Royal Veterinary College
University of London

ASPIRE - Advanced Scientific Practice In the Research Environment: Enhancing the research experience of undergraduate students

Robert C Fowkes Charlotte Lawson Imelda M McGonnell

Veterinary Basic Sciences
Royal Veterinary College
London
NW1 0TU

INTRODUCTION

The BSc Veterinary Sciences programme has pursued and continues to develop a strong practical basis. A major theme throughout the first two years of the programme is the preparation of students for a substantial year 3 research project of 12 weeks duration. Moreover, the course is considered unique by introducing the concepts of scientific research and creativity at the early stages of their undergraduate education. For many students and supervisors these major projects are very successful and in large part this success is due to the preparedness of the students when they enter the research environment. Students are prepared through specific teaching and learning activities in year 1 and year 2 (notably the Foundations of Science module and structured tutorials throughout years 1 and 2). These activities introduce students to the philosophical and theoretical basis of scientific research and, at present, year 2 students also undertake a 6 week practical project.

Finite resources and an evolving model of BSc provision (e.g. the development of a family of BSc programmes with increasing student numbers) is likely to lead to increasing pressure to reduce year 2 laboratory project provision. Feedback from many students indicates that this practical introduction to the research environment proves to be a transformative experience that has led them to re-evaluate their attitude towards a research-centred career beyond year 3. Each year, many year 3 students attract offers of PhD studentships and all of them comment that their year 2 laboratory project oriented them towards post-graduate research. We were, therefore, seeking to maximise the availability of an experiential introduction to the research environment, without the requirement to offer every student an individually-tailored project. The ASPIRE module would provide vertical integration between year 1 and year 2 tutorial provision and translation of theoretical skills to practical skills.

It is hoped that the users of this module would be extended to include new PhD students arriving at the RVC, thereby increasing the portfolio of teaching courses provided by the Graduate School. Similarly, this module could also be given to BVetMed students either as an elective or EMS, with the aim of encouraging these students to embrace concepts of scientific research.

Intended Outcomes

1. To improve competency in general laboratory skills and research practice.
2. To translate theoretical concepts of scientific research into practical experience
3. To further enhance the research ethos within the College's undergraduate student population.

The summary above describes the original concept of the ASPIRE project, submitted for consideration of a James Bee Educators Award in 2006. As a result of staffing changes since the award was made, the ASPIRE project was eventually re-designed and finally delivered in July 2009 (7^{th}-11^{th}), in a much condensed format but still containing the vast majority of components of the original proposal. In marketing of the ASPIRE module, renamed the '*Cell &*

Molecular Biology Workshop', it soon became clear that students from several undergraduate courses at the RVC were interested, and a final cohort of 10 students (5 BSc Bioveterinary Sciences, 5 BVetMed) were recruited. The workshop was oversubscribed twice over.

COURSE DESIGN

The timetable shown in Figure 1 was the basis for the ASPIRE week. The emphasis was firmly placed on practical, hands-on experience of key techniques in cell & molecular biology, presented in an interactive manner which involved the immersion of the staff at all times. Didactic delivery was not a feature of the workshop; instead, a 'see one, do one, teach one' approach enabled all participants to engage in the learning process from the very first morning.

SCIENTIFIC OUTCOMES

Out of the ten students recruited onto the course, one had performed some basic laboratory research during a vacation placement. The practical experience of the remaining nine was limited to those taught practical components of the BSc or BVetMed courses. In five days, the students went from having no experience of working with plasmids, yeast or mammalian cells in culture, to performing transient transfections of fluorescent vectors, confocal microscopy and fluorescence activated cell sorting (FACS). A representative example of their data is shown in the composite Figure 2.

LEARNING OUTCOMES

At the end of the week, the group were invited to a feedback session to discuss their experience and to suggest improvements to the structure and content of the course. The following were identified as learning outcomes:

- It was an experiential learning experience (which didn't suit all students).
- It provided an intense experience, which improved student learning.
- The high staff:student ratio (1:3) greatly enhanced the experience.
- The delivery style of the workshop suited the content, in that it was delivered by research-active staff who perform very similar research in their own labs., and who train research staff on a regular basis; furthermore, this approach allowed the students to feel comfortable in seeking clarification or asking for support.
- The immersed nature of the course allowed students to feel empowered, and it engendered a sense of independence.

