

# **The impact of qualification reform on A level science practical work**

Paper 1: Teacher perspectives after one year



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## 1 Executive summary

Reformed A level science qualifications were introduced for first teaching in September 2015. The assessment arrangements for practical work have changed significantly and Ofqual is conducting a programme of research to evaluate the impact of the reform on students' practical skills (See Annex A for details). This report describes a qualitative research study that was carried out in Spring 2016.

Thirty-eight A level science teachers from 14 schools/colleges took part in either an interview or a focus group. Interviewees were asked how the reform had impacted upon the teaching and learning of practical skills. The 2015/16 academic year provided a unique opportunity for them to directly compare the pre- and post-reform arrangements because they were working with both the final cohort of pre-reform students (exams in summer 2016) and the first cohort of post-reform students (exams in summer 2017). Teachers' views were varied both within and between schools and the main findings can be summarised as follows:

- the post-reform assessment arrangements allow teachers greater flexibility to embed practical work into the course and to balance it across topics throughout the year.
- the outgoing assessment arrangements had, prior to their removal, become beset by serious issues around reliability and fairness.
- for some teachers, there is a lack of clarity with regard to the exact requirements of the post-reform assessment arrangements, both in terms of ensuring outcomes that are valid and reliable and in terms of providing sufficient evidence for exam board monitors.
- there were two distinct views about whether students would undertake more or less practical work as a result of the reform:
  - a) that the reform would *not* make a substantive difference because practical work was already prioritised by the school or college; and
  - b) that the reform would increase the amount of practical work undertaken because the new arrangements require students to more regularly complete 'hands on' assessed practical activities.
- in broad terms, there were three distinct views about how the reform would affect student motivation for practical work:
  - a) that any impact on motivation would be minimal because students held idiosyncratic predispositions towards practical work that were largely unrelated to assessment arrangements;

- b) that student motivation for practical work would increase because the post-reform approach was less stress-inducing and more obviously and consistently linked with the course content; and
- c) that students were now less motivated by practical work because of a desire to focus upon elements of the course that would more directly contribute to their final A level grade.

Overall, the findings are encouraging. Most teachers perceive the reform, or at least many aspects of it, to be positive for the teaching and learning of practical skills. However, it appears schools and colleges have not been affected in a uniform way by the reform. The magnitude and nature of the impact is dependent on the characteristics of the institution. This study explores the mechanisms through which the reform may be being implemented and experienced in different ways.

## **2 Introduction**

### **2.1 Assessing practical work in the new science A levels**

Reformed A level science qualifications were introduced for first teaching in September 2015 and the assessment arrangements for practical work changed significantly. The pre- and post-reform approaches can be described as follows:

- for *pre-reform* specifications, practical work was assessed via 'Non Examined Assessment' (NEA) components. These components contributed to a student's final grade, with a weighting of 20%, and required students to complete a practical activity (or activities) under controlled conditions. The NEA could take a variety of forms and was either 'externally' marked by exam boards or 'internally' marked by teachers (and externally moderated by exam boards). The nature of the NEA components varied between exam boards and specifications, with some requiring students to complete an individual investigation over a period of weeks and others requiring students to complete one or more scaffolded practical tasks within a specific time frame. Only a small percentage of the total marks for the NEA components, typically around 10%, were allocated to the direct observation of practical work, with the majority of marks allocated to written work (eg planning and data analysis); and
- for *post-reform* specifications, assessment of practical skills is achieved in two ways (see Ofqual, 2015). Firstly, 15% of all available marks in the written examinations are allocated to questions which indirectly assess practical skills. Secondly, teachers are required to administer assessment for which students must complete at least twelve 'hands on' practical assignments. This element of the assessment does not contribute to a student's primary grade, instead they

receive a separate result (an 'endorsement') when they certificate with their A level. Students are assessed against five Common Practical Assessment Criteria (CPAC)<sup>1</sup> and receive one of two outcomes: either 'Pass' or 'Not Classified'. Schools and colleges are visited by an exam board 'monitor', whose role is to ensure that students are provided with appropriate opportunity to undertake practical work and that adequate records of activities and achievements are being maintained for the endorsement<sup>2</sup>.

The primary driver for the change in approach was that the pre-reform assessment arrangements had fostered significant concerns relating to marking reliability and the security of assessment materials, issues which had caused exam boards 'to prioritise security and reliability over validity' (Ofqual, 2013, p. 22). Issues that were identified included NEA grade boundaries that were very close together, A\* grade boundaries which were at, or very close to, the maximum available mark, and relatively high levels of alleged teacher malpractice (see Ofqual, 2013). The post-reform arrangements are intended to more firmly embed practical work within the A level science curriculum and to allow exam boards and teachers to focus on maximising its educational value. Though this intention is widely supported, the approach to achieving it has proven controversial.

Cambridge Assessment (2016) discussed the possible benefits of the post-reform approach, suggesting that it will allow teachers to cover a greater breadth of skills and be more flexible in how they include practical work within their lessons. Awarding organisations have also been positive, suggesting that the increased flexibility provides opportunity for more holistic teaching and a better synergy between practical work and course content (Canning, 2015; Evans & Wade, 2015).

However, several stakeholder groups have suggested that the absence of a dedicated practical assessment component (which contributes to the primary grade) may have a detrimental effect on the skills that students acquire (Biology Education Research Group, 2014; Gatsby, 2014; Wellcome Trust, 2014). In response to Ofqual's (2013) consultation, the Gatsby Foundation (2014) suggested that the reform would 'risk sending the message to schools and colleges that practical work is of subsidiary importance to textbook learning' (p.3).

To elaborate, there are two broad concerns. The first is that school leaders and classroom teachers may no longer be as compelled to provide learning opportunities of sufficiently high quality if practical skills are not relevant to the primary grades

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<sup>1</sup> The five Common Practical Assessment Criteria (CPAC) are: follows written procedures; applies investigative approaches and methods when using instruments and equipment; safely uses a range of practical equipment and materials; makes and records observations; researches, references and reports (see Ofqual, 2016, pp. 15–16 for further details).

<sup>2</sup> Any school or college that offers an A level in science must receive a monitoring visit from an exam board at least every two years (Ofqual, 2016).

which students achieve and, therefore, the measures to which schools and colleges are held accountable. As a result, in order to relieve pressure on their budget, schools/colleges may significantly reduce their investment in the staff, apparatus and facilities required to support high quality practical work (Carter, 2014).

The second concern is that students may feel less motivated to complete practical work if they no longer see it as relevant to their qualification outcome, choosing instead to focus on learning opportunities which they believe will enhance their probability of attaining a good grade. Any such reduction in motivation could also have a negative effect on students' enjoyment of science and therefore their likelihood of pursuing science-based careers (Wellcome Trust, 2014). This could theoretically lead to a long term reduction in the number of students graduating with degrees in Science, Technology, Engineering and Maths (STEM).

## **2.2 Research objectives**

To investigate the issues discussed in the previous section, Ofqual is conducting a programme of research to evaluate the impact that A level science reform has had on the teaching and learning of practical skills. The study reported here represents one part of this research programme. This was a series of interviews which drew on the perceptions and experiences of science teachers who were, at the time, working with both the final cohort of pre-reform students (exams in summer 2016) and the first cohort of post-reform students (exams in summer 2017). The research question for this study is a relatively open one:

What are *teachers'* perceptions of the impact of reform on practical skills with regard to the following?

