GCSEs, either have (or will) switch their entries to reformed GCSEs is not known. Whether such schools contribute to the national GCSE results will make a noticeable difference.

Although many GCSE subjects will have been reformed by summer 2018, the final test of these predictions will not be until after summer 2019. In particular, our analysis has shown that some minor Modern Languages (Chinese, Russian, and Italian) are very popular amongst candidates who have achieved straight grade A*s historically and so, only when results for the reformed versions of these subjects are available (summer 2019), will we know the accuracy of our predictions.

Regardless of whether the predictions are right or wrong, one thing is clear: Achieving grade 9 in any GCSE subject is hard. Congratulations to all those students who achieve it in any subject at all.

References

Benton, T. (2016). *A possible formula to determine the percentage of candidates who should receive the new GCSE grade 9 in each subject*. Cambridge Assessment Research Report. Cambridge, UK: Cambridge Assessment. Retrieved from http://www.cambridgeassessment.org.uk/Images/298710-a-possible-formula-to-determine-the-percentage-of-candidates-who-should-receive-the-new-gcse-grade-9-in-each-subject.pdf.

Benton, T. & Bramley, T. (2017). *Some thoughts on the 'Comparative Progression Analysis' method for investigating inter-subject comparability*. Cambridge Assessment Research Report. Cambridge UK: Cambridge Assessment. Retrieved from http://www.cambridgeassessment.org.uk/Images/416591-some-thoughts-on-the-comparative-progression-analysis-method-for-investigating-inter-subject-comparability.pdf/

Benton, T. & Sutch, T. (2013). *Exploring the value of GCSE prediction matrices based upon attainment at Key Stage 2*. Cambridge Assessment Research Report. Cambridge, UK: Cambridge Assessment. Retrieved from http://www.cambridgeassessment.org.uk/Images/181034-exploring-the-value-of-gcse-prediction-matrices-based-upon-attainment-at-key-stage-2.pdf.

Chalmers, R.P. (2012). mirt: A Multidimensional Item Response Theory Package for the R Environment. *Journal of Statistical Software, 48*(6), 1–29. Retrieved from http://www.jstatsoft.org/v48/i06/.

Coe, R. (2008). Comparability of GCSE examinations in different subjects: an application of the Rasch model. *Oxford Review of Education, 34*(5), 609–636.

Gill, T. (2017). *Candidates awarded A* and A grades at GCSE in 2015*. Statistics Report Series No. 111. Cambridge, UK: Cambridge Assessment. Retrieved from http://www.cambridgeassessment.org.uk/Images/352252-candidates-awarded-a-and-a-grades-at-gcse-in-2015.pdf.

Marsman, M., Maris, G., Bechger, T., & Glas, C. (2016). What can we learn from Plausible Values? *Psychometrika, 81*(2), 274–289.

Ofqual. (2014). *Consultation on Setting the Grade Standards of new GCSEs in England*. Ofqual, Ofqual/14/5401, Coventry. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/630155/2014-04-03-consultation-on-setting-the-grade-standards-of-new-gcses-in-england.pdf.

Spearman, C. (1904). "General Intelligence," Objectively Determined and Measured. *The American Journal of Psychology, 15*(2), 201–292. Retrieved from http://www.jstor.org/stable/i261624

Wu, M. (2005). The role of plausible values in large-scale surveys. *Studies in Educational Evaluation, 31*(2–3), 114–128.

How do you solve a problem like transition? A qualitative evaluation of additional support classes at three university Biology departments

Simon Child Research Division, **Sanjana Mehta** Cambridge Assessment English, **Frances Wilson** OCR, **Irenka Suto** Research Division, and **Sally Brown** Cambridge Assessment Network

(The study was completed when the second and third authors were based in the Research Division, and the fifth author was based at OCR)

Introduction

Some university Biology departments have introduced additional support classes for students who struggle with the transition from school or college to higher education (HE). In this study, classes at three contrasting British universities were investigated. The structure and content of the classes were compared, and reasons for introducing the classes were explored. Data collection comprised linked observation and interview methods from three stakeholder perspectives: lecturer, undergraduate, and teacher. This article discusses the transitional challenges identified by the different stakeholders in relation to the recently completed reforms to General Certificate of Education (GCE) Advanced level (A level) qualifications in the Sciences.

Background

Many students experience difficulties in making the transition from school or college to university (Lowe & Cook, 2003; Pampaka, Williams, & Hutcheson, 2012) and lecturers have frequently expressed dissatisfaction with the skills and knowledge that new undergraduates possess when they first enter university following their A levels (Mehta, Suto, & Brown, 2012). In the Biosciences, report-writing and mathematical abilities have been identified as weak (H. Jones, 2011; Suto, 2012). Skills in practical Science, including the use of equipment and data analysis, have also raised concern (J. Wilson, 2008). Poor retention of basic biological concepts has been attributed to a reliance on surface learning during A level (pre-reform) and other pre-university courses (H. Jones et al., 2015). It has been argued that elements of the assessment model of the pre-reform A levels, such as the modular approach and the assessment of practical Science, contributed to the issues identified (H. Jones, 2011). This prompted a period of qualifications reform that began in 2012, with new Science A levels being introduced for first teaching from September 2015.

