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Transitions in University Lab Teaching in an Age of Pandemic

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Abstract

No sooner had I completed a full review and revision of my first-year Chemistry lab course at the University of Sheffield, with a focus on more intelligently managing the transition from A-level and other university-precursor studies, than the global coronavirus pandemic hit. Suddenly, like thousands more academics across the world, I was thrust into a new reality full of new challenges. Choices had to be made rapidly, about what could move online and what was essential to teach in person with appropriate risk management. As I was already conducting pedagogic research into how my new course had been received, though time was short, I chose to continue surveys and discussions with my new year group of students as we faced these challenges together. The result: the safe and successful delivery of eight full lab days of face-to-face practical teaching with each student in their first semester, informed by regular student feedback and discussion. Here, I will share my experiences with what worked and what did not, as well as some preliminary findings from my ongoing pedagogic research with the students.

Keywords: *pandemic, chemistry, practical, lab, challenge, teaching.*

1. Introduction

"…the most useful designation I have found for them is *Digital Natives*. Our students today are all "native speakers" of the digital language of computers, video games and the internet."

-Marc Prensky, 2001 [1]

"I could use more help with this [assignment] … I've never really used a computer before"

-A current first-year UK home student from an average economic background, born in 2002 [2]

This implied disconnect between what we think our students' life experiences may be like according to generational stereotype, and the reality, is nothing new – but it has serious implications for how we teach. I begin this paper with the high-profile example of the debate over 'digital natives'[3] as delivering digital distance learning has grown even more important since the outbreak of the Covid-19 pandemic.[4] However, there are many other examples, some less universal but no less fundamental for an individual student experience, of how lack of teacher understanding of the student experience can undermine student confidence in the educational process. Such confidence is vital to retain student engagement. A simple example of this is that many disciplines will require repetitive practice at basic techniques to demonstrate mastery before the end goal is in sight[5] – and a student must have confidence in the teacher's assurance that that end goal exists, and is worth his or her time and effort at work that might otherwise be perceived as tedious.

I was inspired to conduct this research by an example of such a disconnect in my own student life, back in 2003. I was a member of only the second cohort to complete A-levels (England's primary pre-university qualification) after a significant reform by the UK's (then) Department for Education and Employment. Though I was studying at a storied institution under some of the finest minds in science, it was clear that the course design had not taken these recent changes to A-levels into account, or perhaps sought to be inclusive of different educational backgrounds by not assuming knowledge they included by default. This became clear in the important chemistry field of Nuclear Magnetic Resonance (NMR) spectroscopy, in which the course was designed under the assumption new students lacked familiarity with it; the first year only covered carbon NMR, with the more complex and useful proton NMR relegated to second year. In fact, my Chemistry A-level qualification had already covered the latter to a significant depth. This had two negative consequences; firstly, it implicitly dented my confidence in my lecturers as said above, and secondly it gave me a sense of complacency and false confidence in my own existing knowledge in general.

2. Redesigning my Lab Course

Mindful of this life experience, when the A-level syllabus changed again in the late 2010s, I was keen to avoid giving my own students a similar experience of disconnect. I worked closely with the AQA A-level exam board through their Higher Education Stakeholders programme to ensure I had a good theoretical understanding of the changes to the Chemistry A-level.[6] The primary change was the addition of a 'practical endorsement' which, simplifying for space reasons, essentially requires schools to give pupils a minimum of 12 practical experiments as part of the curriculum, with an inspection regime to enforce this. While there remains a disparity between different schools *beyond* the 12, this change creates a minimum baseline of practical experience.

As I had just taken responsibility for the University of Sheffield's first-year Chemistry lab course, it was clear to me that the course needed to change to take this into account. There was no time to do so for the first cohort of students to have taken the new A-levels, but (via the Student Observation Of Teaching scheme operated by Tim Herrick)[7] I was therefore able to gain new student responses to the existing course to inform my reforms. I also consulted with my postgraduate lab teachers for their experiences teaching the students. Some findings were predictable – the students displayed more confidence in working with basic equipment and there were fewer elementary questions, allowing a change to a less 'recipe-based' or 'hand-holding' approach in the lab manual guidance for a better pedagogic experience. Other findings were less predictable – for alleged 'digital natives' the students displayed an increasing lack of familiarity with spreadsheet work compared to previous cohorts, perhaps reflecting a shift in emphasis. The students also supported my proposal to divide practical techniques into a generic skills manual separate from the introductory protocols for individual experiments – making it easier for them to look back on the former the next time they used that technique. The emphasis on different techniques also shifted; a consequence of the new A-levels was that 100% of home UK students had all already performed a recrystallisation before, for example, allowing me to add in extra techniques previously relegated to second year. (It was, however, always important to remember those students from non-A-level backgrounds who might need additional support).