- The quality of teaching and learning
- The process and experience of teaching
- The motivation of students to study (and continue studying) science
- The burden on teachers and students

It is worth noting that the research literature is discussed only briefly in this report. A full literature review regarding the teaching, learning and assessment of science practical skills will accompany Ofqual's main report about the research programme. Literature pertaining to specific points raised by interviewees will, however, be included where appropriate.

## **2.3 Defining practical skills**

Before discussing the research methodology and findings in further detail, it is important to consider what one might be referring to when using the term 'practical skills'. This is not a straightforward matter. The term can be defined in a multitude of

ways and the extent to which academics, stakeholders and practitioners integrate sub-components such as 'conceptual understanding', 'subject knowledge' and 'technical skill' within their overall definition varies significantly. How an interviewee defines 'practical skills' may therefore have a significant impact on what they consider to be the optimal approach for teaching and assessing them.

In the context of their paper, Abrahams, Reiss, & Sharpe (2013) use the term 'practical skills' to mean only 'those skills the mastery of which increases a student's competence to undertake any type of science learning activity in which they are involved in manipulating and/or observing real objects and materials' (p. 210). This definition purposefully emphasises the technical skills required to facilitate practical work rather than any deeper conceptual understanding that may be required to conduct, for example, a scientific investigation.

Gott & Duggan (2002) propose two possible models for defining practical skills within the context of a scientific investigation; one which separates basic (technical) skills from conceptual understanding (similar to the definition above) and the other postulating that practical skills are reliant on an individual's understanding of the procedural concepts associated with the collection and validation of evidence. Broader still, the Science Community Representing Education (SCORE, 2014) suggests that effective practical work comprises the use of technical and manipulative skills, extended investigation (including planning, observing, analysing and evaluating) and the development of conceptual understanding.

These differing definitions are worth considering for this study because they illustrate nuances in thinking which may influence the type of things a teacher is likely to consider important when evaluating the reform. A teacher applying a definition that emphasises technical skills may choose to focus on providing students with opportunity to repeatedly practice a given procedure (while conveying related scientific theory somewhat separately). A teacher using a broader definition may wish to focus their practical lessons on the principles of the scientific method and experimentation, incorporating the teaching of specific procedures as a broader part of this learning.

With regard to assessment, Abrahams, Reiss, & Sharpe (2013) make a useful conceptual distinction between Direct Assessment of Practical Skills (DAPS) and Indirect Assessment of Practical Skills (IAPS). DAPS refers to assessment which requires the student to demonstrate their level of competence through the physical manipulation of objects, while IAPS refers to assessment which seeks to infer the student's level of competence through the data they generate, the materials they produce, or through their performance in a written test (Abrahams & Reiss, 2015). DAPS has a greater focus on technical skills compared to IAPS, which often places a greater emphasis on procedural knowledge. This terminology will be useful for contextualising data from the teacher interviews.



## **3 Methodology**

### **3.1 Research design**

A qualitative design involving direct engagement with A level science teachers was deemed the most appropriate approach for addressing the central research question. Although qualitative research of this type should not be generalised beyond the sample, the approach was chosen to enhance our understanding of *how* the reform may affect teachers, schools and students, whether those effects be intended or unintended, expected or unexpected. The strength of qualitative analysis lies in exploring the mechanisms through which the reform may impact upon a school or college and how these impacts may manifest themselves differentially, depending on the characteristics of that specific institution.

Schools and colleges could participate through either a focus group (a group interview involving several teachers from the same school/college) or a series of one to one interviews, with both types of interview involving teachers from each of the three science specialisms (biology, chemistry and physics). The choice of interview type at each school/college was largely pragmatic (eg it was the easiest or only possible approach for that particular school/college) but the use of both types may have contributed to the breadth of the data. There is some evidence to suggest that individual interviews and focus groups elicit somewhat different responses from participants, with the former more likely to generate a wider range of ideas and the latter more likely to lead to greater elaboration of ideas (Heary & Hennessy, 2006).

The interviews were semi-structured, with questions which aimed to elicit comparison between pre- and post-reform arrangements for practical work. These questions were focussed on the teaching, learning and assessment of practical skills, as well as students' motivation for practical work and their enjoyment of it (see Annex B for the full interview schedule). The researchers conducting the interviews encouraged interviewees to digress from the interview schedule whenever they thought it appropriate. Interviewees were also encouraged to raise any additional issues they thought were not addressed, and to discuss anything which they believed was important to the context of the interview.

Note that the research was not designed to explicitly draw comparisons between subject specialisms because the assessment arrangements and criteria (the CPAC) are consistent across biology, chemistry and physics. There are likely to be nuances with regard to how the subject specific content interacts with the assessment arrangements, but exploring these in depth is beyond the scope of the current study.

### **3.2 Sample, participants and data collection**

It was decided that stratifying schools and colleges based on their average A level performance was the most satisfactory method for engaging with a small but

relatively broad range of institutions<sup>3</sup>. Publically available data from the Department for Education (2016) was used to allocate all schools and colleges in England to one of three strata based on the average A level grade obtained by their students across all subjects in the 2014/15 academic year ('A or B', 'C' or 'D or E')<sup>4</sup>. Twenty eligible<sup>5</sup> schools and colleges were then randomly selected from each stratum and sent a letter and an email inviting them to participate in the research. Initially, the intention was to conduct interviews at five institutions from each stratum, however those from the 'D or E' group proved difficult to recruit. A further random sample of 17 schools and colleges was contacted in an effort to address this under representation but the issue could not be entirely eliminated.

The average A level grade of the final sample, broken down by institution type, is shown in Table 1. Fourteen schools or colleges took part in the research, providing representation from twelve local authorities. A breakdown of participating schools/colleges by their local authority can be found in Annex C.

*Table 1. Participating schools and colleges by type and average A level grade in the 2014-15 academic year.*

School/college type	Av. A level grade		
	A or B	C	D or E
Comprehensive	3	3	2
Independent / Selective / Grammar	3	0	0
Sixth form college	0	2	1
Total	6	5	3

All research interviews, whether conducted on a one to one basis or as a focus group, were completed using the same interview schedule (Annex B). Three researchers from Ofqual's research team conducted the interviews, visiting between 3 and 8 schools or colleges each. Of the 14 schools/colleges that took part, data was collected from one to one interviews in 7 cases and by focus group in 7 cases. A total of 38 teachers were interviewed, 17 on a one to one basis and 21 as part of a focus group (Table 2). Interviews ranged between around 10 and 60 minutes in duration, with an average duration of approximately 35 minutes. All interviews and focus groups were recorded using a dictaphone.

<sup>3</sup> Given the relatively small scale of the study, variables such as school/college type encompass too great a breadth of categories to facilitate an adequate stratified sample.

<sup>4</sup> No schools or colleges had an average A level grade of A\* in 2014/15.

<sup>5</sup> Only schools/colleges easily accessible from Ofqual's Coventry office (eg a return journey that was no more than 4 hours' in duration) were sampled for reasons of efficiency.