Further transitional challenges relate to changes in culture, novel subject content (Conley, 2010) and unfamiliar pedagogical approaches. For example, difficulties can result from reduced contact time (McDonald & Robinson, 2014) and an increased focus on independent learning (Zimmerman, 2008). Linked to this, changes in assessment practice, including reduced formative feedback, can be problematic (Beaumont, O'Doherty, & Shannon, 2011; Race, 2009). There may be a long-term impact on students' learning approaches, engagement, and subsequent degree success (B.D. Jones, 2009; McDonald & Robinson, 2014).

As a potential remedy for the issues identified with students' transitions to university prior to the introduction of reformed A levels, some universities introduced additional support classes for first-year undergraduates. There were two main approaches: (i) 'bolt-on' study skills courses, offered as stand-alone modules (Wingate, 2006); and (ii) 'built-in' integrated modules which embed the development of transferable skills with knowledge building within a subject area (Mehta et al., 2012). In recent years there have been examples of pre-university courses offered by university departments that have aimed to ease the subsequent transition for students (H. Jones, Gaskell, Prendergast & Bavage, 2017). Suto (2012) reported that almost 60 per cent of Biology lecturers claimed their institutions offered additional support classes. Most classes focused on writing, numeracy, independent learning, and other interdisciplinary skills. However, some also covered subject-specific content knowledge, and content in related subjects such as Chemistry. McDonald and Robinson (2014) found that additional support benefits first-year undergraduates in Biology, improving both engagement and examination results.

To date, additional support classes have been analysed primarily within individual institutions (Jansen & Suhre, 2010; Knox, 2005; Laing, Robinson, & Johnston, 2005). As universities vary considerably in size, student and lecturer characteristics, and course structure, these evaluations may lack generalisability. Furthermore, classes supporting new Biology undergraduates have typically been evaluated via retention statistics (e.g., McDonald & Robinson, 2014) or student questionnaires. A key limitation of such approaches is their failure to capture the perspectives of other stakeholders. Arguably, a broader and more holistic approach is needed.

In this article, 'built-in' additional support classes at three British universities with contrasting affiliations and student intakes were investigated. Linked observation and interview methods were used to obtain multiple-stakeholder perspectives. That is, in addition to undergraduates, lecturers responsible for class delivery, and teachers with an in-depth understanding of pre-reform A level Biology (the main pre-university curriculum at the time of data collection) and its underpinning pedagogy, were invited to evaluate the classes. Unusually, the A level teachers visited the universities in person, observing the additional support classes and discussing them subsequently with the lecturers who delivered them. As the teachers could draw upon their specialist knowledge in these discussions, qualitative data with high integrity could be generated, comprising well-informed perspectives on the classes.

Analysis across universities offered the potential to triangulate transitional issues and common approaches underpinning the three courses. Four research questions were addressed:

1. How are the classes structured?
2. What is taught?
3. Why were the classes introduced?
4. How effective are the classes?

The research was conducted in the context of reforms to A level Biology (The Office of Qualifications and Examinations Regulation [Ofqual], 2015). Engaging the HE community in the redevelopment of A level qualifications was regarded as an imperative of the reform agenda, as demonstrated by the publication of the Smith Report (Smith, 2013) commissioned by Ofqual, and the founding of the A-Level Content Advisory Board (ALCAB). The Smith Report (2013) and ALCAB consulted with the HE community so that it could "… play a more active, substantial and ongoing role in A levels" (Smith, 2013, p.3). The findings we describe in this article were intended to inform those with responsibility for ensuring that future pre-university curricula would better meet the requirements of HE, thereby reducing the need for additional support classes in the future.

Materials and methods

Three Biology lecturers, each at different universities offering additional support classes (see Table 1), and three A level teachers, each from different schools, took part. All were recruited from a database of previous research participants who had stated a willingness to participate again. They were selected to cover a diversity of institutions, engendering breadth in the data generated. Each lecturer recruited two second-year undergraduates who had taken A level Biology prior to university and who had experienced the entire support provided by their respective courses during their first undergraduate year. Subsequently, each undergraduate's individual consent was obtained by the researchers. All participants' characteristics are shown in Table 2.

Table 1: University affiliations and Biology undergraduate course details

	University A	*University B*	*University C*
Affiliation	Russell Group	Former 1994 Group	No affiliation
Typical A level grade entry requirements	AAB	AAB	BBB
Undergraduate courses offered	Biomedical Sciences; Biology; Biochemical, Molecular & Macro Biology; Sports & Exercise Sciences	Biological Sciences; Biochemistry; Biomedicine; Ecology; Molecular Biology & Genetics	Biomedical Science; Biological Sciences; Ecology; Pharmaceutical & Chemical Sciences

Data was collected over three weeks. At each university, four types of data were obtained. Firstly, the lecturer was interviewed. Secondly, a paired interview was conducted with the two undergraduates. All interviews were semi-structured in the same way and were designed to elicit structural and content information, as well as views on the additional support classes and the transition between school and university.