In the 2019-20 academic year I rolled out my new course and conducted surveys of the new cohort of students (the second to have completed the new A-levels). It was my intention to have the survey findings discussed by student focus groups after the course was over. However, the pandemic then intervened…

3. Response to the Covid-19 pandemic

The pandemic hit almost at the end of my 2019-20 lab programme; students therefore did not miss out on much remaining course material (which, like colleagues around the world, I taught online in an initially *ad hoc* manner). However, it did mean that my planned focus groups sadly did not happen, leaving me only with the initial survey data. My focus was then on preparing to teach in the 2020-21 academic year. Following committee discussions about online lab alternatives, it was concluded that a majority of the learning outcomes could not be completed except with face-to-face lab teaching, albeit supported by interactive simulations (the setup of which was driven by student feedback).

Under normal circumstances, a student year group is divided into cohorts of perhaps 40 students, a pair sharing a fume cupboard, and is taught by a single academic and two or three postgraduate lab teachers supported by a technician. This was clearly non-viable under pandemic conditions. However, the size of our teaching lab and spacing of fume cupboards meant that single fume cupboard occupancy was safely possible with 2m social distancing (as deduced thanks to work by the technical staff). A risk assessment and Standard Operating Procedure was drawn up by myself and my Head of Department. By dividing the year group into more, smaller groups (18 students) with each having 4 days a week in the lab, it became possible to deliver the lab course with relatively minimal changes. Each student had a set of equipment, a single rotary evaporator and a single computer assigned to their sole use, etc., meaning there was no need for cleaning procedures mid-week. Viral matter was therefore allowed to decay over the weekend before the next class group would come in for their four days, supported by additional cleaning before and after for a 'belt-and-braces' approach.

The remarkable result of these changes was that (at time of writing), half our lab course (48 contact hours) has been successfully delivered to the students with only minor alterations to procedure, and there have been no cases of Covid-19 transmission in the lab. Indeed, the more significant issue from

my perspective was of post-lab written assessment, which I naturally shifted online to avoid contamination issues. Once again, for 'digital natives' there was a substantial variance in students' ability to scan and create PDFs, use Google Forms and so on! In consequence of this I created resources to talk students through the submission steps required.

A key concern with online teaching is students losing a sense of community and the experience feeling impersonal.[8] I and my postgraduate lab teachers noted how much our students seemed to benefit just from the (distanced!) human contact of in-lab teaching. Reflecting this, I took the decision to write personalised feedback emails for each weekly student lab report, a significant time investment but one which was appreciated by students; "…seeing those grades and constructive feedback has helped me so much."[9]

4. Continuing research and preliminary findings

Despite time constraints, this was an obvious opportunity to continue my existing pedagogic research – at time of writing I am carrying out the same surveys of this group, exploring online solutions for focus groups. As these are presently incomplete, I here present selected findings from the survey of the 2019-20 pre-pandemic group.[10]

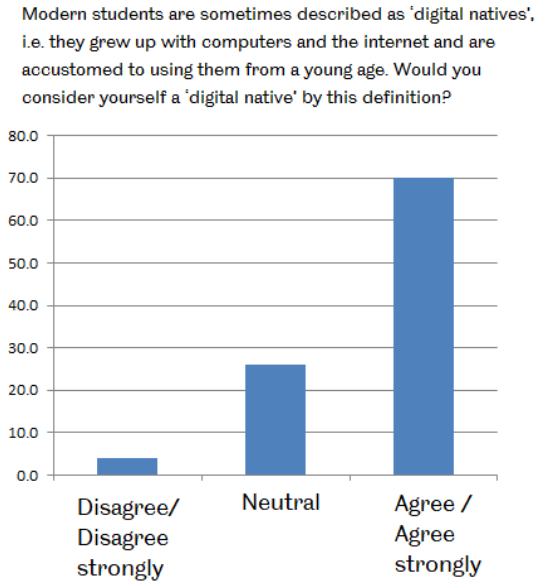

Fig. 1. Are you a digital native?

In Figure 1, we see that most (though not all) students do agree they qualify for the definition of 'digital native' given here. However, it is also clear that the details of how some teachers may translate this description to reality may vary from the student experience.

