Teachers' views of the impact of the new Chemistry A-level on students entering university in 2017/18

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Version 1.02 03/09/2017

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Introduction and background

In 2015, we published a review (see: http://edshare.soton.ac.uk/14806/) of the new A-level in Chemistry in which we compared the content of the different specifications from awarding bodies in England and Wales (with Northern Ireland included from a previous analysis). To follow this up, we have compiled this report on teachers' perceptions of the impact of the new specifications on their students in comparison with previous cohorts who studied the 'old' A-level. Our primary aim is to provide some guidance to those who are involved in the delivery of chemistry degree programmes by giving an indication of some of the differences they might expect to observe in their 2017 cohort of incoming students. The report may be of interest to a range of other stakeholders, including teachers, staff at awarding bodies and learned societies etc. Note that this is not a formal piece of published work, and is presented in a 'rough-and-ready' format. If you do find any errors, typographical or otherwise, please let us know (d.read@soton.ac.uk) and we will update the document. To check that you have the latest version of this document, please visit EdShare: http://edshare.soton.ac.uk/18928/.

The survey

An online survey was constructed using the University of Southampton's institutional survey tool, iSurvey, and was disseminated nationally via social media and our network of contacts in the chemistry education community. 61 teachers completed the survey prior to 25th July 2017, and their responses have been analysed resulting in the data presented herein. **Note that we have only undertaken a rudimentary analysis of the data collected**. If you are interested in analysing the data in more depth yourself, please feel free to get in touch to discuss a collaboration.

The survey was split into five distinct sections: specification and school/college; practical skills; other skills; impacts on students; and overall views of the changes. Most survey items were made up of a statement (e.g. "A 2017 student's hands-on practical skills will be...") accompanied by a list of responses based around a 5 point Likert-scale (typically 'Much stronger' to 'Much weaker'). Some teachers did not select responses to all questions, but we have kept their responses in the dataset as they did respond to questions at the end of the survey rather than abandoning it in the middle. This explains the variation in the numbers of teachers responding to each survey item. Additionally, most of the survey items were accompanied by a text-response item with the prompt "Briefly explain your answers to the previous question…", facilitating the collection of qualitative data to provide context for the quantitative data. As noted above, the qualitative data has not been subjected to a detailed analysis, and has simply been used to help weave a narrative around the charts presented in the report.

In order to get the most from this report, it should be read in conjunction with our original report summarising the changes that were made to the specifications for first teaching in 2015. As noted above, this can be downloaded here: http://edshare.soton.ac.uk/14806/.

Disclaimer: We are reporting the views of the teachers who responded to our survey. If there's anything you disagree with, please don't shoot the messengers!

Section one: specification and school/college:

The first section collected information about the teachers based on the specifications they have been teaching and the type of school that they are teaching at.

Item 1a: Which A-level Chemistry specification were you teaching up until June 2015 ('old' spec)?

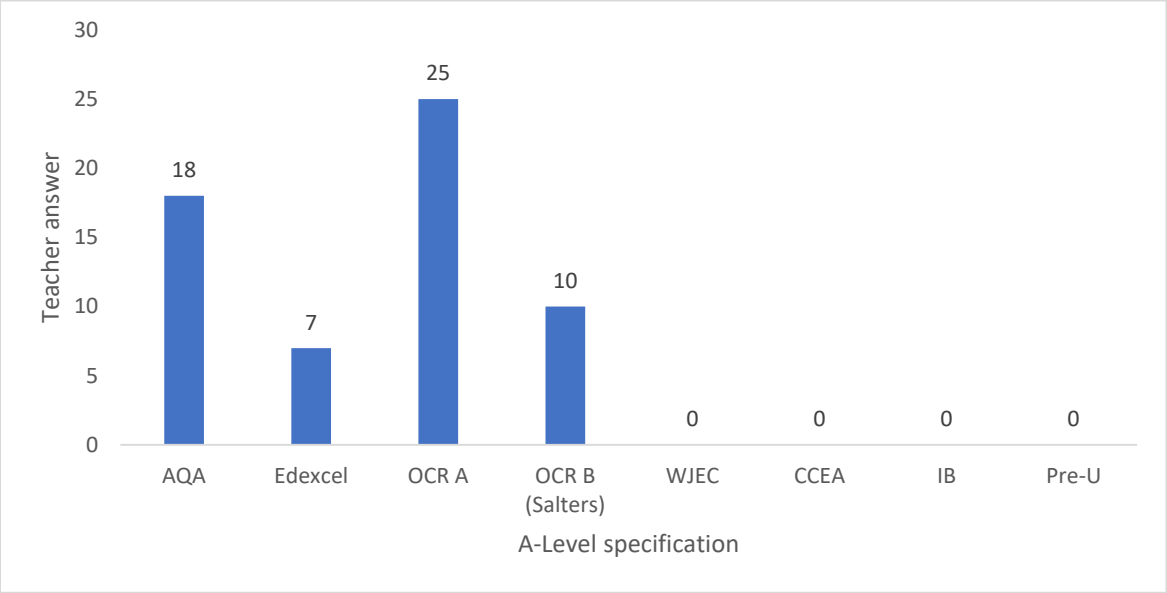

Figure 1

Item 1b: Which A-level Chemistry specification are you teaching now?