Table 2: Study participants

	University A	*University B*	*University C*
LECTURERS			
Title	Lecturer of Human Physiology	Senior Lecturer of Biology	Principal Lecturer & Deputy Head of School
No. of years' experience	10	13	17
Teaching responsibilities	Teaches first-, second-, and third-year undergraduates	Teaches first-year undergraduates	Teaches first-, second-, and third-year undergraduates
UNDERGRADUATE 1			
Degree course	Biological Sciences	Biology	Biomedical Sciences
Length of course (years)	3	4	3
Subjects taken at A level	Biology, Mathematics, Sociology, and Physical Education (AS)[a]	Biology, Chemistry, and Mathematics	Biology, Chemistry, Mathematics, and Psychology (AS)[a]
Year of A level completion	2011	2011	2010
UNDERGRADUATE 2			
Degree course	Biological Sciences	Biology BSc (Honours)	*N/A (Only one student was interviewed at University C due to the withdrawal of the second student at late notice)*
Length of course (years)	3	3	
Subjects taken at A level	Biology, Chemistry, Mathematics, and Drama & Theatre Studies (AS)[a]	Biology, Geography, and Law	
Year of A level completion	2011	2011	
A LEVEL TEACHER			
School type	State comprehensive	Independent	State comprehensive
No. of years' experience	20+	12	4

a. Advanced Subsidiary level.

Questions on the latter focussed on:

- the usefulness of the knowledge and skills learned at A level Biology for university study;
- the effectiveness of skills developed in additional support classes; and
- future changes to A level Biology.

Thirdly, the A level teacher observed an additional support class. To structure observations and aid note-taking, a form was provided. This prompted the teacher on: (a) positive or negative aspects of the class, and (b) similarities and differences to A level, in terms of (i) content, (ii) use of facilities and resources, and (iii) teaching technique.

The form provided space for further reflective comments on: content, the depth of knowledge exhibited by students, pedagogy, the transition to university, and changes in personal perceptions of A levels as a result of the observations. Additionally, each teacher received the teaching materials provided to students across the entire course of additional support classes, to enable a more complete view of its aims and content.

Fourthly, a researcher-facilitated discussion took place between the lecturer and the A level teacher. The researcher used pre-prepared prompts to stimulate the transfer of views and opinions. The prompts related to class aims, communication between schools and universities, and other potential improvements to the transition process.

Data analysis

Audio recordings of the interviews and facilitated discussions were transcribed. Following a preliminary reading of the transcripts, an initial framework was formulated. This enabled the data to be segmented, and then coded by source and theme, using MAXQDA (software for qualitative and mixed methods data analysis, VERBI, 2013). In an iterative process involving two researchers, content addressing each research question was identified and coded further using a refined framework of more nuanced codes. The coding was conducted by two researchers separately and was compared subsequently to confirm reliability. Using a linked framework containing some overlapping codes, comments from the A level teachers' observation forms were coded by hand. All data relating to each research question was then collated, and analysed qualitatively, to make comparisons and discern shared and conflicting perspectives.

Results

Class structure and content

Addressing the first two research questions, Table 3 provides an overview of how the courses were structured and what was taught.

Despite their contrasting student cohorts, similarities across the universities were found. At all three, classes took place regularly throughout the academic year, and were presented by a range of teaching staff. Coverage of particular topics was timed strategically to coincide with and therefore facilitate students' study and assignments in related areas. In all three observed classes, presenters made links with parts of the traditional undergraduate curriculum, thereby supporting the development of genuinely transferable skills. There was also considerable overlap in content. Courses at all three universities covered report-writing and data presentation, and two out of the three focused on each of: independent learning, literature searches, and data analysis and interpretation. This indicates shared concerns about the transferable skills of new undergraduates, including those with high A level grades. There were also differences in content among the courses. Classes at University A had a greater focus on assessment in the wider undergraduate course and how to get the best from it. University B included content on employability and employment options after graduation. University C had a greater focus on practical skills and scientific method. A description of the observed classes follows.

University A

The class covered scientific report-writing. The 45-minute formal element comprised 3 short presentations. Firstly, a librarian presented

Table 3: Structure and content of additional support courses

		University A	*University B*	*University C*
Year of introduction		2009	2000	2004
Format		Fortnightly sessions – 45-minute formal presentation then small group discussions with peer support mentors. Portfolio of internet resources and 'top tips' for each topic compiled by the course director	Weekly alternating 1-hour lectures and seminars	Weekly alternating lectures and laboratory work, lasting 2–3 hours
Duration (years)		1	1	1
Attendance		Optional	Compulsory	Compulsory
Assessment		No assessment	One coursework essay; a poster presentation; synoptic exam which includes an essay on 1 of 10 options	Examination (50%) on the principles of laboratory techniques. Coursework (50%) comprised learning exercises with self-assessments of study skills, scientific communication and laboratory skills. Students also completed practical assessment and report-writing tasks
No. of students in the observed class		64	100	150
Class teachers		Individual topics delivered by members of the department and the wider university. Four second-year undergraduate students employed as peer support mentors	Individual topics delivered by different lecturers from the department. Additional contributions from non-academic staff from across the university	Individual topics delivered by different lecturers from the department
Content	*Independent learning, including self-monitoring and goal-setting*	Yes	—	Yes
	Teamwork	—	Yes	—
	Literature searches	—	Yes	Yes
	Laboratory skills	—	—	Yes
	Scientific method and measurement	—	—	Yes
	Data analysis and interpretation	—	Yes	Yes
	Data presentation	Yes	Yes	Yes
	Report-writing, including structuring arguments	Yes	Yes	Yes
	Referencing skills	Yes	—	—
	Presentation skills	—	Yes	—
	Understanding marking and assessment criteria	Yes	—	—
	Using feedback	Yes	—	—
	Employability and employment options	—	Yes	—