Table 2. *Teacher interviewees by specialism and interview type*

Interview type	Subject		
	Biology	Chemistry	Physics
One to one interview	6	6	5
Focus group	7	7	7
Total	13	13	12

### **3.3 Data analysis**

All interviews were transcribed verbatim by an external transcription organisation. Researchers had access to both the transcript and the original audio recording of each interview while conducting data analysis. Data was analysed thematically (e.g. Aronson, 1995), allowing researchers to take a flexible approach and provide a 'rich and detailed, yet complex, account of data' (Braun & Clarke, 2006, p. 78). Analysis was broadly deductive in nature, with researchers developing the themes from the data rather than consciously applying preconceived theories. Despite this, it is important to acknowledge the role of the interview schedule, which provided a natural structure for the data and therefore is likely to have influenced the analysis.

Data were analysed using the NVivo qualitative analysis software package. The transcripts were coded line by line by two researchers who regularly consulted to discuss and refine codes as they were developed as part of an iterative process. An effort was made to code passages of text rather than individual quotes, so to better contextualise data extracts. After the initial coding process, the two researchers collaborated to identify and discuss cross-cutting themes that related to teachers' evaluation of the pre- and post-reform qualifications. The researchers then jointly revisited the data sources to validate these themes, searching for any evidence which undermined or elaborated them in order to further refine their understanding.

Before moving on, it is important to highlight the fact that this study was conducted by the Office of Qualifications and Examinations Regulation (Ofqual), meaning that the research team are stakeholders in the assessment system. Interpretation of the data may be subject to the particular perspectives and prior knowledge held by the researchers involved. For example, it is possible that interviewers may have held a subconscious preference for the post-reform assessment arrangements because of the organisation's role in developing them. Though every effort was made to identify and challenge preconceptions or biases, research of this type can never be entirely objective because some degree of interpretation is a necessary part of the process (Braun & Clarke, 2006). It should also be noted the researchers had no involvement in the original policy making for reforming science A level.

## 4 Results

This section is organised under seven interlinked themes, several of which reflect directly upon the questions from the interview schedule (Annex B). The themes reflect teachers' views on the following: the extent to which the quantity of practical work that is being undertaken has changed as a result of the reform; whether there has been an impact on the type of activities that are taking place; the integration of practical and theoretical learning; the impact of the reform on student motivation; perceptions of reliability and fairness in the assessment of practical work, the level of administrative burden associated with pre- and post-reform systems; and, the overarching impact of the reform on students' science practical skills.

### 4.1 Quantity of practical work

One of the main discussion points centred on whether the reformed qualifications had (or would) lead to a change in the amount of practical work undertaken in schools and colleges. Many of the teachers suggested that the impact was actually rather minimal, stating they had always emphasised practical work and that many of the new 'required' and 'suggested' practical activities reflected those that they would have carried out anyway.

Well it's not really changed anything in terms of what we want to do practically with the students. All the twelve suggested practicals, we would do (*anyway*)... in a normal year.

*Chemistry teacher, Sixth form college C (av. grade C)*

This sense of business as usual, at least in terms of *how much* practical work students are doing, was commonly expressed. It is worth noting that several teachers suggested that their school/college was likely to be unusual in the extent to which it had always emphasised practical work at A level; it is conceivable that those who were keen to participate in this research study were disproportionately likely to also be those who had placed particular emphasis on practical work prior to the reform.

Not all of the teachers interviewed shared the view that there had been minimal change in the amount of practical work they were undertaking. Some of the teachers said that the new arrangements required them to deliver more comprehensive practical activities, which had led to an increase in the total amount of lesson time they were spending on practical work.

...rather than doing a 'quicky' practical, just to get the idea, the concept over, we do the Full Monty as it were. We do the full thing, so that is time consuming... it is the whole lesson.

*Focus group, Sixth form college A (av. grade D-E)*

Some teachers said that the amount of 'hands on' practical work had changed rather than the total amount of time in the classroom allocated to practical activities. They suggested that students were now required to complete the work themselves so that they could be individually assessed against the criteria (the CPAC), whereas previously some of the practical work had been demonstrated by the teacher.

...there's one or two that we would have done as a demonstration and now we try and do them more as (a) class practical.

*Focus group, Comprehensive B (av. grade D-E)*

None of the teachers interviewed suggested that the reform would lead them to undertake less practical activity (though, as we will discuss, some did suggest that the perceived importance of the work had changed). There was, however, a suggestion that the amount of practical work undertaken in a given school or college would be partly dependent on the size of its intake. For example, the teacher quoted below was suggesting it would be much more difficult to deliver frequent practical activities if they had a larger class.

If you've got a class of 24 and you're doing an experiment with toxic chemicals... if you've only got one fume cupboard you can only operate so many children at once.

*Chemistry teacher, Independent B (av. grade A-B)*

There was a clear sense that, in terms of the amount of practical work undertaken, the impact of the reform on a school or college would depend on the size of their classes and the availability of laboratory space and apparatus.

Finally, some of the teachers discussed how the reform had introduced a greater amount of subject content to cover and placed a stronger emphasis on mathematical skills. This was perceived by some teachers as a threat to how much practical work they could realistically deliver and a sense of competing priorities.

...the chemistry course is so jammed pack full of ideas, and all the new maths that's coming on board as well this year... I mean it's very mathematical in second year and that takes a lot of work, you know, week after week to get your students up to those background skills... But it doesn't leave you a lot of scope for going off and doing a bit of research-type work. There isn't really the time in the curriculum for doing that.

*Chemistry teacher, Sixth form college C (av. Grade C)*

So if I was in charge and had a magic wand I would probably trim about 15-20% of the whole syllabus. There is no breathing space. We have a schedule that goes from lesson one in September to lesson 145 in May and there's no leeway at all.

*Biology teacher, Sixth form college C (av. Grade C)*

This point illustrates an issue for any qualification reform - that multiple elements of a qualification are changed simultaneously and it is not always clear how these changes will interact. Even if facets of the reform encourage particular (desirable) activities, these incentives may be undermined by other facets that are having unintended consequences.

## **4.2 Type of practical work**

Distinct from discussion about the *quantity* of practical work was a theme about whether the *nature* of practical work had changed (or might later change) as a result of the reform. This theme encompasses a variety of nuanced factors about how practical work is conducted and taught.

Several teachers suggested that the reform had caused them to change the emphasis of their practical work. Whereas previously they had used practical sessions to set up demonstrations for the purpose of illustrating theory, they were now using sessions to teach and practice technical skills. The teacher quoted below is suggesting that their students are now required to repeat certain skills on multiple occasions in order to gain competency. This shift was mostly perceived as positive by those who discussed it, with teachers suggesting that it would instil students with greater hands on experience and a greater breadth of practical skills.

I never demonstrate anything these days.... There is absolutely no way you can give them one titration and achieve success at it, because it's a skill that they need to learn.

*Chemistry teacher, Independent B (av. grade A-B)*

An increased emphasis on skills was not perceived as positive by all of the teachers. There were suggestions that, in some cases, discouraging the use of demonstrations may undermine the role of practical work in conveying scientific concepts to students.