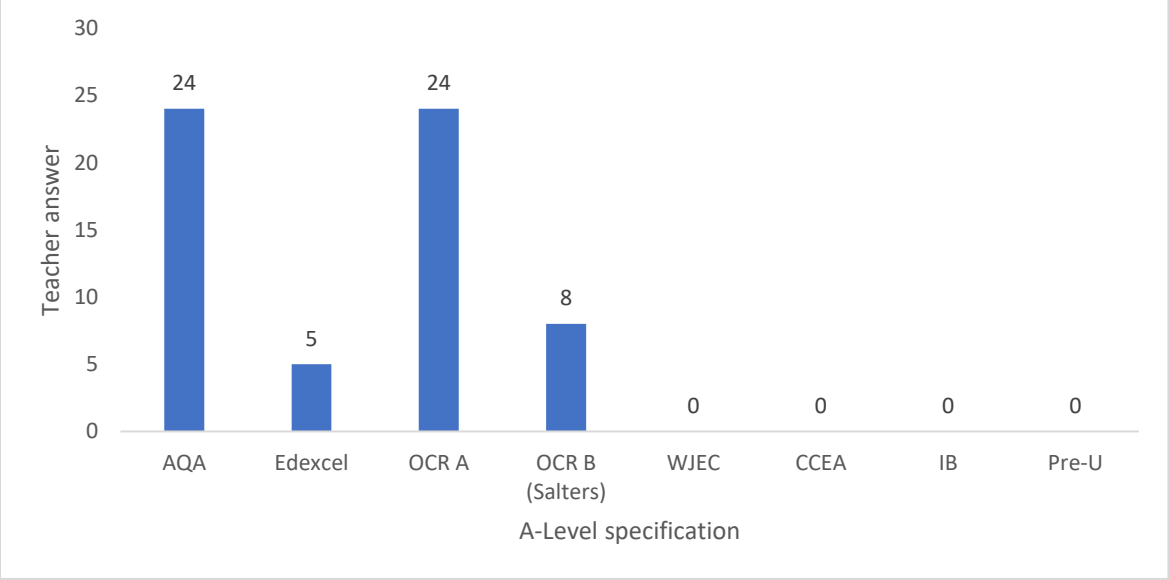

Figure 2

The data shows that there is little change in the overall profile of specifications taught by this group of teachers on moving to the new specifications. In terms of the spread of the data, OCR A and AQA are known to be the most widely taught A-level Chemistry specifications, which is reflected above. The lack of responses from WJEC teachers is likely due to a failure to disseminate publicity about the survey to teachers in the principality, and CCEA teachers would not be expected to respond as Northern Irish A-levels did not undergo the same kind of reform as those in England and Wales. IB and Pre-U were included in case any of the teachers responded had taught these qualifications prior to 2015, which evidently was not the case.

Item 1c: In what type of school/college do you teach?

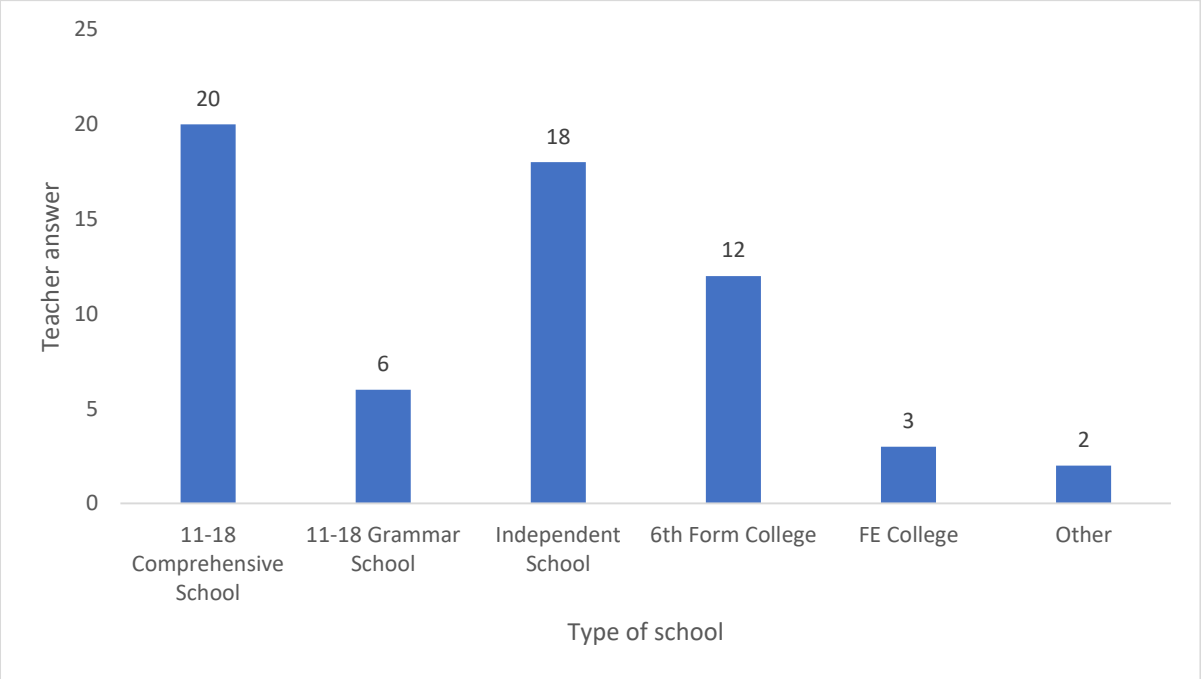

Figure 3: Just under two thirds of the teachers who took part in the survey in the were from either 11-18 comprehensive schools and independent schools. The remainder of the teachers were from grammar schools, 6th form or FE colleges.

Item 1d: In which area of the country is your school/college?

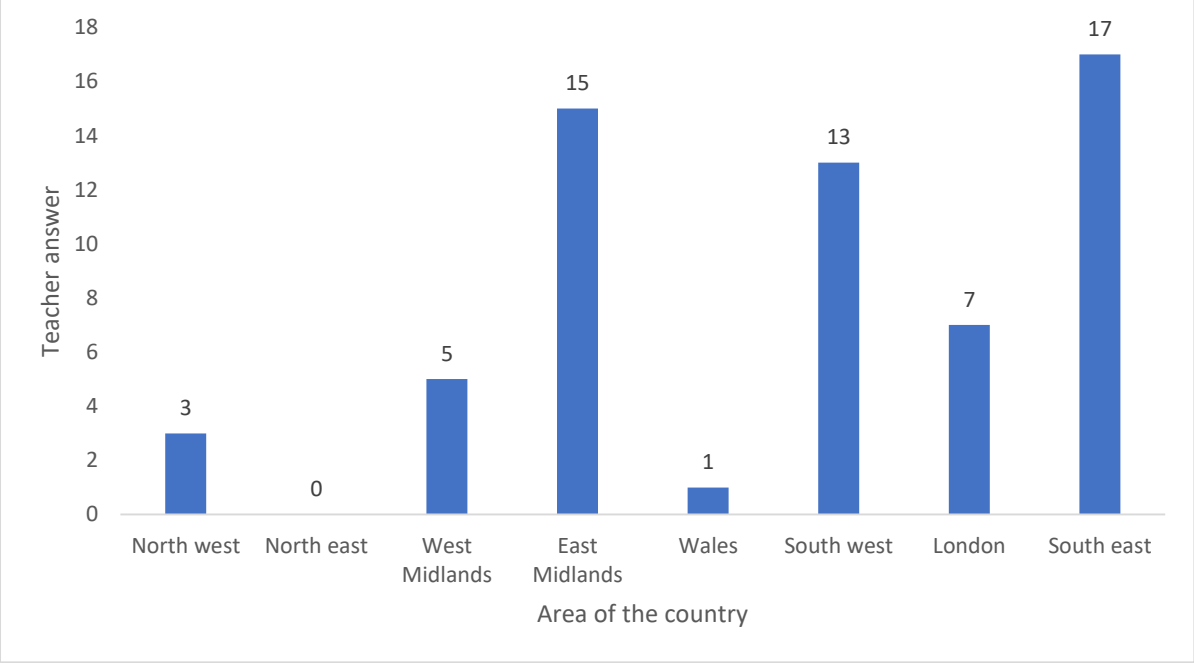

Figure 4: The teachers who took part in the survey primarily were from the south east, south west and the east midlands. The remainder of the teachers were from London, west midlands, north west and Wales.