information on referencing styles and systems. The topic was introduced with a short quiz to engage students. The librarian then explained the importance of correct referencing, differences between references and citations, and referencing software. Secondly, a lecturer presented the topic of scientific report-writing, explaining the need for different sections (e.g., introduction, materials and methods). Students were shown examples of well- and poorly-drawn figures, and the formality of the language needed in reports was emphasised. A third lecturer explained the qualitative criteria used to assess practical reports. The criteria corresponded to different grade bands, with a description of the standards expected at each band in relation to different sections of the report.

University B

The class was delivered primarily as a lecture, and covered data analysis and presentation. Experimental data was used to describe frequency histograms. Mean values were calculated, and the interpretation of frequency histograms was then explained. Further explanation of error bars, standard deviation, standard error and confidence intervals was also provided. The lecturer also explained when to use different types of graphs and encouraged students to look at graphs in published papers. Towards the end, the students were asked to complete a task about labelling graphs and writing legends.

University C

The class comprised two parts. The first part focussed on safe laboratory practices and writing laboratory reports. A quiz was used to explore scientific attitudes and the behaviours and discipline needed for laboratory work. The students reviewed laboratory photographs and discussed their observations concerning fire hazards, contamination, obstructions, and radiation. A presentation on laboratory reports included points on writing long and short reports with an explanation of the standard structure used. The lecturer also covered the presentation of graphs and tables. Students were shown examples of well- and poorly-constructed graphs, and graphs from published scientific papers. The style of language used in reports was explained.

In the second part, feedback was given on a scientific calculations exercise that all students were expected to have completed in advance. The lecturer adopted a guided problem-solving teaching technique, solving equations on the board and encouraging questions from students related to intermediate steps. The lecturer linked these calculations to students' practical work.

Reasons for introducing the classes

When interviewed, the lecturers were asked why their departments had introduced additional support classes. All three offered reasons which related ultimately to improving report-writing, practical skills, and mathematical or statistical skills, which are known contributors to transitional problems (H. Jones, 2011; Suto, 2012; J. Wilson, 2008). Additionally, and in line with needs identified by Beaumont, O'Doherty, & Shannon (2011), the classes at University B had been introduced to reorient students towards unfamiliar types of assessment. Where made during other stages of data collection, comments on these themes from the students and A level teachers concurred with those of the lecturers.

Report-writing, practical and statistical skills

According to the lecturer from University B, the classes were introduced to understand new undergraduates' levels of preparedness in Mathematics and other key areas, in order to plan further learning. The classes were also intended to highlight to students the importance of certain skills by teaching them in a biological context. All three lecturers indicated that a challenge for classes was to contextualise students' understanding of Mathematics and Statistics in relation to Biology in a manner that students "don't realise often that they are doing Maths". One lecturer believed that Statistics at A level was taught "in a very dry format" and, as a result, students fail to make links between Statistics and Biology.

The lecturer from University C explained that classes were introduced in response to perceived weaknesses of new undergraduates in the practical elements of data collection and analysis, including health and safety in the laboratory, the use of specific equipment such as centrifuges, and statistical analysis. This explanation was supported by the focus of the observed class at University C on practical work, and by the interviewed student at University C, who commented:

> *I had never seen them [gills and pipettes] in my life. But, as soon as we came here, it's like a weekly thing now. You are constantly working with gills and pipettes. It's just simple things like that… You do a lab, at least once a week, sometimes two to three… If you had a bit of a better foundation [at A level], you would be more confident when you are in the laboratory… And like laboratory books… you have to maintain your laboratory book and keep it up-to-date… All the basic skills that you could have easily picked up at Biology A level just by having a book... We didn't have that.* (Undergraduate, University C)

Similarly, a student at University B attributed difficulties in scientific design, practical work and report-writing, to inexperience at A level:

> *[At A level] you would never plan an experiment, or do an experiment and write it up, so you wouldn't gain the writing skills. You get to university and they say, "write a scientific report", and you have never written one before in your life.* (Undergraduate 1, University B)

Concurring, another student commented that they had "missed out on constructing an argument and writing scientifically" in A level Biology. The lecturer at University A also linked under-preparedness in report-writing to her perception of the main pre-university curricula:

> *… Some of these students, if they do Science A levels, haven't written a full sentence since GCSEs[1]. In fact, one student told me today he managed to do GCSEs without writing many sentences! Those [skills] are so fundamental and what they don't understand is that biologists are judged by how they communicate through their writing… There is a real lack of understanding of what it is to study Biology.* (Lecturer, University A)