You would demo it to get across the understanding and the concept... you could achieve the outcome that you would want that would then lead into teaching the concept.

*Physics teacher, Comprehensive F (av. grade D-E)*

To unpack this quote a little further, this teacher is suggesting that their practical demonstrations allowed students more opportunity to focus on the scientific theory underpinning an experiment without becoming distracted by the practicalities of trying to get the experiment to work for themselves.

Linked to this, there was a discussion of 'investigative skills' and the extent to which the post-reform A level qualifications foster them. Some of the teachers thought that the need to cover the CPAC competencies, combined with the increased freedom of the post-reform arrangements, provided them with greater opportunity to foster investigative skills.

I suppose in some ways it's making us think about getting them to control their own variables and, you know, plan and experiment and think about experiment design more.

*Biology teacher, Independent C (av. grade A-B)*

This was paired with a view that the pre-reform qualifications had not encouraged the use of investigative skills because the assessment had been too tightly structured. The previous assessment arrangements had required students to adhere to instructions in order to complete specific tasks - tasks which had strict limitations with regard to completion time and the use of apparatus. The need to focus attention on the assessment had reduced the scope for teachers to provide students with opportunities for investigative work.

We didn't have any investigative skills really... They had no freedom in terms of what they did. It was much more, 'why did they do it in this way', and that kind of thing. Whereas now they actually have to think about how they'll do it and generate it themselves in certain instances and I think that's much better.

*Focus group, Sixth form college B (av. grade C)*

Not all teachers expressed this view. Some believed the new arrangements were just as prescriptive as the previous NEA and that students would therefore continue to receive limited experience of scientific investigation. There was a suggestion that running scientific investigations over several weeks with a large number of students was logistically challenging, particularly in contexts where there are large class sizes or limited resources (a topic to which this paper will return later).

It is also worth noting that not all pre-reform specifications took the same approach to NEA. One chemistry teacher spoke in some depth about a specific outgoing specification which had placed a strong emphasis on scientific investigation, lamenting the fact that this specification would no longer be available. This outgoing specification required individual students to complete a significant scientific investigation over a period of several weeks<sup>6</sup>.

...we used to spend eight weeks on that, and the full eight weeks, and all the chemistry lessons were devoted to that and at the end of it you got a comprehensive project. I would say about 50% of our students go on to do some sort of chemistry course at university and they've come back to me and said that was the most useful part... how to conduct, write up a big piece of work. And in a way that makes me a little bit sad, because the students really get into it and go into a lot of depth and are independent.

*Chemistry teacher, Comprehensive F, (av. Grade D-E)*

Conversely, there was also a more positive view about how the type of practical work required by the reformed qualifications may assist students in making the transition to university. Some teachers thought that the reform had changed the way in which students were required to record their practical work, encouraging them to take a more thorough and engaged approach.

Now they're having to write a full method, full results, set a full conclusion for every single practical we're doing, they will probably retain it more.

*Biology teacher, Comprehensive F (av. grade D-E)*

The use of books or folders to record and write up experiments<sup>7</sup> was also perceived to be positive because it replicates an activity that students are regularly required to undertake at university.

I like the fact that we are getting them to do a lab book, which is more like you would do if you were studying at an undergraduate level.

*Biology teacher, Comprehensive H (av. grade C)*

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<sup>6</sup> Note that, while not a requirement, the post-reform assessment arrangements do not prevent such an investigation from being conducted and used for assessment against the CPAC.

<sup>7</sup> *The use of a lab book or folder is not a necessity of the new assessment arrangements, but it is recommended by exam boards as a way of recording, assessing and evidencing student performance for the endorsement.*



To summarise, there was a range of views regarding how the reform had changed the nature of the practical work which was being undertaken. The impact seems to somewhat depend on the previous approach of the teacher and the specification that they were teaching.

### **4.3 Integration of practical work and course content**

This theme refers to the extent to which course content is complemented by practical work (and vice versa). In other words, do teachers think that the reform has changed the degree to which practical activities facilitate understanding of the course content? Many of the teachers thought that the new arrangements meant that practical work was now better integrated with the course content overall, or would at least facilitate improved integration in the future.

So we've embedded it more into the actual units that we're teaching. So when the required practicals are coming up, we're actually teaching it along with the topic and the knowledge.

*Focus group, Comprehensive B (av. grade D-E)*

Many of the teachers suggested that the pre-reform assessment system had incentivised the separation of practical skills and course content because it had overemphasised the NEA components. Linked to this was the idea that, because the controlled assessment tended to take place towards the end of the course, practical work also tended to be disproportionately scheduled to take place in the second year. The overall effect was an assessment-focussed approach which was at the expense of a broader experience of practical work; teachers were compelled to focus their teaching on the specific practical activities which were likely to be assessed and the type of questions that were likely to be asked.

Often a lot of our practical work over the last few years has become very much tailored towards preparing the pupils for the [NEA], and actually it became less about the process of practical work and more about the sort of questions they would get in the practical exam... I think this reform, I'm hoping, is going to allow greater integration of practical work into the A level syllabus.

*Biology teacher, Independent A (av. grade A-B)*

By way of contrast, the quote below provides an illustration of how the logistical demands of the post-reform assessment arrangements might impede a school's ability to integrate practical activities with the course content.

We had to do a circus over a few weeks... three groups will work on this experiment, three groups will work on that experiment, three groups will work on that experiment, then swap. And you couldn't take it further out of context. So it was just a meaningless few weeks of doing stuff that they didn't really understand... because it was divorced from theory.

*Focus group, Comprehensive D (av. Grade A-B)*

It is worth noting that not all of the teachers who were interviewed thought that the integration of practical and theoretical science was a relevant issue. A minority believed that the practical and theoretical elements were not as strongly connected (or connectable) as one might expect.

I'm a little bit sceptical that there's a really significant link between practical work and theoretical understanding. ...I think very few students have the cognitive ability to go from what they see in the lab to what they understand at a molecular level.

*Chemistry teacher, Independent A (av. grade A-B)*

Indeed, a number of teachers distinguished between the needs of 'theoretical' and 'practical' students, indirectly playing down the extent to which practical work and theoretical understanding can, and perhaps should, be fused together.

#### **4.4 Student motivation for practical work**

There was not a consensus with regard to how the change in assessment arrangements had impacted upon students' motivation for practical work. In broad terms, three distinct views were expressed:

1. that the reform has not had a substantial impact on the attitudes or motivation of students, who either like or dislike practical work regardless of how it is assessed;
2. that, because of a more contextualised and less high stakes approach to assessment, the reformed qualifications have led to students becoming better engaged with practical work; and
3. that the reformed qualifications are causing students to become less motivated by practical work because they prefer to focus on elements of the course that will directly contribute to their primary grade.

This divergence of views relates to one of the main concerns about the reform and it is therefore useful to illustrate and unpack each of these three perspectives in turn.

Firstly, those teachers who did not think that the reform would affect the motivation of students somewhat undermined the notion that *any* approach to assessment will, or indeed can, have either a negative or positive impact upon engagement.

No, they don't think about it in quite the depth we do. And I think the people that come to do the sciences, whether it's physics or the other two, they just go with whatever the precise arrangements are for what's put in front of them, you know.

