within one subject domain, students need to assimilate information from a range of experiences and curriculum areas before being able to have that *light bulb moment*, so progress is rarely smooth. When conceptual progress in biology, chemistry and physics are considered alongside ongoing investigative and practical skills, arriving at an accurate picture of a student's progress in science quickly becomes complicated. Progress in science is rarely accurately measured through comparison of scores on end of topic tests, especially as consecutive topics may be unrelated. Therefore, unpicking the general markers of student progress described above provides a more accurate picture and may reflect differential progress between the subjects.

It is important that the nature of progress in science and how it can be assessed is communicated to stakeholders so that it can be used to inform appropriate assessment and reporting strategies that provide an accurate picture of student progress.

Question 4: How can progress be assessed most effectively in science?

Some thoughts from the expert panel discussion

Different tasks and tools may be used formatively to assess progression. It is important for teachers to have a wide repertoire of AfL strategies that they can incorporate into their practice, selecting the most appropriate strategy for each assessment.

Talking and listening to students is an essential assessment tool. This enables teachers to fully grasp the students' thought processes while the students are actively engaged in their thinking.

Test key ideas that span different modules. Much of science teaching is modular in nature and this has guided students to 'think in chunks' about the work. Extended assessment tasks provide an opportunity to test wider knowledge and exemplify how students draw different ideas together.

'Hinge questions' provide a clear and quick way of discovering commonly held misconceptions about specific topics. These can range from simple multiple choice questions to more detailed probing discussions during a lesson. The key is to draw out any specific student misconceptions to be addressed or areas that require further teaching.

Peer and self-marking is a (teaching and learning) tool in itself. Where students have critiqued other students' work and, crucially, seen different ways of thinking around the same topic, this allows progress to be evidenced. Constructing and critiquing model answers can also be used, although it is important to use real student responses that demonstrate progress in scientific thinking.

Teacher feedback to the student is vital. Feedback needs to be immediate if it is to inform the student's thought processes. Prompt formative feedback (even if brief) often has more impact on students than detailed feedback delivered after the student has 'moved on' from a topic.

Assessment feedback is most successful where specific lessons are set aside for this. This allows opportunities for self and peer reflection. Members of the expert panel considered that 'you can see more progress being made in that feedback lesson' because it encourages an explicit formative dialogue between the teacher and students about progress: what students can do, where they need to go and the strategies to get there.

There is some excellent practice out there where AfL has been integrated into teaching and learning and this needs to be celebrated. However, strategies are often used without thought about how the outcomes can be used formatively. This highlights the need for all teachers to have a deep understanding of science skills and how young people learn through effective CPD on pedagogy and assessment.

At the departmental level, science curriculum models need to be very flexible to allow for formative approaches. In addition to specified lesson time for feedback, it is important to allow time to revisit specific lessons or topics and to adapt teaching strategies based on the outcomes of the formative approaches. It is noted that there is a tension here with the sometimes prescriptive and content-heavy science curricula and thought needs to be given to achieving an appropriate balance.

A final point is that *formative assessment is not going to work unless we share experiences*. Departmentally, this involves moderation of qualitative judgements. Effective formative assessment is a reflective process not just for students but for teachers. Schools can help by setting up a *reflective culture* and having a school policy that is *flexible enough to respond to reflection from its practitioners*.

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