The data shows that survey respondents came from a range of different types of school/college, with slight over-representation from independent school teachers compared with the general cohort. A reasonable geographical spread was obtained, although some parts of the country are not well represented. Nonetheless, the data shows that responses have been obtained from a reasonably representative sample of teachers.

Section two: practical skills

Teachers were asked about how the new specification would impact students' practical skills, with separate survey items relating to hands-on practical skills, writing up practical work, and interpreting the results of experiments.

Item 2a: A 2017 student's hands-on practical skills will be...

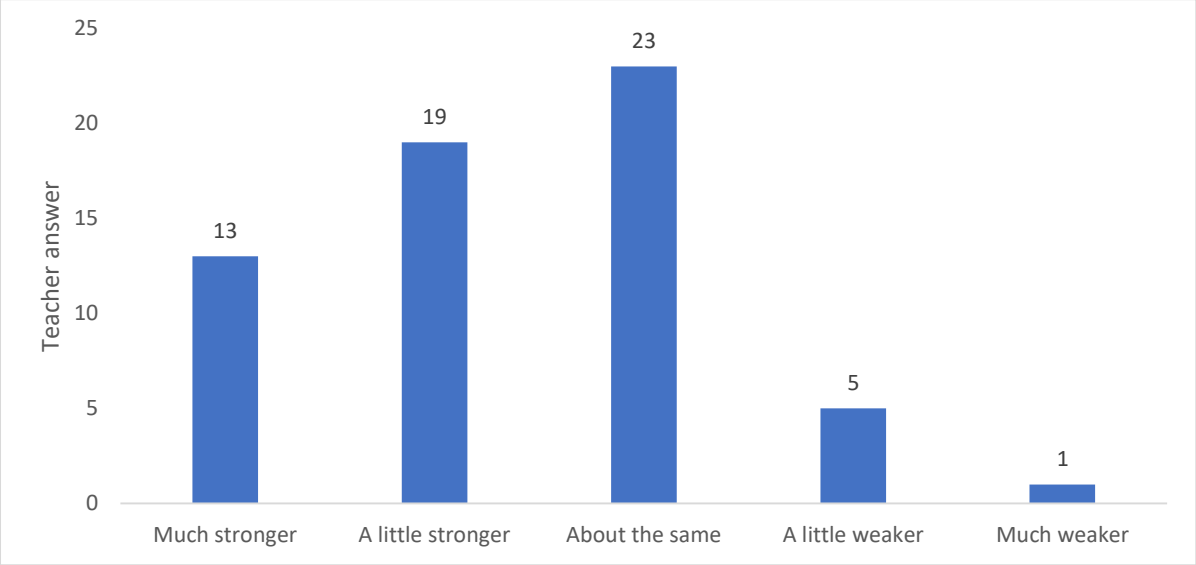

Figure 5: On average, just over 50% of the teachers said that they thought pupils would have a stronger hands on practical skill with the new specification. Around 40% of teachers believed that a student's practical skills would remain the same with just under 10% believing that the practical skills would be weaker.

Comments from teachers who indicated that hands-on skills would be stronger (32/61):

- Students are required to follow a method and are encouraged to be more independent and adopt a more investigative approach.
- Students are asked questions during the practicals to ensure that they understand what they are doing and why they are doing it.
- Less repetition than before.
- Greater focus on laboratory *skills* specifically.
- Students are now undertaking a wider range of practicals and a broader range of techniques than previously.
- Teachers are now using practical work to teach chemistry rather than teaching them to answer questions on a practical assessment.
- Students are more focused and take ownership of their practical work.
- Students have been more relaxed and open to making mistakes, and correcting them

Comments from teachers who indicated that hands-on skills would be about the same (23/61)

- A few teachers commented that they used to undertake more practicals, but now fewer practicals are completed.

- One teacher noted that their school had always placed a strong emphasis on practical skills anyway.
- Students still receive a similar practical experience as before, and that very little has changed about practical teaching. The amount of practical work done was not changed, there is now a wider range of practicals that could be completed as less emphasis is based on ISA-style practical assessments.

Comments from teachers who indicated that hands-on skills would be weaker (6/61)

- A number of teachers who responded in this way were OCR Salters who lamented the loss of the individual investigation, developed students' practical skills in a way that the new PAG activities cannot. One stated that "The investigation turned A-level chemistry students into chemists. It is a great loss."
- Some teachers noted that the practicals themselves are now not worth anything, and that they don't do a great deal during practical activities.
- One teacher felt that the new practicals were more prescriptive than the old ones.

Item 2b: A 2017 student's skills in writing up practical work will be...