*Physics teacher, Sixth form college C (av. grade C)*

This perspective posits that the personal preferences and individual characteristics of students have a far greater influence on motivation than factors associated with the assessment arrangements. In other words, students who like practical work will always be motivated by it, regardless of whether or not it is assessed or serves as preparation for an exam, while those who do not like practical work will remain relatively uninspired and unengaged.

Secondly, teachers who thought that the reform would have a positive impact on student motivation believed that the pre-reform NEAs had been detrimental to students' enjoyment of, and engagement with, practical work because the process had induced stress.

So I think the coursework was always seen as a dreaded assessment... I think they don't feel pressured in the same way (*now*). It doesn't feel like an exam. And I think that probably will lead to a better view of practical work and its value.

*Chemistry teacher, Independent A (av. grade A-B)*

Linked to this was a view that strict limitations on the amount of support students were permitted to receive during pre-reform assessments had undermined confidence, while the more regular and collaborative practical work that is facilitated by the post-reform arrangements was better for fostering it.

I think they've gained a little more confidence. I think my Year 12s are more confident because they're not focussed on the terror of the [NEA] approach... that just knocks their confidence in their skills.

*Focus group, Comprehensive A (av. grade C)*

The teacher quoted below suggests that regular assessment of hands on practical work would be particularly engaging for lower ability students and may perhaps motivate them to continue studying science:

...the ones it's potentially going to affect most are the less able. Because they will find routes into accessing aspects of the course through the practical that they might have struggled with theoretically. And it's certainly been my experience in the past that a lot of the most able would quite happily just sit through theory lessons and quite a lot of the most able are the worst at the practical. So I think if it's going to impact anybody it will impact those who are perhaps borderline whether they want to carry on into A2.

*Focus group, Comprehensive E (av. grade A-B)*

The post-reform approach was also positively received by some teachers for allowing students to build up their practical skills and demonstrate competence in their own time, with support from peers and teachers. Some teachers suggested that keeping lab books meant that the students experienced an increased sense of ownership over their practical work and were therefore more engaged by it.

It's quite motivating in a way I think for them. ...it's theirs, it's their lab book, it stays in the lab all the time, it's their work. They know it's part of their practical endorsement and they know it's their job to keep it up to date and it's their responsibility, so yeah actually it gives a bit more ownership back to them I guess.

*Chemistry teacher, Sixth form college C (av. grade C)*

The third perspective was that the reform had affected student motivation in a negative way. Teachers expressing this point of view believed that motivation is dependent on students perceiving a significant link between the practical work they are doing and their level of achievement in the qualification.

So I think the students (*know*) that it doesn't really count for anything; they're sort of like 'what's the point, what's the drama?' They soon become savvy.

*Chemistry teacher, Comprehensive G (av. grade A-B)*

This perspective seemed to be largely associated with high achieving students, those who were aiming for the top grades and keen to employ strategies that might help them to achieve their goals. The argument here is that the CPAC competencies are not sufficiently stretching for high ability students who, once they have achieved them, will become less engaged with practical work and more motivated by activities which will prepare them for their exams.

We do find that *(they)* aren't taking it as seriously because it isn't assessed. It's only the competency we're assessing; there isn't an exam in it. They don't put the effort into it that they used to when it was assessed. They used to get quite frantic about building their skills for the big day... It's the difference between good enough to pass the CPAC and being the best they possibly can be because they're aiming for A and A\*s.

*Focus group, Comprehensive D (av. grade A-B)*

In summary, as has been the case with the other themes, the evidence suggests that the reform may not have the same effect in each school or college. In our small sample, these were the three views that were represented. Some teachers are perceiving (or anticipating) a positive impact on student motivation, some are perceiving a negative impact, while others are experiencing very little difference. Factors determined by the context of the individual school and its student intake are interacting with factors relating to the reform.

#### **4.5 Assessment quality and fairness**

Teachers discussed the pre- and post-reform assessment arrangements both comparatively and independently in terms of each system's strengths and weaknesses. It was clear that most teachers thought that the pre-reform system of NEAs was significantly flawed, with several expressing doubts that it had provided a valid assessment of practical skills.

Definitely not *[a]* fan - some of the questions that they had on there were so random and they're not testing their practical skills.

*Biology teacher, Comprehensive G (av. grade A-B)*

A more prominent concern related to fairness. Many teachers described how the grade boundaries for NEA components had become increasingly high, and that the assessment had ceased to reliably differentiate across the ability range.

The whole previous scheme was just getting ridiculous. There was just so much pressure to get your students right up to top marks all the time, everybody top marks. The grade boundaries went up higher and higher and higher and higher.

*Chemistry teacher, Sixth form college C (av. grade C)*

Teachers also expressed unease about perceived malpractice in the pre-reform system, specifically a concern that some schools had been providing students with

an unfair (and prohibited) level of support. Though some teachers provided examples of malpractice they had heard about (though not experienced), a more common point was that schools could operate within grey areas in order to bend the rules. Several teachers suggested the pre-reform system had placed them in a difficult ethical position whereby there was a clear tension between their obligation to deliver fair assessment and their duty to help each of their students to achieve the best grade possible.

The practical exams were so open to abuse; it was so unfair. It leaves you feeling very awkward as a teacher. I'm glad that I haven't got to have that certain moral debate with myself about how much support I should be giving and how unfair it is that other schools are doing this, that and the other.

*Focus group, Comprehensive B (av. grade D-E)*

By comparison, the new system, in which teacher assessment of practical work is considered to be under less pressure due to its exclusion from the A level grade, was viewed to be relatively fair.

I feel this is much, much fairer where we are now, yeah. You do your practical work, you teach as you go along, you teach the skills as you do the practical work.

*Chemistry teacher, Sixth form college C (av. grade C)*

Though perceived to be an improvement on what had preceded it, there was still a mixed reception for the post-reform assessment arrangements. Many teachers expressed uncertainty and concern about how consistently the CPAC could be assessed, suggesting the criteria were vague and the requirements for providing evidence to examination boards were ambiguous.

Well actually to be honest that's one of the real things that is a big worry to me, because I don't know whether I'm doing this right. You're still working on my judgement - which is lovely, because I do feel I have an ability to make a judgement on them, but I still think I should have some sort of boundaries that I'm working within.

*Chemistry teacher, Independent B (av. grade A-B)*

Linked to this was a concern about assessing a full class of students simultaneously and how this might impact on the quality of that assessment.

You know, it's not that they're doing it on their own individually in a room and you can see how they're getting on; you've got a room full of them doing it all at once.

*Biology teacher, Independent school C (av. grade A-B)*

Several teachers were keen to discuss the practical skills examination questions that would appear in the reformed A levels. A number of teachers suggested that the new questions would not provide a valid assessment of practical skills because they relied on knowledge about skills rather than their physical execution (ie indirect assessment). They expressed concern that it may be possible for a student to perform well in the examination even if they had not had much hands on experience of practical work.

They could watch the practical on YouTube, couldn't they, and still get the same out of it?

*Focus group, Comprehensive B (av. grade D-E)*

This was not the only perspective however, with several teachers stating they considered the practical work to be very important for driving up exam performance.