This perception was corroborated by an A level teacher, who observed the class on scientific report-writing and referencing skills at University A. In her reflective comments, she stated that this content was not covered at A level Biology as there is no requirement for report-writing. Subsequently, they explained to the lecturer that although the presentation of graphs and bar charts, and data analysis, are covered at A level Biology, this is only in a piecemeal way:

> *Under the present A level specification only very few skills are covered… and these tend to be a 'bitty' and not in the context of a complete investigation …*
> (A level teacher during discussion with Lecturer, University A)

The A level teacher who observed the class on data analysis and presentation at University B indicated that A level students are taught graph drawing, including the plotting of error bars and the calculation of standard deviation, but were not taught how to write detailed legends, which formed an important part of the class she observed. She also suggested that A level Biology students were not given sufficient practice in evaluating results. Moreover, the A level teacher who observed the class on scientific calculations at University C thought the calculations were more difficult compared to those in A level Biology, because they required prior knowledge of moles and molarity.

Differences in assessment approaches

The lecturer at University A explained that the additional support classes had originally been designed to support new undergraduates with BTEC

1. General Certificate of Secondary Education, usually taken at age 16.

qualifications, as part of an opening access agenda. It was felt that the assessments experienced by these students differed substantially from university assessments, and the classes were needed to reorient students. Level 3 Technical qualifications (such as BTECs and Cambridge Technicals) were perceived to differ in terms of their assessment model because they were criterion-referenced (based on meeting of specified learning outcomes) and internally assessed (Wolf, 2011)[2]. Level 3 Technical qualifications also contain a variety of optional units. This can mean that students arrive at university with a range of assessment 'routes' through this qualification type. After a pilot year, however, the initiative was opened up to all undergraduates in the department on a non-compulsory basis and had steadily increased in popularity.

The A level teachers and the undergraduates also perceived important differences in assessment styles between A level and undergraduate courses, and in their washback on learning. According to the teachers, their students tended to be driven completely by exam preparation and were unable to appreciate that learning at A level links to the next stage. Concurring with H. Jones et al. (2015), the undergraduates indicated that this resulted in surface learning at A level. For example:

> *[At university] it just becomes more obvious that you have to go away and do your own reading, and you have to figure out how to learn, whereas before, you could get away with just reading through and, like, just 'blagging' it.* (Undergraduate 2, University A)

Class efficacy

Within the broad theme of class efficacy, the interview and observation data supported three main strands of evaluation. That is, the participants reviewed the classes in terms of: (i) the pedagogical approaches used; (ii) the transferable skills developed; and (iii) the overlap and gaps with A level curricula.

Pedagogy

All three teachers indicated that teaching approaches used in the classes differed markedly from those at A level. The observed classes generally comprised formal presentations with limited interaction between the presenter and students, relative to that in a school classroom. Each teacher noted that each class covered multiple topics, which were delivered rapidly and were therefore challenging for students to adapt to. One teacher wrote:

> *From an Ofsted [schools inspection authority] point of view, schools are now expected to include many teaching and learning styles within the hour, whereas, at university, to sit and listen, and make notes for half an hour, is considered the norm. Therefore, there will be some students who will find it difficult to sit and listen and make notes.*
> (A level teacher observing class at University B)

The teachers most valued the parts of the classes that comprised more interactive teaching, such as quizzes and group discussions. However, they felt there was greater scope for further questioning and interaction, which would help to build students' confidence to ask questions in a large lecture room. During discussions with the lecturers there was some recognition, however, that the lecturers had made the classes less interactive due to time constraints.

2. External assessment has since been introduced for new versions of Level 3 Technical qualifications.

Three further aspects of pedagogy were valued highly. First, the teacher visiting University A thought the presentation of objectives at the outset of the class was an effective teaching strategy, as it facilitated understanding of the session's relevance. Moreover, she suggested that A level classes should also start with such clear objectives. Secondly, the teacher visiting University C regarded the lecturer's approach of making explicit links between the calculation questions and students' practical work requirements a positive and useful teaching strategy.

Thirdly, the teacher visiting University A appreciated the use of second-year undergraduates as mentors to first years. She reported that similar initiatives were being implemented in many schools, where final-year A level students acted as mentors to younger students. The undergraduates at University A also appreciated the peer support mentors in their first year, and the amount of contact time provided with them.

Transferable skills

The undergraduates shared many positive experiences of the support they had received through the classes. All felt they had improved specific skills which they could apply to other modules in the first year, then continue to use in their second year. These included: essay and report-writing, reading journals, study skills, statistics, and data presentation. In their paired interview, the undergraduates at University A commented:

> *Yes, it is more of a development step, rather than being like the be all and the end all.* (Undergraduate 1, University A)

> *Sometimes you just need a few pointers to then develop your own way of doing things.* (Undergraduate 2, University A)

> *The scientific reports we have got this year [in the second year] are obviously the same sort of thing. The questions are different and the way they are laid out is different, but obviously the basic skills that you have got about explaining your results and things like that, you can carry through.* (Undergraduate 1, University A)

These two undergraduates felt that the largely informal, formative nature of assessment in classes at University A aided the development of these skills.