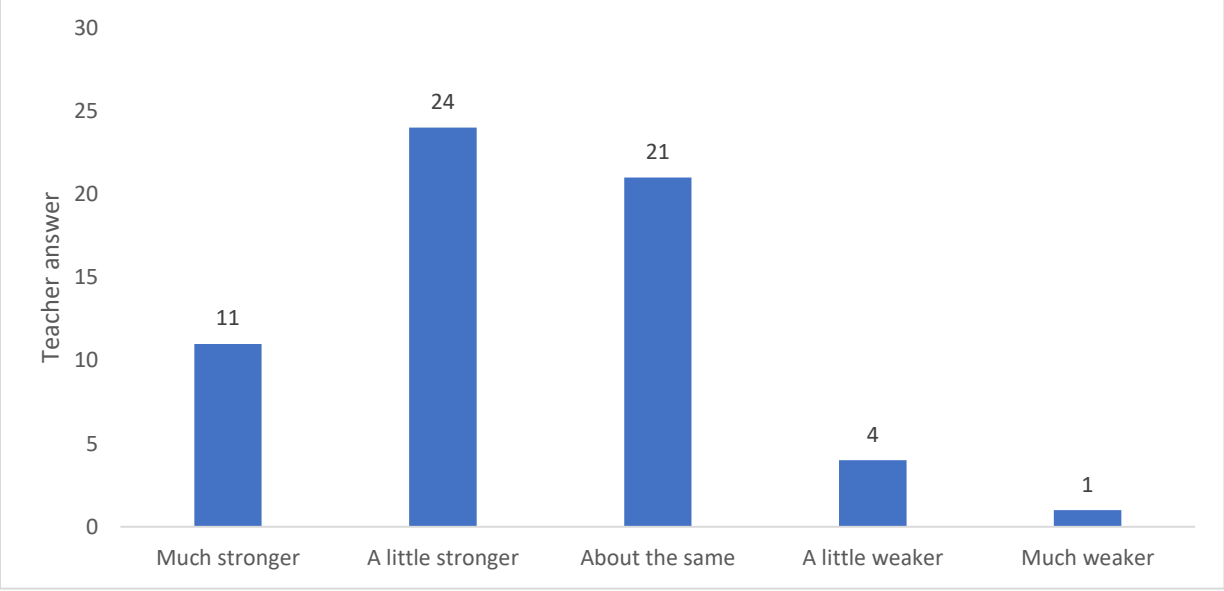

Figure 6: Just under 60% of teachers said that a students' skills in writing up practical work will be stronger. Around 35% of the teachers said that their write up skills will be the same and less than 10% of teachers said that the new specification would make a student's write up skills weaker.

NB. See below item 2c for comments relating to this item

Item 2c: A 2017 student's skills in interpreting the results of experimental work will be...

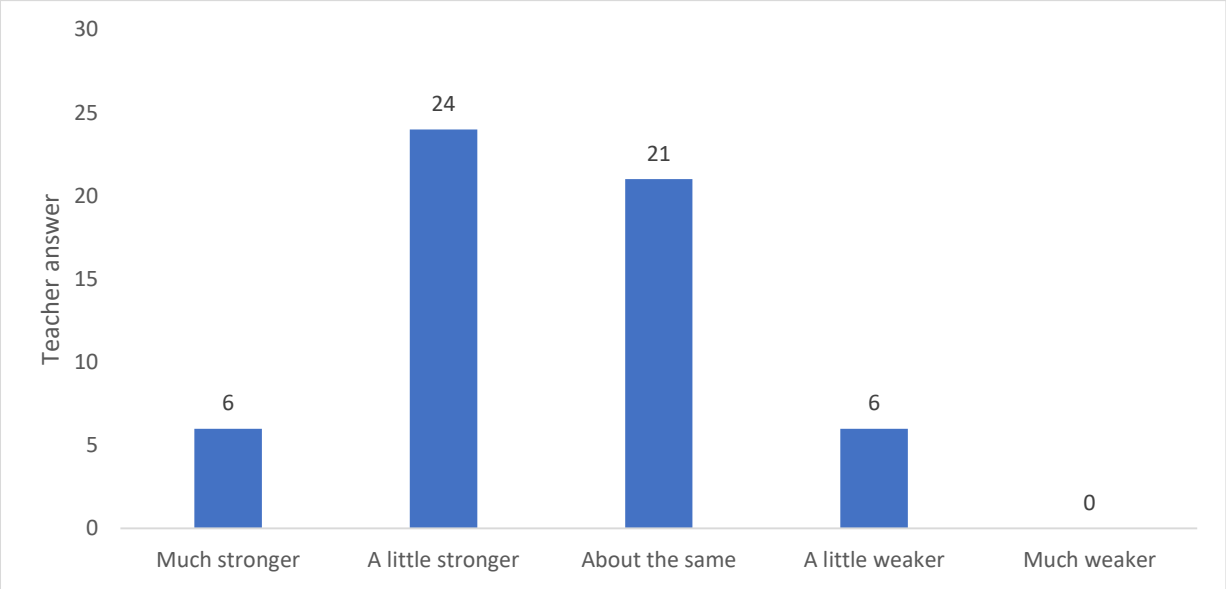

Figure 7: Just over 50% of teachers said that a student's skills in interpreting results of experimental work would be stronger. Around 35% of teachers said that students' skills in interpreting experimental work would be the same. 10% of the teachers said that students' skills in interpreting experimental results will be a little weaker.

Comments from teachers who indicated that writing up (35/61) / interpretation skills would be stronger (30/57):

Some teachers felt that the broad range of experiments would improve analysis of experimental data. Some teachers noted that there are clear guidelines for each practical and what is expected from them in accompanying activity sheets, which ensures that students apply themselves to the task of interpreting their results. Some teachers felt that the increased emphasis on practical-based questions in exams indicate that practical work is valued, encouraging students to engage more. It was also suggested that the use of a lab book has ensured that students complete a full write up and understand the processes they are undertaking, with increased opportunities for reflection on the whole process. The fact that students are required to research and devise methodology as well as carry out risk assessments was seen as being beneficial by some respondents, and that it would support students in learning to apply their knowledge.

Comments from teachers who indicated that writing up (21/61) / interpretation skills would be about the same (21/57):

Teachers who felt that there would be no change in students' skills when writing and interpreting results said that as there are no requirements in the practical endorsement, they had not changed their practice in terms of expectations of their students. Similarly, some noted that practical work has always been a key part of chemistry teaching and it will continue to be so, albeit with a different form of assessment. It was indicated by a few teachers that the previous practical assessments had tested skills of interpretation anyway. It was noted by some teachers that changes to assessments (i.e. removal of coursework and teacher-marked work) shouldn't have driven curriculum changes.

Comments from teachers who indicated that writing up (5/61) / interpretation skills would be weaker (6/57):

Teachers in this group were mainly Salters teachers who cited the loss of the individual investigation which required students to produce a "cohesive and deeply thought out document". It was also noted that the fact that marks are no longer awarded for practical work, which might act to reduce student commitment to the development of these skills.

Section three: Other skills

Item 3a: A 2017 student's problem-solving skills will be...