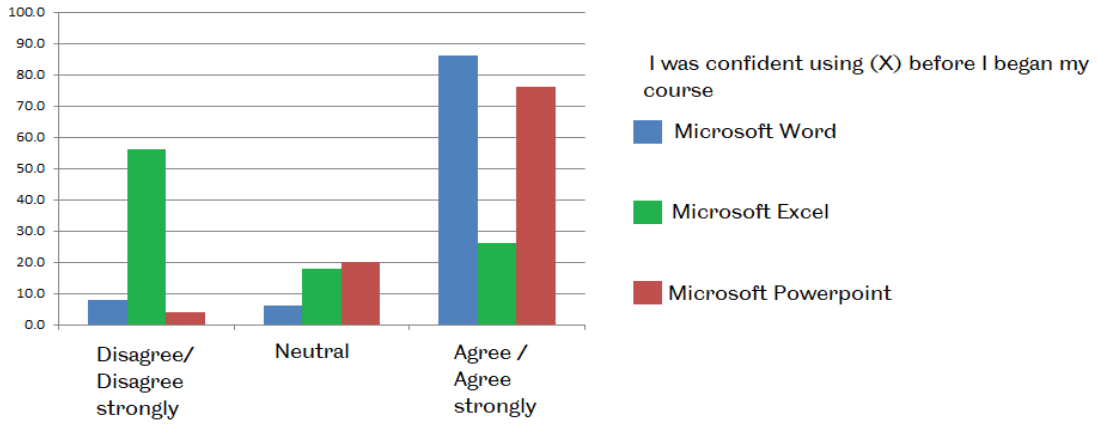

Fig.2. Familiarity with different Microsoft Office programs

Figure 2 illustrates that the anecdotally noted lack of student familiarity with, specifically, spreadsheet programs is supported by survey data. Some students, consulted more directly, report never using spreadsheets in A-level Chemistry *at all* (I hope to back this up with more rigorous focus group data in future). I have fed this back to my contacts on the A-level exam boards and it was a surprise to their representatives, who felt use of spreadsheet software was implicitly required by the Chemistry syllabus. This indicates the importance of managing the A-level to university transition as a two-way process, avoiding the perceived disconnects in the student experience I discussed at the beginning of this paper.

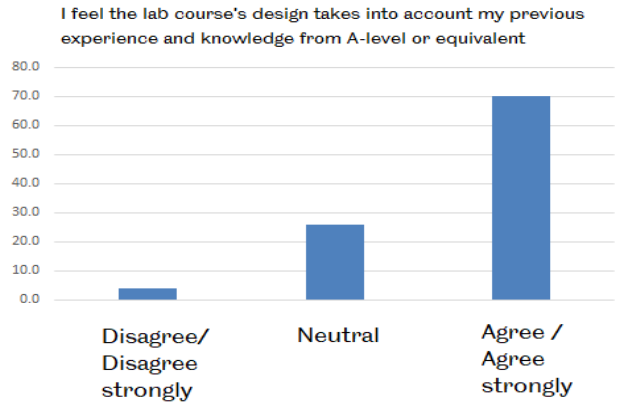

Fig.3. Does the course design take previous experience and knowledge into account?

I conclude with the results of a survey question explicitly asking the students about how the course manages this transition (Figure 3). Given the students were not afraid to give more critical responses to other specific questions in the anonymised survey, I feel this 70% approval justifies the course I took in prioritising the management of the impact of reforms to the A-levels on lab teaching. However, there is more work to be done in further understanding the student experience.

4. Conclusion

The student experience cannot be reduced to stereotypes. Close consultation with and survey of the student population not only informed my reforms to manage the transition from the altered A-level course; it was also a vital tool in building a Covid-safe lab course. This illustrates the importance of pedagogic research-led teaching in the modern university.

5. References

[1] Prensky, M. “Digital Natives, Digital Immigrants”, *On the Horizon*, MCB University Press, 2001, 9(5) 1-6
[2] Verbal comment to myself, reproduced with permission.
[3] Bennett, S et al. “The ‘digital natives’ debate: a critical review of the evidence”, British Journal of Educational Technology, 2008, 39(5), 775-786
[4] Rapanta, C., et al. “Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity.” *Postdigit Sci Educ 2*, 2020, 923–945
[5] Kulik, C.-L. et al, “Effectiveness of Mastery Learning Programs: A Meta-Analysis”, Review of Educational Research, 1990, 60(2) 265-299.
[6] A summary of the reformed A-level practical chemistry assessment, as discussed in the Higher Education Stakeholders group, can be found here: https://www.aqa.org.uk/subjects/science/as-and-a-level/chemistry-7404-7405/a-level-practical-assessment [accessed 24/01/2020]
[7] Further information on this program can be found here: https://www.sheffield.ac.uk/ssid/301/soot [accessed 24/01/2020]
[8] Fawns, T. “Postdigital Education in Design and Practice”, *Postdigit Sci Educ 1*, 2019, 132–145 (Although note that Fawns rightly critiques an overly simplistic division between digital and face-to-face learning in this characterisation).
[9] Quoted from an unsolicited email from a student to myself, reproduced with permission.
[10] N=63 (97% response rate), using an anonymised paper survey approved by the University of Sheffield’s ethics approval process. Further details available on request.