At University B, the undergraduates believed the classes had facilitated their understanding of the demands and expectations of university study as well as developing their skills. For example, in relation to support with scientific report-writing, one commented:

> *We went through it [report-writing] in a lot of depth, started slowly and built up from there… We started off with small tasks in groups and they gave us a lot of support for the first report we wrote… where to start off, what subjects to go into, what to read up on. At the start, it was even where to read up.* (Undergraduate 1, University B)

The teacher who visited University A reported that students who study A level Biology are not taught referencing skills or the formulation of hypotheses, and do not develop sufficient experience in using statistical methods. She therefore considered the additional support classes essential for developing these transferable skills. The A level teacher who observed the class at University B (on data analysis and presentation) concurred.

Overlap and gaps with A level content

When evaluating the subject content of additional support classes and the wider Biology curricula, the participants held mixed views on the extent of overlap and gaps between A level and the first year of university. This may have reflected differences in the curricula of different institutions and examination boards. Overlap, where it arose, was not generally viewed as problematic. For example, several students identified considerable overlap in topics such as metabolism and genetics but were not dissatisfied. They explained that in general, the Biology content at university was more advanced and detailed compared to at A level, but the difference was manageable:

> *I think at A level there are snippets of each bit, whereas when you get up here to university, they explain it in more context and link it all together.* (Undergraduate 1, University B)

Another student thought that although the content taught at A level was appropriate, students were misled into believing they had covered topics comprehensively. She implied it would be better for A level students to be taught that their curriculum was part of a bigger picture:

> *It wasn't just that they [at A level] didn't go into nearly as much detail, which is what you would expect, but because they oversimplified it. You kind of thought this was the whole picture. So, when you come here [to university] and they told you that there is this, this, this, this, this, it didn't really help knowing the previous knowledge because it had loads of gaps in it and it didn't really make sense as a whole anymore.* (Undergraduate 2, University A)

The lecturers felt they had a good understanding of the subject knowledge students were likely to have upon entering university. Areas of perceived gaps in knowledge included Physiology, Cell Biology, and Evolution. The lecturers endeavoured to sculpt classes accordingly. For example, the lecturer at University B explained that her additional support course included a combination of several basic concepts in relation to some topics, and sophisticated concepts in relation to other topics:

> *For these topics [Plant Biology]… we can't teach detail. We have to teach them basic concepts because they don't have them there, whereas, with the molecular and genetic stuff, it is obvious that they're coming in with much better knowledge now. Whatever they are doing in schools takes two or three years to feed in.* (Lecturer, University B)

Similarly, when comparing the content of her classes with A level content, the lecturer at University A explained:

> *I am not saying we repeat A level content. We do it in a different way. We do it related to what they need to know as an undergraduate in that particular programme.* (Lecturer, University A)

Discussion

This research identifies important similarities across contrasting universities in how they address the transitional gaps between school or college and HE. Additional support classes were introduced to target a particular subset of skills related to scientific investigation that university lecturers had prioritised. Areas of perceived weakness included the component elements that contribute to an effective research report including initial data collection (practical skills), analysis, and the conventions of academic writing.

Although this article describes findings from only a small sample of universities, the method afforded the opportunity for comparisons to be made across the transitional divide between A level and undergraduate study. The second-year undergraduates interviewed had reflected effectively on their experiences when beginning university, whilst the A level teachers and lecturers were able to discuss areas of overlap with respect to their pedagogical approaches and content coverage. This innovative approach meant that new insights and the triangulation of views were possible.

The research contributed to the evidence base that determined what was required to improve the transition to university for first-year undergraduates. The reform agenda in England and Wales was underpinned by a 'design down' method (Baber, Castro, & Bragg, 2010; Conley, 2010; Smith, 2013), based on the principle that the needs of higher levels of education dictate the format, structure, and content of assignments at the lower level. An important outcome of the research for qualifications reform in scientific subjects was a renewed consideration of how students could obtain a more well-rounded experience of practical Science that more closely resembled university study, whilst simultaneously meeting the assessment obligations underpinning the delivery of large-scale general qualifications (Abrahams & Reiss, 2015).

The pre-reform assessment model at A level assessed practical Science through externally set but internally marked controlled assessments. The issues that were identified with practical skills informed the development of a new 'endorsement' assessment model for practical Science in the reformed A level Science qualifications. This reformed approach to practical Science was piloted in late 2014 (Inter-Board Working Group, 2014), before becoming part of the specification for all A level Science qualifications from September 2015. It comprises observations of a student's practical skills conducted by the teacher (called the *practical endorsement*), and a written examination element (Evans & Wade, 2015; Wade & Abrahams, 2015). For the practical endorsement, students receive either a pass or a fail grade which is based on Common Practical Assessment Criteria (CPAC) that the teacher applies in their observations of an individual student's practical activities. The practical activities targeted are defined by the specification, for example, OCR's A levels in Science subjects define 12 practical 'groups', with each containing 3 potential practical activities. It is intended that schools choose a minimum of 12 activities that cover the required range of skills and techniques contained in the specification (Evans & Wade, 2015). Students also maintain a record of their activities in a log book. To supplement the practical endorsement, a minimum of 15 per cent of the written examination marks must be related to the 12 practical activities covered as part of the course.