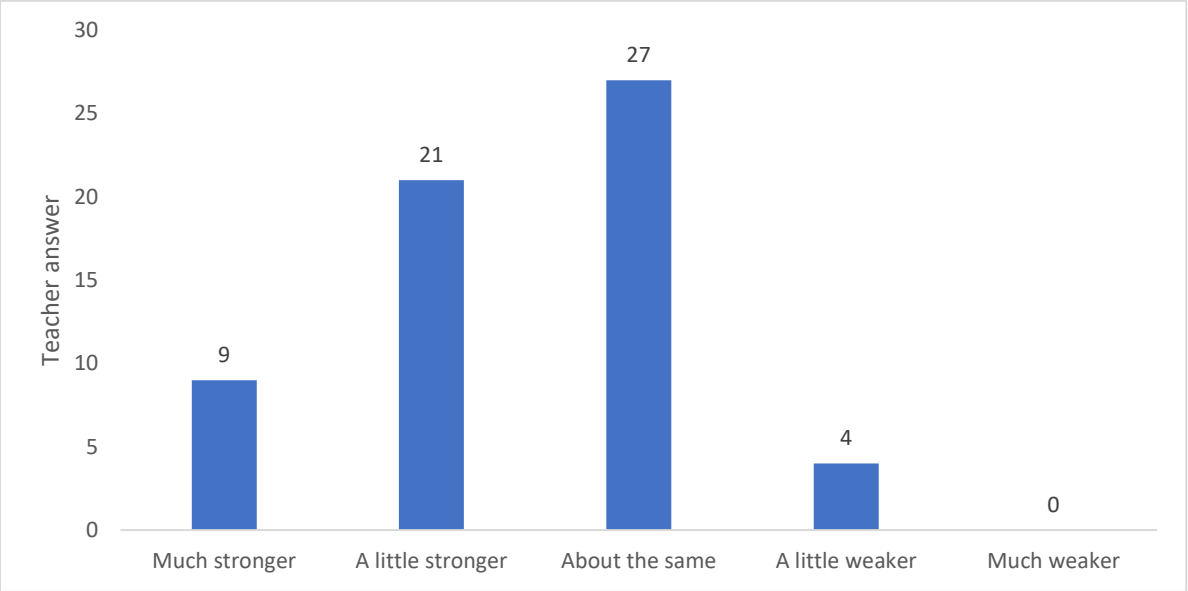

Figure 8: Just under 50% of teachers said that students' problems solving skills would be stronger with the new specifications. Around 45% of teachers said that students' problem solving skills would be the same and only 6% of teachers said that they would be a little weaker.

Comments from teachers who indicated that problem-solving skills would be stronger (30/61):

There was a suggestion that the linear nature of the course supported a much more synoptic approach to teaching, which facilitated the development of problem solving skills. Other comments included:

- Memory is no longer sufficient for exam success. Students are required to understand the content.
- Greater focus on application of knowledge and more emphasis on problem solving.
- Students are required to think about what they are doing and why they are doing it.
- "Linear A-level permits the kind of spaced, interleaved retrieval practice that promotes a strong foundation of accessible and transferable knowledge."
- More maths in the new course.
- Students are thinking more about their practical work, and are aware of the effects of changes on their results.

Comments from teachers who indicated that problem-solving skills would be about the same (27/61):

Teachers in this group noted that there was not much change between the old and new specifications and felt that that the new versions do not specifically focus on problem solving. Some teachers also believe that students generally struggle with problem-solving and this is likely to be the limiting factor rather than the demands of the specification. It was also suggested that students in this first cohort have not had time to develop their problem-solving skills sufficiently to accept the challenge that the new papers present, with the implication that the availability of past papers with

more demanding problem-solving questions in future years will encourage students to do this more effectively.

Comments from teachers who indicated that problem-solving skills would be weaker (4/61):

Finally, teachers who said that students' problem solving skills will be weaker said that students were provided with a method on most occasions, and are not finding solutions to their own problems. One teacher in this group also suggested that students were actually less independent in practical work, and therefore more reliant on others for help.

Item 3b: A 2017 student's skills in applying mathematics to chemistry will be...

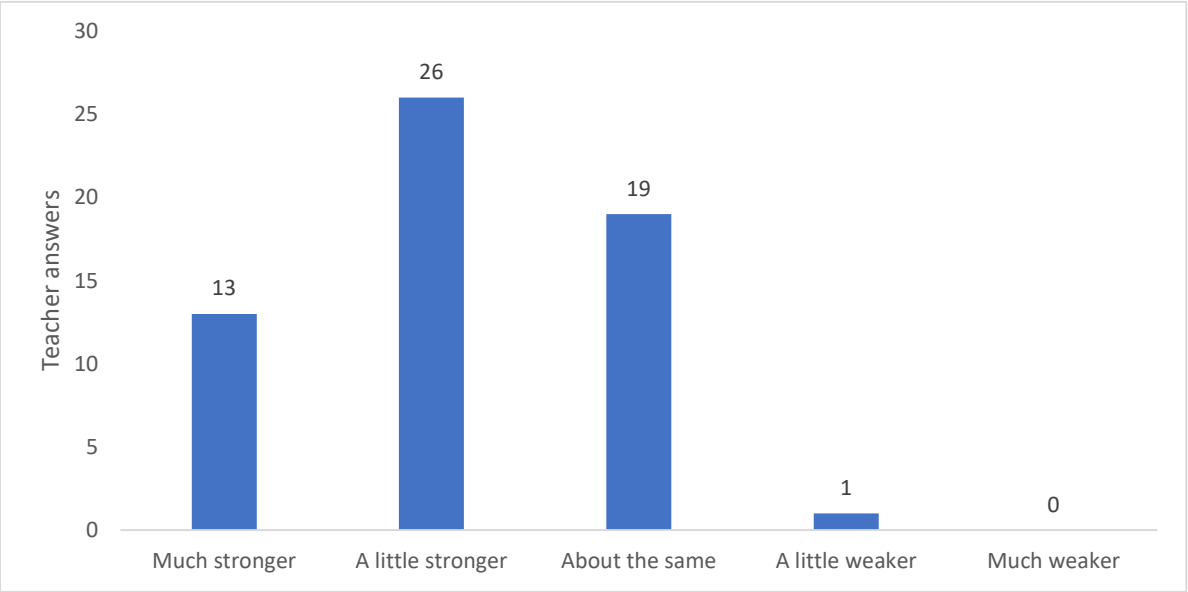

Figure 9: just over two thirds of teachers said that a student's skill in applying maths to chemistry will be stronger. One third of teachers said that a students' skill in applying maths would be the same. With only 1 teacher saying that the maths would be weaker.

Item 3c: A 2017 student's understanding of mathematics in chemistry will be...