... I think there's an added incentive and pressure on teachers to actually do the experiments now that wasn't there before. Yeah, so it would be a strange choice really to slack off on the practicals if you knew that was coming up in the real exams.

*Focus group, Sixth form college B (av. grade C)*

The new written papers were considered to be an unknown quantity and some teachers expressed significant anxiety about preparing their students for the practical skills questions. This was exacerbated by the move to linear assessment and the decoupling of AS and A level (Gove, 2013), which compounded the sense of uncertainty and insecurity because it removed resit opportunities for students who required more time to develop.

Finally, there was a sense that trying to develop an operable, reliable and fair assessment for practical skills was a significant challenge, one with which the education community had been struggling for decades.

It's an age old question isn't it? It's always been a bit of a problem I think... trying to make it fair.

*Chemistry teacher, Comprehensive G (av. grade A-B)*

In summary, although there was fairly universal approval that the pre-reform system has been discontinued, many of the teachers harboured concerns around the new approach, whilst others wished to withhold judgement on the new arrangements until they have been in place for a few years.

#### **4.6 Administrative burden and resource intensity**

The relative demands of operating the pre- and post-reform systems were discussed in terms of both administrative burden (the demands of planning, delivery and paperwork) and resource intensity (the difficulties associated with acquiring necessary apparatus and materials). Though many of the teachers suggested that some of the issues may be transitional (a product of acclimatising to a new system that requires refinement), some concerns were of a more systemic nature.

Several teachers suggested the reform had burdened them with significantly more paperwork because they were now required to track students' progress against the various skills and competencies that underpin the endorsement. The teacher quoted below suggests that this extra burden was not associated with any apparent benefits to teaching or learning.

So I feel under a lot of pressure to deliver this for the paperwork. It didn't change what I'm teaching, it didn't change our ethos or what the kids are doing but it's much more lengthy.

*Chemistry teacher, Independent school C (av. grade A-B)*

This view was not universal. Some teachers suggested that, on balance, there had not been a great deal of change because the administrative burden of the NEA had also been substantial. The difference was that pre-reform administrative tasks had been concentrated into a short and specific time period – the preparation for, and delivery of, the assessment itself. These teachers thought that the post-reform system was equally burdensome but that the workload was more evenly distributed throughout the duration of the course. A few teachers suggested the pre-reform arrangements had actually been the more burdensome.

I think the new system is much easier to administer. Certainly the amount of paperwork and the amount of recordkeeping and the amount of just general administration that went with coursework, I'm very pleased to see the back of.

*Chemistry teacher, Independent school A (av. grade A-B)*



With regard to timetabling, some teachers thought that single lessons were often of insufficient length to accommodate the more comprehensive practical activities associated with the post-reform assessment arrangements. This had caused difficulties with scheduling because double lessons (back to back sessions in the same laboratory or classroom) were at a premium.

We're having a little bit of an issue with timing, with the lesson length. Because there's more of an emphasis now on the students doing it themselves, so not doing demonstrations... and also there seems to be an emphasis on them planning and selecting equipment. So we're finding that whole process is actually taking quite a long time.

*Focus group, Sixth form college A (av. grade D-E)*

Presumably the extent to which the school timetable facilitates or impedes regular practical work varies between institutions. The teacher below describes how a change to the school timetable, which was not driven by science or A level reform, had fortuitously fit with their teaching plans for practical work.

I'd like to just preface this with the fact that it was also accompanied by a significant timetable change within our organisation. We went from two periods a week to three, which actually meant that we anyway would have changed our style of delivery to make one of the three a practical session and the other two more theoretical.

*Focus group, Sixth form college B (av. grade C)*

A number of teachers appreciated the flexibility and transparency of the post-reform assessment system, which allowed them to better plan and schedule their resource needs for the full course. This was in contrast to the pre-reform system, which required them to wait for the release of NEA briefing documents from exam boards before they could begin their planning. Documentation about the NEAs was purposefully provided for specific and limited time windows in an effort to ensure that all schools and colleges had an equal opportunity to engage with the assessment, but this had created the need for short and intense periods of activity. Indeed, the need to rapidly acquire very specific resources for each NEA was considered arduous and stressful by some of the interviewees.

You know, you might be doing things with horse blood and you've got to find horse blood from somewhere...

*Biology teacher, Comprehensive H (av. grade C)*

For these teachers, the post-reform approach allowed them a greater degree of control; they could choose when to conduct activities and adjust apparatus and materials to better suit their own context. This view was not shared by all teachers and some believed that the level of prescription and financial cost had increased as a result of the post-reform system's 'required' practical activities.

The equipment requirement has been horrendous, absolutely horrendous. We are in a very fortunate position that because we have very large departments, the finance office has been kind to us.

*Focus group, Comprehensive D (av. grade A-B)*

Teachers at sixth form colleges expressed a particular concern that the requirements of the reform were likely to interact with the unique pressures associated with the way in which post 16 institutions are currently funded (see Janowski & Kewin, 2016).

As a sector we've been particularly hit financially so it is getting increasingly difficult... we've got quite a few chemistry classes that aren't being taught in a chemistry lab for most of the sessions.

*Focus group, Sixth form college B (av. grade C)*

This point illustrates how important it is to consider the wider educational context when interpreting qualitative data, particularly with regard to how apparently disparate contexts (assessment and school finances) may interact.

Moving on to discuss burden in a more general sense, the views expressed by the teachers often reflected a degree of uncertainty about the new arrangements, with many pointing out that it was still too early to tell how schools/colleges and teachers would adapt.

It's very much a work in progress... But we're all very conscientious within the department... we want to do it right and so we do tend to sometimes put a little bit more emphasis on things than perhaps other places would do - which I hope is the right thing to do, but we'll learn from the visit whether we're doing it a little bit too much maybe.

*Focus group, Sixth form college B (av. grade C)*

At the time when the interviews were conducted, Spring 2016, a significant proportion of schools and colleges were yet to receive a visit from an exam board monitor. Whether or not the teacher or school/college had received this visit seemed to have a significant influence on how confident they were regarding the administration of the new arrangements.

We have had no visit, no contact, nothing ...that's quite a worrying thing for me as a teacher, because I know they say 'oh, they're only going to check what I was doing is right', but actually if I don't know what I'm doing, I don't want them [the students] to fail or to be let down because I'm really working in the blind.

*Chemistry teacher, Independent school B (av. grade A-B)*

There is not a guarantee that a monitoring visit would be reassuring or lead to a reduction in workload - the monitor may unveil mandatory work that has not yet been completed, increasing the level of burden. This demonstrates that it is somewhat difficult to evaluate the administration of new assessment arrangements at such an early point in the lifecycle of a qualification. It is reasonable to expect a period of adaptation and it is difficult to disentangle those issues which are the result of the 'bedding in' of new systems, approaches and philosophies and those which are caused by systemic flaws in the new arrangements.

In relation to this point, many of the teachers expressed a dissatisfaction with the speed at which reform had been introduced and how this had impeded their ability to understand and deliver the new qualifications to a high standard.