It is argued that this approach to practical Science assessment rewards both procedural skills (e.g., a student's ability in using materials and equipment) and process skills (e.g., conceptual understanding, making predictions and communication) through assessment (Abrahams & Reiss, 2015). It was intended that the new approach to practical Science assessment would encourage a broader range of practical activity in schools through the practical endorsement, whilst also assessing aspects of understanding through the written examination component (Evans & Wade, 2015). Others were critical of the practical endorsement approach for potentially devaluing practical Science, because the pass/fail grading does not contribute to the overall grade for the A level (Biology Education Research Group, 2014). An initial evaluation of the practical endorsement assessment model from the perspective of the teachers who delivered the course has been conducted by Cadwallader and Clinkemaillie (2017) at Ofqual. The teachers interviewed in the study stated that the practical endorsement approach had increased the amount of practical work undertaken by students. The teachers explained that the new arrangements required students to take a more 'hands on' approach and there was an element of repetition of practical tasks that improved students' skills with equipment and procedures. This finding suggests that one of the issues we have raised in this article, that first-year undergraduates were not well prepared in using laboratory techniques, is effectively targeted in the reformed A level Biology.

The reformed A levels also have an increased emphasis on mathematical understanding. One of the issues raised in our research was that statistical methods and presentation were only studied in a 'piecemeal' way in the pre-reform A level Biology. In the reformed A level, however, mathematical content is intended to be covered within full practical investigations and embedded throughout the syllabus content. For example, OCR (2015) has mapped mathematical techniques and understanding that will be demonstrated across different sections of the syllabus content for A level Biology. Cadwallader and Clinkemaillie (2017) found that whilst students were covering more mathematical content in the reformed A levels, this introduced difficulties in finding sufficient time to complete scientific investigations. It is not clear how teachers are reconciling this tension in their pedagogical approaches and how this might affect the skills that students acquire before university study in Science subjects.

Cadwallader and Clinkemaillie (2017) also reported that teachers perceived that the reforms will improve the transition to university. The first cohort of students that were taught the reformed qualifications are, at the time of writing, in their first year of undergraduate study. It remains an open question whether the transitional challenges observed in our study have been resolved, and to what extent any observed improvements are due to the reformed qualifications. It is also important to acknowledge, that even if the reforms have achieved closer alignment between the knowledge and skills acquired at A level and those required for first-year undergraduate study, that there are also other transitional challenges that students must negotiate. Amongst other things, students have to embed themselves in university culture and adapt to a greater range of assessment methods (Beaumont et al., 2011; F. Wilson, Child & Suto, 2013). In our study, the pedagogical methods in the university classes were noted to be markedly different to how A level teachers would approach teaching similar (but more advanced) content. The students themselves noted that understanding the expectations of university study was an important outcome of the additional support classes. Students' emerging awareness of academic conventions related to report-writing, statistics and practical work can be applied in their first summative assessment attempts (Conley, 2010), which for Biology courses typically take place at the end of the first semester (Child, F. Wilson, & Suto, 2013; F. Wilson et al., 2013). Assessment of learning in the additional support modules is typically simultaneous with first assessment attempts in other modules (Child et al., 2013; F. Wilson et al., 2013). This suggests that there is mutual application of knowledge and understanding from additional support classes to the course as a whole. In the subsequent semesters, students are also able to use the feedback they receive to guide their later assessment attempts (H. Jones, 2013).

Finally, A levels are not just designed for students applying to university. One focus of the practical endorsement approach is improving students' abilities in using technical equipment. This might have implications for students who are intending to move into employment or onto Further Education in vocational areas. The focus of this article was on one specific section of the overall cohort: students who attend university to study a Science-based subject. It is a question for future research to understand the impact of reforms of general qualifications for students moving onto other educational or employment destinations.

Acknowledgements

We are grateful to Sylvia Green, formerly of the Research Division, and Gill Elliott, Research Division, for their helpful advice on an earlier draft of this article. We would also like to thank Magda Werno, formerly of the Research Division, for her administrative assistance, and Fiona Beedle, Assessment Research and Development, for her help with the literature search for this research. Finally, we are especially grateful to the university lecturers, A level teachers, and university students for their engagement with the study.

References

Abrahams, I., & Reiss, M. J. (2015). The assessment of practical skills. *School Science Review, 96*(357), 40–44.

Baber, L. D., Castro, E. L., & Bragg, D. D. (2010). *Measuring success: David Conley's college readiness framework and the Illinois College and Career Readiness Act*. Champaign, IL: Office of Community College Research and Leadership.

Beaumont, C., O'Doherty, M., & Shannon, L. (2011). Reconceptualising assessment feedback: A key to improving student learning? *Studies in Higher Education, 36*(6), 671–687.

Biology Education Research Group. (2014). How important is the assessment of practical work? An opinion piece on the new Biology A-level from BERG. *Journal of Biological Education, 48*(4), 176–178.

Cadwallader, S., & Clinckemaille, L. (2017). *The impact of qualification reform on A level science practical work. Paper 1: Teacher perspectives after one year*. Retrieved 23 January 2018 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633574/Research_report_on_A_level_science_practicals_27.07.2017.pdf

Child, S. F. J., Wilson, F., & Suto, I. (2013). *"I've never done one of these before." A comparison of the assessment 'diet' at A level and the first year of university*. Paper presented at the 4th Assessment in Higher Education conference, Birmingham, UK.