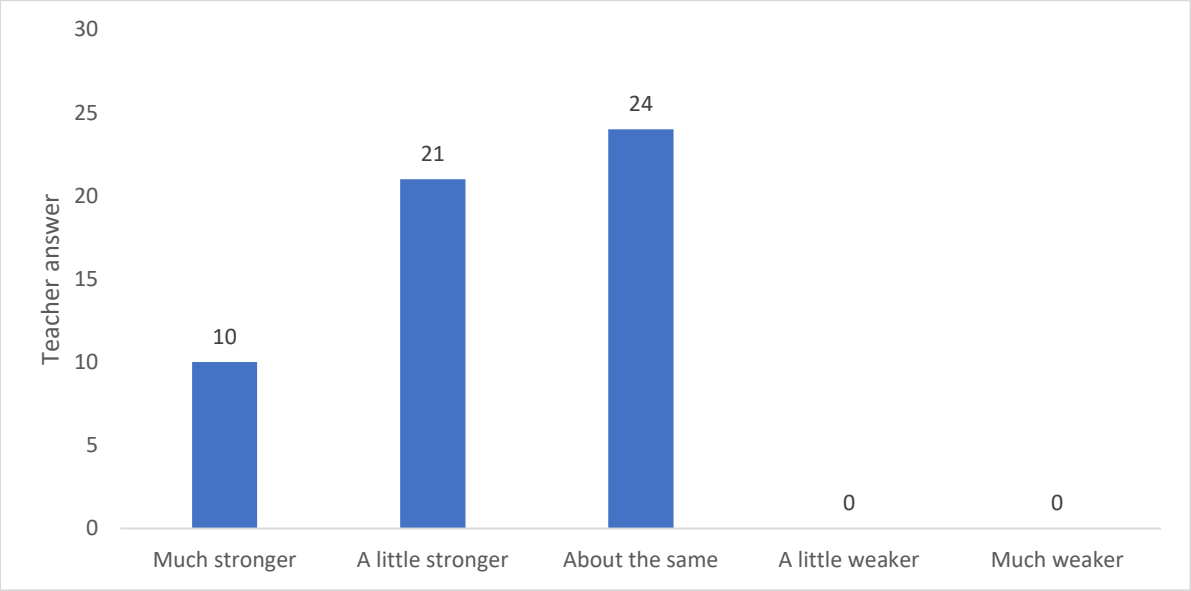

Figure 10: 55% of the teachers said that a students' understanding of mathematics in chemistry will be either a little or much stronger. The remaining teachers said that the students' understanding of maths in chemistry would be the same. No teachers said that their understanding of maths in chemistry would be weaker.

Comments from teachers who indicated that students' skills in applying maths (39/59) / understanding of maths would be stronger (31/55):

The increased emphasis on mathematics in the new A-levels has clearly had an impact on how teachers approach the teaching, resulting in an overall improvement in the skills of applying maths. An example cited by one teacher was an observation of a deeper understanding of mole calculations exhibited by their students. Several teachers noted that students would now have a better understanding of units and their interconversion. It was also suggested that students will be better at "picking out" the data relevant to answering specific questions, as this has been a focus in the new specifications. It was also noted by one teacher that pupils with good mathematical ability will be successful, but those who are not as capable will struggle. One teacher stated that the "Removal of scaffolding has benefitted both ends of the spectrum of ability. It has allowed freedom for students to select their own routes in solving problems."

Comments from teachers who indicated that students' skills in applying maths (19/59) / understanding of maths would be about the same (24/55):

Teachers who said that a students' ability to apply and understand mathematics in chemistry will be about the same felt that there was very little difference in mathematical content in the new specifications, and so it is difficult to observe any change in ability. It was also noted that equations can still be rote learned by students and applied where needed without deep understanding.

Comment from the 1 teacher who felt that students' skills in this area would be weaker:

"Doing 3 A levels, there is no opportunity to take AS maths at our centre. Furthermore, weak students who would have dropped chemistry at AS are now obliged to continue to the full A Level as they are only starting with 3 subjects."

Item 3d: A 2017 student's independent learning skills will be...

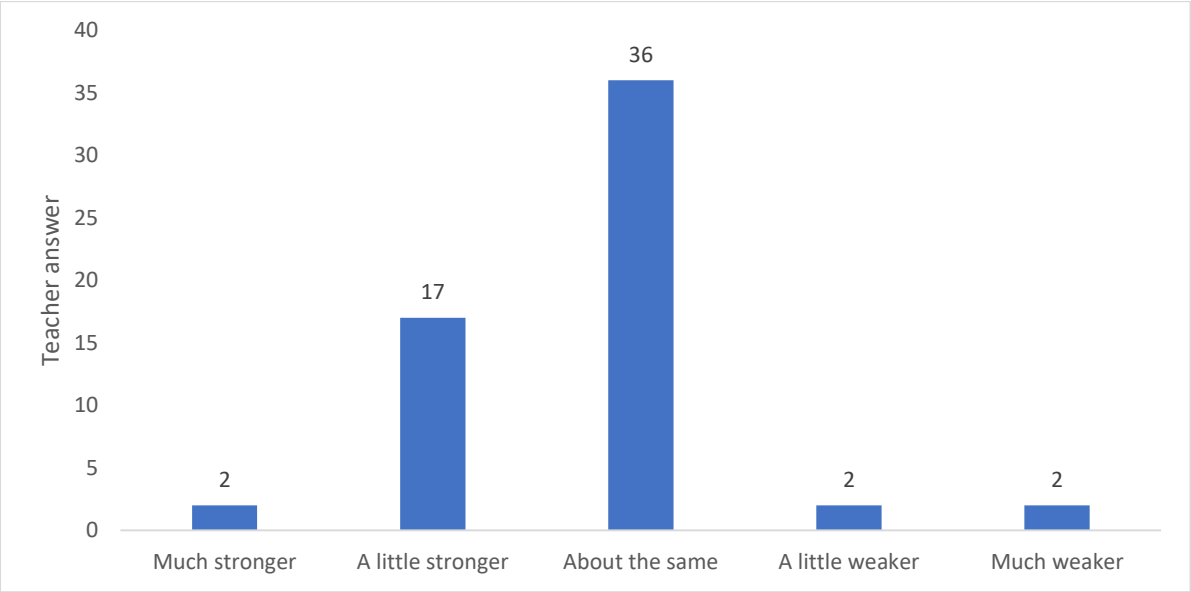

Figure 11: One third of teachers said that a students' independent learning skills will be stronger. 61% of teachers said that the independent learning skills would be the same. The remaining teachers (6%) said that a student's independent learning skill would be weaker.