So we did have a bit of a hand-to-mouth existence at certain times. Once the sample assessment materials came out and we realised (that) actually in the next six weeks... we need to rewrite those lessons. And that was, I think it's fair to say, an extra stress on members of staff, when they had an already full teaching timetable.

*Focus group, Comprehensive C (av. grade C)*

This issue was partly due to the timing of the accreditation decisions, which were considered to have occurred too late.

So the accreditations were close to when we needed to start teaching. The textbooks, exam support materials, were all very late in the day, (we) had to make very quick decisions and I would've liked more time.

*Chemistry teacher, Independent school A (av. grade A-B)*

There were significant concerns about introducing change so quickly, regardless of whether or not such change is ultimately for the better. Qualification reform can be disconcerting, particularly if it is introduced rapidly, and this can be confusing and worrying for all stakeholders, be they teachers, awarding organisation staff or students (Elwood, 2012). It is important to note the reform of assessment

arrangements for A level science did not occur in a vacuum. It was part of a much wider programme of reform that applied to all A level subjects (Ofqual, 2013).

#### **4.7 Impact on practical skills**

The six themes described above hint at whether teachers perceive the reform to be positive, neutral or negative with regard to its impact on the practical skills of students. Many of the questions in the interviews touched on this issue indirectly, but teachers also responded to a direct question which explicitly asked them to consider whether students' practical skills would get better or worse as a result of the change to assessment arrangements.

Views were mixed. Many teachers were keen to point out that practical skills were affected by a range of factors, limiting the extent to which any reform could lead to a substantive change in the skills of the student population. Others stated that it was still too early to tell and that any comment would be speculation. Some teachers were more positive, suggesting that, certainly in comparison to the pre-reform arrangements, the new approach was likely to facilitate an improvement in students' overall practical skills.

I think ultimately it is going to lead to an improvement in practical skills. Certainly the way we're doing it and the way I envisage it should be done should lead to an improvement in practical skills, because [NEA], like I say, became quite mechanistic.

*Physics teacher, Comprehensive F (av. grade D-E)*

The potential for a positive impact was often discussed in relation to the transition from school to university, with some teachers feeling that the post-reform approach to practical work had more in common with what students did at university.

I think they will find it much easier if they pursue science at university level to go in to a university lab and fulfil the criteria that they require, because they will have been doing similar things over their two years of A level.

*Focus group, Comprehensive E (av. grade A-B)*

Some teachers believed the reform would cause an increase in students' breadth of experience and range of skills, though there was acknowledgement that particular skills may be taught in less depth where they had previously been a common topic for the pre-reform NEA.

They might in the past have applied a small number of skills to a particular situation. Now they've got a large pool of skills and they can choose to dip

in to any part of that pool in any practical that they do. I think they probably use more skills more often than they did before.

*Physics teacher, Comprehensive G (av. grade A-B)*

Many of the teachers also perceived an educational benefit from the reform; it provided more encouragement for them to repeat practical activities multiple times in different ways, until a student had developed a particular skill or competency. The view among these teachers was that the reformed qualifications were better at facilitating a more formative approach to assessment.

What we have found really beneficial is the way that we can conduct the practicals, so if they are doing a technique poorly we can run over and correct them, or other students can.

*Focus group, Sixth form college B (av. grade C)*

In some instances, this element was contrasted directly with the pre-reform system of controlled assessment, which was perceived as offering limited educational value. This came from a belief that the focus on preparing students for a specific assessment (and adhering to the rules of that assessment) appeared to override the need to contextualise that practical activity and integrate it in to students' wider science education.

...previously the assessment was very much a closed box, a black box: we go in, we do the marking, we come back out, we tell them the marks but we can't really tell them where they lost the marks and which ones they need to focus on. And I found that very frustrating, as did the students.

*Physics teacher, Independent A, (av. grade A-B)*

In contrast, as discussed under the motivation theme above, there were also teachers that thought the pre-reform system's more rigid assessment framework had been beneficial to students because it had motivated them to focus on skills.

I feel that they're coming out of the AS year with less developed practical skills than they did before, definitely, without a shadow of a doubt. Their analysis skills are definitely poorer because they haven't had the drive to hone them.

*Focus group, Comprehensive D (av. grade A-B)*

Similarly, the quote below represents a level of unease about the disconnect between a student's overall grade and their practical skills. The teacher is not confident that the post-reform system will lead to accurate assessment.

We could be sending them to university with poor practical skills, but as long as they understand the theory behind the practical, they're still going to get all the credit.

*Focus group, Comprehensive B (av. grade D-E)*

Finally, though it is useful to explore explicit opinions in this way, there is some risk that, in using such a direct line of questioning, we are bypassing important nuance and may misunderstand how teachers are evaluating the reform. Many of the teachers were well aware that all they could offer at this stage was speculation. Some were also keen to point out that the post-reform assessment arrangements were inherently flexible in a way that the pre-reform system had not been, which meant that the impact on practical skills, positive or negative, was now somewhat up to the school or college.

Well I think it will depend on how different teachers approach it. If they just go for twelve practicals then the students are not necessarily going to pick up the skills... because they might only visit each one once I guess.

*Chemistry teacher, Sixth form college C (av. grade C)*

## **5 Discussion**

### **5.1 The perceived impact of reform**

The diversity of schools and colleges that teach A level science in England is such that any reform is unlikely to have a uniform impact. Each institution is a specific context into which the post-reform assessment arrangements must be integrated. Indeed, it is notable that teachers were often keen to emphasise the importance of factors which are not directly related to the specific assessment arrangements for A level science and are more contextual. Examples include school timetabling (finding the 'double periods' that are often required for practical work), funding for science (particularly in sixth form colleges, where rules around student funding have recently undergone change), and the navigation of the broader reform (adjusting to the introduction of a largely linear assessment model).

One feature of the reformed qualifications is an increased level of freedom to conduct practical work and assessment in a manner that the teacher believes to be appropriate. Though there are particular competencies and skills that must be

assessed there is flexibility with regard to the exact nature of the activities<sup>8</sup> that are to be undertaken and freedom for teachers to decide when, within the two-year course, each practical activity takes place.

Based on these interviews, this level of flexibility appears to have the potential to be a double-edged sword. Some schools and colleges may embrace the opportunity to emphasise practical work in their planning while others may decide to focus on other areas of the course. The drivers for such decisions may be financial (based on the availability of budget for delivering practical work), philosophical (based on teachers' beliefs about the importance of practical work in science education), or pragmatic (based on what teachers believe will be most important for the students' grades). There is an extent to which it is up to schools, with guidance and oversight from the exam boards, to ensure that the post-reform flexibility is used positively.

One of the key drivers for conducting this research was a concern that the decoupling of practical skills assessment from the student's primary grade may have the unintended consequence of devaluing practical work and therefore causing the skills of students to decline (e.g. Biology Education Research Group, 2014; Wellcome Trust, 2014). Evidence from these interviews does not suggest that this will be a significant issue, with most teachers of the belief that student motivation for undertaking practical work will either be unaffected or somewhat boosted by the reform. The factors that teachers thought may lead to better student engagement included a more formative approach to assessment, an increased sense of ownership for students (fostered by the use of lab books), and a more obvious linkage between practical work and the course content.