Conley, D. T. (2010). *College and career ready: Helping all students succeed beyond high school*. San Francisco: Jossey-Bass.

Evans, S., & Wade, N. (2015). Endorsing the practical endorsement? OCR's approach to practical assessment in science A-levels. *School Science Review, 96*(357), 59–68.

Inter-board Working Group for A Level Science Practicals. (2014). *Summary of Cross-Board Trialling of the A Level Science Practical Endorsement*. Retrieved 12 March 2018 from: http://www.ocr.org.uk/Images/202103-summary-of-cross-board-trialling-of-the-a-level-science-practical-endorsement.pdf

Jansen, E. P. W. A., & Suhre, C. J. M. (2010). The effect of secondary school study skills preparation on first-year university achievement. *Educational Studies, 36*(5), 569–580.

Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC model of academic motivation. *International Journal of Teaching and Learning in Higher Education, 21*(2), 272–285.

Jones, H. (2011). Are our students prepared for university? *Bioscience Education, 18*(2), 1–12.

Jones, H., Gaskell, E. H., Prendergast, J. R., & Bavage, A. D. (2017). Unexpected benefits of pre-university skills training for A-level students. *Educational Studies, 43*(1), 67–70.

Jones, H., Hoppitt, L., James. H., Prendergast, J. Rutherford, S., Yeoman, K., & Young, M. (2013). Exploring students' initial reactions to feedback they receive on coursework. *Bioscience Education, 20*(1), 3–21.

Jones, H., Black, B., Green, J., Langton, P., Rutherford, S., Scott, J., & Brown, S. (2015). Indications of knowledge retention in the transition to higher education. *Journal of Biological Education,49*(3), 261–273.

Knox, H. (2005). Making the transition from further to higher education: The impact of a preparatory module on retention, progression and performance. *Journal of Further and Higher Education, 29*(2), 103–110.

Laing, C., Robinson, A., & Johnston, V. (2005). Managing the transition into higher education. *Active Learning in Higher Education, 6*(3), 243–255.

Lowe, H., & Cook, A. (2003). Mind the gap: Are students prepared for higher education? *Journal of Further and Higher Education, 27*(1), 53–76.

OCR. (2015). *A Level Specification: Biology A.* Retrieved from: http://www.ocr.org.uk/Images/171736-specification-accredited-a-level-gce-Biology-a-h420.pdf

McDonald, J. E., & Robinson, R. L. (2014). Enhancing first year undergraduate student engagement via the School of Biological Sciences tutorials module. *Bioscience Education, 22*(1), 54–69.

Mehta, S., Suto, I., & Brown, S. (2012). *How effective are curricula for 16 to 19 year olds as preparation for university? A qualitative investigation of lecturers' views*. Retrieved from http://www.cambridgeassessment.org.uk/Images/116015-cambridge-assessment-he-research-qualitative-investigation-executive-summary.pdf

Ofqual. (2015). *Get the facts: GCSE and A level reform*. Retrieved 25 January, 2018 from https://www.gov.uk/government/publications/get-the-facts-gcse-and-a-level-reform.

Pampaka, M., Williams, J., & Hutcheson, G. (2012). Measuring students' transition into university and its association with learning outcomes. *British Educational Research Journal, 38*(6), 1041–1071.

Race, P. (2009). Assessment. In The Higher Education Academy (Ed.), *Assessment: Resources, references and tools for assessment in the biosciences* (pp.1–4). Leeds: The Higher Education Academy UK Centre for Bioscience.

Smith, M. E. (2013). *Independent chair's report on the review of current GCE 'specification content' within subject criteria: A report to Ofqual*. Retrieved 12 February 2018, from http://ofqual.gov.uk/qualifications-and-assessments/qualification-reform/a-level-reform/

Suto, I. (2012). *How well prepared are new undergraduates for university study? An investigation of lecturers' perceptions and experiences*. Paper presented at the annual conference of the Society for Research into Higher Education, Newport, Wales, UK.

Wade, N., & Abrahams, I. (2015). *Validity issues in the reform of a practical science assessment: An English case study*. Paper presented at the conference of the International Association for Educational Assessment, University of Kansas, USA.

Wilson, J. et al. (2008). *1st year practicals: Their role in developing future bioscientists*. Retrieved 22 January 2018 from https://synergy.st-andrews.ac.uk/vannesmithlab/files/2015/08/Adams_et_al08CentreBioReport.pdf

Wilson, F., Child, S. F. J., & Suto, I. (2013). *Aspiring to bridge the gap between A level and HE: A study of assessment and additional support lessons*. Paper presented at the conference of the Society for Research in Higher Education, Newport, Wales.

Wingate, U. (2006). Doing away with 'study skills'. *Teaching in Higher Education, 11*(4), 457–469.

Wolf, A. (2011). *Review of Vocational Education – The Wolf Report*. (DfE-00031-2011). London: Department for Education.

VERBI. (2013). MAXQDA [Computer software]. Retrieved from http://www.maxqda.com/products

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45*(1), 166–183.