Text-response comments were not collected in relation to this survey item.

Section four: Summary questions

Item 4a: A 2017 student's understanding of chemistry will be...

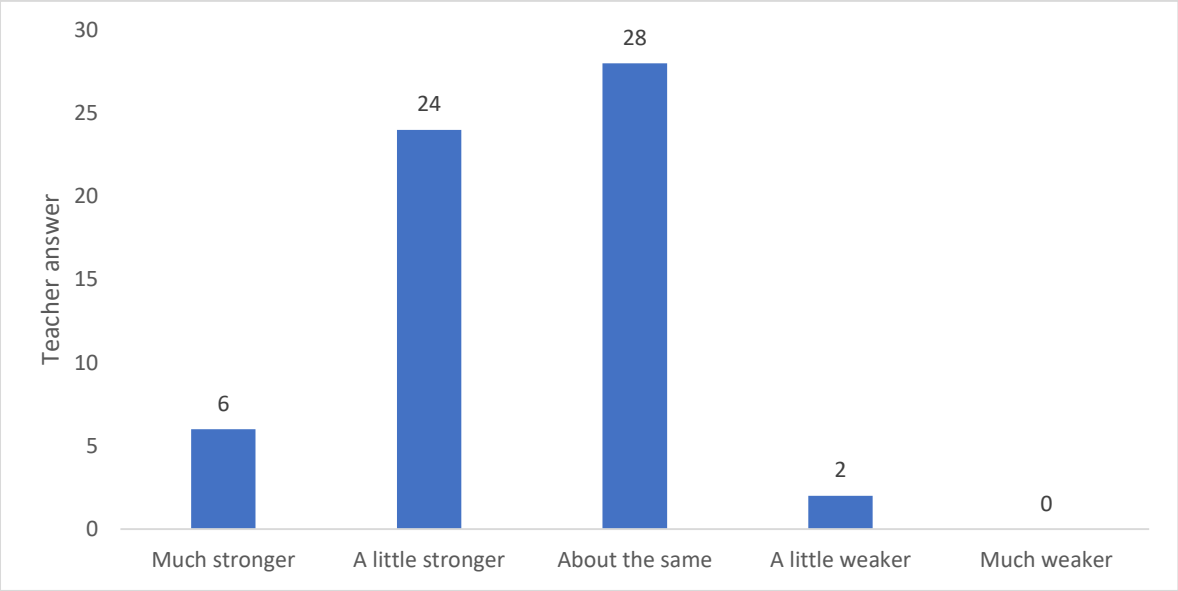

Figure 12: 50% of the teachers said that a students' understanding of chemistry would be stronger. Just under 50% of teachers said that their understanding of chemistry would remain the self with the remaining teachers (2%) saying it would be weaker.

Item 4b: A 2017 student's resilience when faced with the challenge of adapting to degree level study will be...

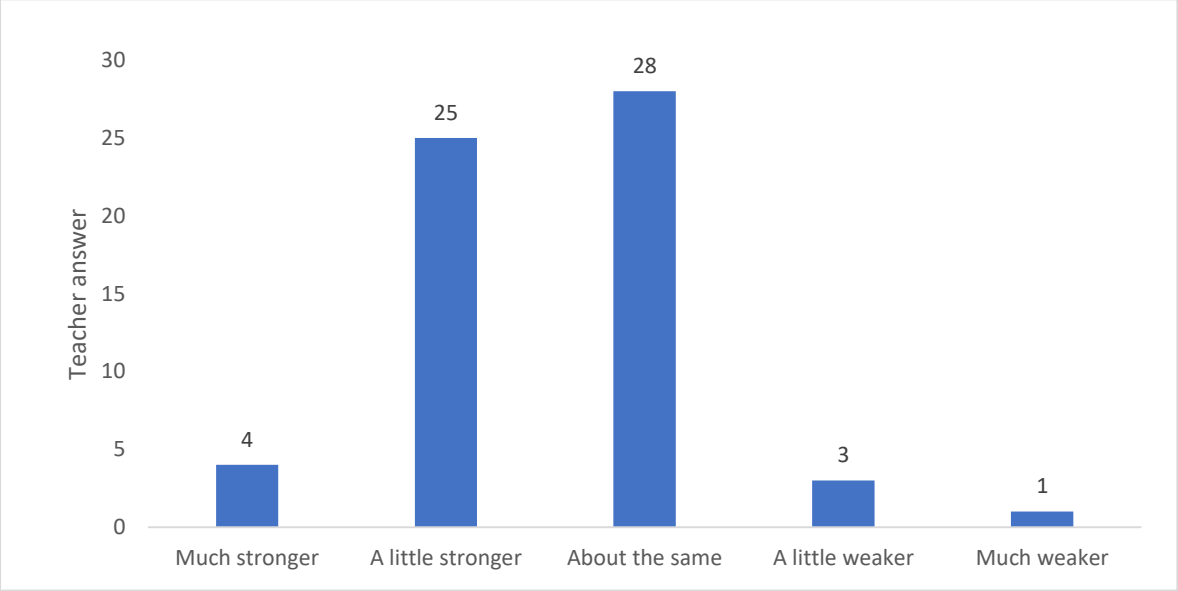

Figure 13: Just under 50% of teachers said that a students' resilience when faced with the challenge of adapting to degree level study will be stronger. 45% of teachers said that the resilience of students' when faced with the challenge of adapting to degree level would be the same. The remaining teachers (6%) said that the students would be weaker when faced with the challenge of adapting to degree level studies.

Comments from teachers who indicated that students' understanding of chemistry (30/60) / resilience when faced with the challenge of adapting to degree level study (29/61) will be stronger:

Teachers in this group commented that students are now forced to engage with the subject itself rather than memorising mark schemes in order to tackle synoptic questions with more problem-

solving. It was also suggested that the linear A-level means that students will be better prepared for degree-level study, with additional challenge and synoptic assessment. The removal of modules forces students to link concepts together across different areas of the specification. Additional comments were that the new exam papers are more challenging and demanding, and also that the content is more enjoyable to teach and learn.

Comments from teachers who indicated that students' understanding of chemistry (28/60) / resilience when faced with the challenge of adapting to degree level study (28/61) will be about the same:

The general view of teachers in this group is summed up by this comment from one teacher: "in reality, the A-level exam has got more demanding, so it means that the majority of students just get fewer questions right. The new A-levels wont suddenly improve the quality of student, as they are coming from the same starting point as previous cohorts and had the same length of time (and contact hours with teachers) to improve." It was also stated that those who achieve high grades are resilient regardless of any specification changes, and that as the core content hasn't changed, there is little change in understanding.