However, there was one school which took a strikingly different view. This school suggested that their students, who were mostly targeting the top grades of A\* and A, were now less engaged with practical activities because they wanted to prioritise work which they believed would more directly influence their grade. These students were motivated only to meet the minimum standard required for passing the endorsement, with further work on their practical skills considered somewhat wasteful. This case is an important illustration of how the reform is unlikely to be impacting upon all schools, teachers and students in the same way.

It is worth recalling that the practical skills exam questions (which contribute 15% of the total exam marks) are intended to indirectly assess practical skills, thus providing a significant advantage to those students who have conducted sufficient practical work. It is therefore likely that the level of engagement experienced by students, schools and teachers will be an evolving issue; one that is dependent, at least in part, on whether a strong connection is perceived between performance on the new

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<sup>8</sup> Some exam boards / specifications do specify that particular practical activities are 'required', though there is flexibility about exactly how they are conducted.

written exams and the amount and type of practical work that is undertaken throughout the course.

Finally, it is important to point out that some teachers were experiencing difficulties with the post-reform arrangements that were not systemic and could probably be resolved with refinements. For example, there was some confusion about the level of documentation required as evidence for students' performance against the CPAC. Many such issues are likely to be known by exam boards and some may already be being tackled. However, these interviews provide a useful barometer for how successfully teachers are delivering the changes and some clues as to where improvements could be made or additional support provided.

In summary, despite these issues and nuances, the data does imply that the reform has been received in a largely positive way by most teachers. There was a strong level of discontent with the pre-reform system, which was considered overly prescriptive, unreliable and open to malpractice. Though views were varied, many teachers believed the post-reform system would allow them to better integrate practical work with the course content and would encourage them to deliver more practical work in a more supportive and valuable way.

## **5.2 Limitations of the study**

A key but unavoidable limitation of this study is the self-selecting nature of the teachers who participated - it may be that schools and colleges that were willing to engage with the research were also those more likely to be vocal about the impact of the reform. Similarly, it is worth reiterating that this study sampled only a small number of A level science teachers and the findings cannot, therefore, be generalised to the entire population. The goal was to explore and understand the various mechanisms through which the reform of science A level may impact upon practical work in different schools and colleges, not to make strong inferences about its net effect. For example, it is beyond the scope of this study to make comparisons based on school type, even though it is a variable that is likely to be important in determining the impact of the reform at the level of the individual school or college<sup>9</sup>.

Finally, these interviews took place in the only year during which teachers were extensively teaching both the pre- and post-reform specifications. While this has clear advantages from a comparative point of view, it is important to note that the reform has not yet 'bedded in'. Various positive and negative points about the post-reform system are likely to emerge as teachers and students become acclimatised to

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<sup>9</sup> For example, there is evidence that independent schools have a larger budget for science, with findings from a survey commissioned by SCORE (2013) suggesting that per capita spend was around three times higher in independent schools (£27.29) compared to state funded schools (£8.81).



it. Indeed, the teachers themselves were keen to remind the researchers that it is too early to be drawing any firm conclusions.

### **5.3 Conclusion and recommendations**

It is too early to evaluate the reform of science A level in a conclusive way, but we are now in a position where the impacts, both positive and negative, are being experienced at the classroom level. It is important to appreciate that the change to the assessment of practical skills represents a relatively small part of what is a significant reform for all general qualifications (both GCSEs and A levels). This makes the process of evaluation challenging; there are many changes occurring simultaneously and these changes are likely to interact in a multitude of ways, some more predictable than others.

On balance, the reform is being embraced positively by the teachers we interviewed, though there are a number of issues and therefore scope for clarification and refinement. There is an extent to which any reform can only be successful if the expertise and infrastructure is in place to support the changes which are introduced - the impact of this reform will depend on how the individual school or college chooses to implement change within their specific context and the level of support and oversight which they receive.

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## **7 Annex A: Ofqual's A level science research programme**

Reformed A level qualifications in most subjects were introduced for first teaching in September 2015 (Gove, 2013). With regard to science, the reform led to significant changes to the assessment arrangements for practical skills (Ofqual, 2016). Ofqual is conducting a programme of research to evaluate the impact of A level qualification reform on the teaching and learning of science practical skills.

The programme is comprised of four main studies:

- Study 1: Teacher interviews – Perspectives on A level reform after one year
- Study 2: Pre and Post reform evaluation of practical ability – A comparison of science practical skills in pre and post reform cohorts of undergraduate students
- Study 3: Valid discrimination in practical skills assessment – An exploration of classification reliability when assessing the performance of practical skills
- Study 4: Technical functioning of assessment – An analysis of A level examination items that assess science practical skills

## **8 Annex B: Focus group/interview schedule**

We would like to discuss how A level reform has affected you and your students with regard to practical work. With this in mind, we would like you to compare the new reformed qualification, which commenced last September, to the previous qualification which finishes this summer. We have a series of questions that we would like to ask you but we do not want to lead the conversation – we are keen for you to tell us what you think is important.

Please could you read the **Informed Consent Form** and sign it if you are happy to do so. I would like to reassure you that our goal is to complete an objective and independent evaluation of the impact of reform, not to in any way evaluate your performance or the performance of your students or your school/college. You, your students and your school/college will be completely anonymous in any published report of this research.

### **Your teaching experience**

*We would like to start by finding out about you.*

- Please tell us about your background as a science teacher.
  - How many years of teaching experience do you have?
  - What are your subject specialisms?
  - How long have you been at this school/college?
  - With which exam boards are you taking pre- and post-reform A levels?

### **Teaching practical skills**

*These questions are about how reform has influenced the way in which you teach.*

- To what extent has the reform of A level Science influenced your approach to practical work?
  - Planning and carrying out practical work
  - Carrying out administrative tasks related to practical work
  - Integration of practical work into teaching the course
- To what extent has the reform had an impact on your experience of teaching practical work?
  - Enjoyment of teaching practical work

- Burden, in terms of time and stress

### **Learning practical skills**

*These questions are about how reform has influenced what students are learning.*

- What impact do you think the reform has had and will have on the practical *skills* that students acquire?
  - Their level of practical competence
  - The type of practical skills they acquire
  - The retention and transferability of their skills (eg to university)
- To what extent have changes in the approach to practical work had an impact upon students' theoretical understanding of the subject?
  - Understanding of scientific concepts that underpin the practical work
  - Investigative skills

### **Motivation and future study**

*These questions are about how the reform has affected students' motivation for science and their aspirations for future study*

- To what extent has the reform impacted upon your students' attitudes and feelings towards science and practical work?
  - Confidence in their practical ability
  - Feelings about science
  - Interest in science outside of the class room
  - Aspirations for the future (career, HE)

### **And finally...**

- Is there anything important about the impact of reform which we have not yet covered?
- If you were Ofqual, what would you focus on when evaluating the reform?

## **9 Annex C: Participants by local authority (LA)**

Table 3. *Participating schools and colleges by local authority (LA)*

Local authority	Count
Birmingham	1
Cheshire East	1
Coventry	2
Derbyshire	1
Harrow	1
Herefordshire	1
Hertfordshire	1
Kingston upon Thames	1
Leicestershire	1
Newham	1
Nottingham	2
Warwickshire	1
Total	14

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