Comments from teachers who indicated that students' understanding of chemistry (2/60) / resilience when faced with the challenge of adapting to degree level study (4/61) will be weaker:

Teachers in this group commented that the students most affected by the changes are those that do not want to be chemists. Mirroring previous comments, Salters teachers noted that removal of the extended project means students do not have to push themselves and improve their resilience. One teacher cautioned that "I fear that the new A-levels will simply filter those who can look terror in the face without crumbling – a return to a past era?"

Section five: other impacts of the changes to A-level chemistry

Will there be any specific gaps in students' chemistry knowledge in comparison with students who studied the old specs?

The majority of teachers said there would not be any gaps in knowledge in comparison with before. However, some teachers did identify gaps arising from changes to individual specifications. **Note that we are reporting what teachers have indicated in their survey responses based on their current specification, and their teaching of the content. They may have taught a different specification previously. For a comprehensive (and hopefully accurate) analysis of changes to the specification content, see our original review** http://edshare.soton.ac.uk/14806/. Gaps identified by teachers were:

AQA:

- The appreciation of macro models explain micro phenomena
- K_{stab}
- Azo dye synthesis
- Less specific transition metal chemistry
- Green chemistry

EDEXCEL

- Azo dye synthesis
- Report writing
- Gaps in applying chemistry, especially in the environment sector

OCR A

- DNA and protein synthesis
- Azo dye synthesis
- Project writing skills
- Less transition metal chemistry
- Relevance of chemistry to today's world

OCR B Salters

- Born-Haber cycles
- pH curves
- Green chemistry
- Catalytic converters
- Less biochemistry

Will there be any specific differences in the capabilities of the most able students? How about the not so high flyers i.e. those who might achieve a low B grade.

The most able students have a deeper understanding of the subject. This is stretched further by the inclusion of more complicated concepts such as the Arrhenius equation (new to all specs apart from Edexcel). They are better at applying knowledge and must be more mathematically literate. "Students are worried they won't cut it at degree level if they achieve a B at A-level."

The less able students have a greater phobia of exams and struggle with an increased problem solving and mathematical content. The students will have a better mathematical skill than students

on the old specification, but may struggle with the synoptic links to begin with. Some teachers anticipate a widening gap between the most and least able students. Those who could comfortably obtain a B in the old specification may struggle now. Some teachers said that the lack of coursework may penalise the less able disproportionately, and that students will not be able to apply their knowledge to unknown situations as well, but this has always been the case.

Do you have suggestions for strategies that university chemistry departments can adopt to support the 2017 cohort as a result of changes at A-level?

The following were suggested by teachers:

- Won't be many differences with previous cohorts.
- Stronger focus on time in labs.
- A boot camp for practical work and taking a more independent approach.
- Awareness of different specifications and that their difficulties differ. Don't assume that everyone has covered the same content.
- Simply be aware of the changes. E.g. "Universities should realise that they will have a cohort who are more familiar with maths and problem solving and that there might be conflicting information to use." "Many HE academics really do not know what is happening at A-level."
- "A bridging framework that uses the standardised criteria that students understand and can relate to."
- Open up and allow more visits.
- Take note that their A-level grade is 100% exam-based.
- More teaching, less lecturing at university.
- Some students will have done 3 rather than 4 AS's/A-levels, meaning that breadth of knowledge beyond chemistry could be weaker.
- Students respond well to discussion of links between schools and universities.
- Model what you expect from students from Day One. Should be a continuous process.
- Get a baseline assessment by giving an A-level paper at the beginning of the course.
- Set transition questions for students to do at school.
- Encourage teachers to create extended projects with students.
- "Lobby the government to drop league tables."

What are the pros and cons of terminal assessment at the end of Y13 in terms of the impact on students and their learning?

Suggested pros include the fact that assessment which links different topics together gives a better synoptic overview of the subject, supporting application of knowledge. It was suggested that the increased challenge would lead to more able students developing better independent learning skills. Teachers with a favourable view of the changes to practical work felt that students will have a good overview of practical skills and will be better prepared for university.

Suggested cons were that students may lose confidence early on in their studies and become stressed, potentially leading to increased incidence of mental health issues. Weaker students also struggle more, with a higher dropout rate than previously due to increased difficulty. A problem with terminal assessment is summarised in this comment from a teacher: "whilst the recall of basic chemical principles is essential, I don't think the terminal examinations give a realistic expectation or example of what being a working chemist is about. In reality, it is important to know how to pull together information sources (papers etc) and apply this to whatever chemistry you are working on in the lab."

Having taught the whole of A-level, what's your view of the impact of the new specifications?

A few important quotes that summarise the general feeling of the teachers:

"I think the overall impact of the new spec will be that more typically academic students, those with exceptional memories and problem solving skills will thrive. However the students that may have a solid understanding of chemical principles, but who struggle to apply these principles to unfamiliar examples and have an inferior memory are going to be less successful."

"The challenge is good, the application means that there is less learning, and so is more challenging to students who have become used to getting excellent grades by learning rather than understanding. I think we will lose talented students with the potential to do very well in chemistry because they will perceive the subject as too challenging compared to other subjects and will not take the chance of studying it to A level because of this."

"A little confusing at first (practical work expectations) but having seen the first exams, it seems a little less intimidating than originally thought."

"The changes in content are not that great, I prefer the less rote learning aspects but worry this year examinations tested very little if the year 12 work, it will give very polarised examination grades come august and I suspect the grades boundaries will be lowered to accommodate the higher failure rate in the lower and middle grades E to C."

"Overall positive. Much better understanding of how topics link together. Sadly changes to practicals have not really worked."

"The new spec is much better in terms of the focus on the chemical concepts involved. It's easier to teach chemistry rather than teaching the chemistry exam. I much prefer the new spec."

"Implementation has been rushed, there has been insufficient time to consider students' prior learning at the start of the A-level and there have, so far, been limited resources available to support teaching. The new spec seems to have a similar amount of content and has certainly challenged the most able. Jury is out on whether it is really an improvement."

"Recording of practical achievement has been a nightmare as has 'what is a pass' of the practical verification. Insufficient guidance from exam boards."

"So little has changed really, one wonders what exactly was the point."