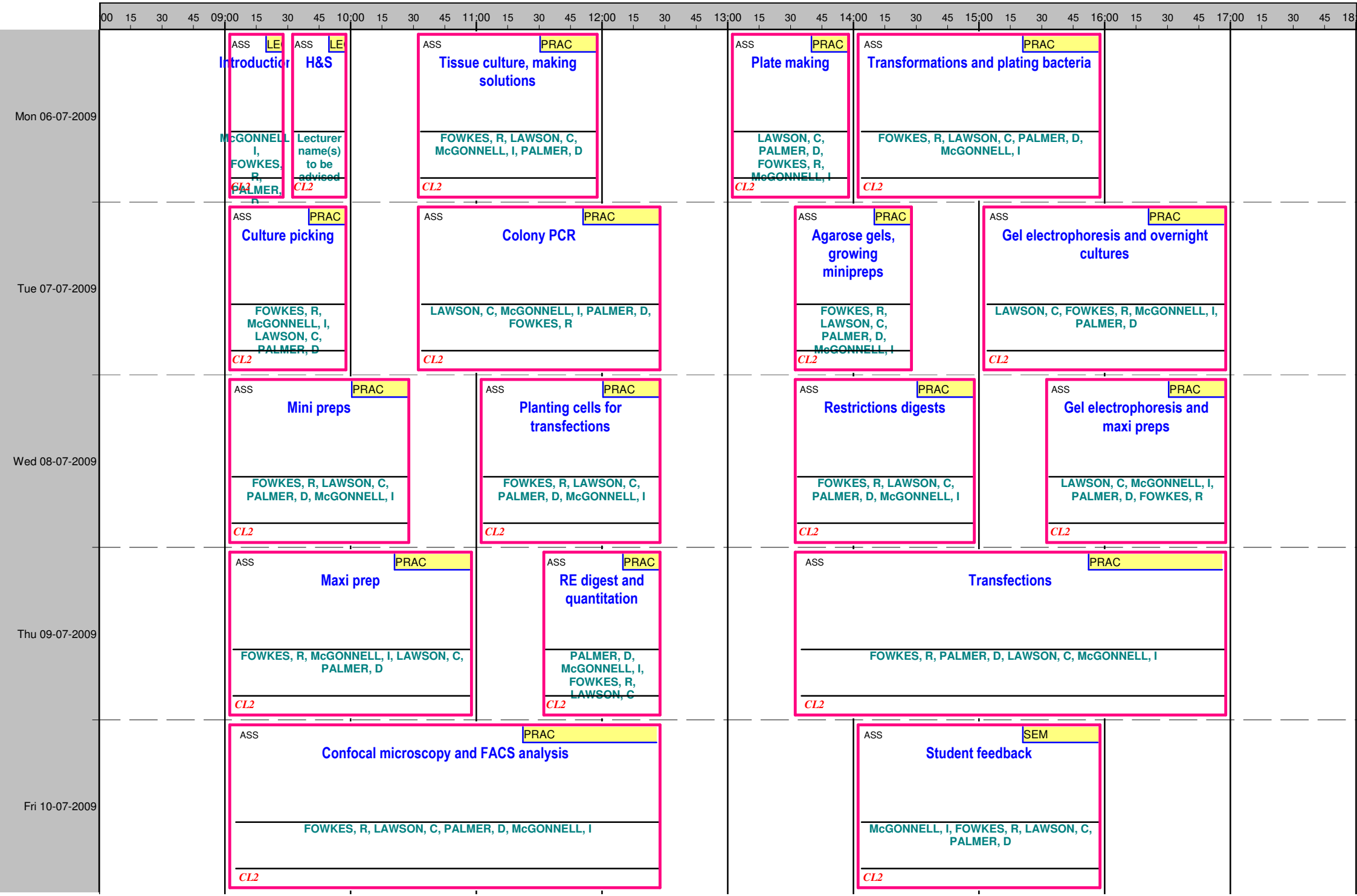
DISCUSSION & CONCLUSIONS

Student feedback

The course content was ambitious for a group this size. The three staff members have several years worth of experience in providing training of this nature, yet it was the first time any of us had attempted to train such a large group of students in complex and technically demanding protocols and techniques. There were several key areas in which the students required some familiarity, which were recombinant DNA technology (plasmids),

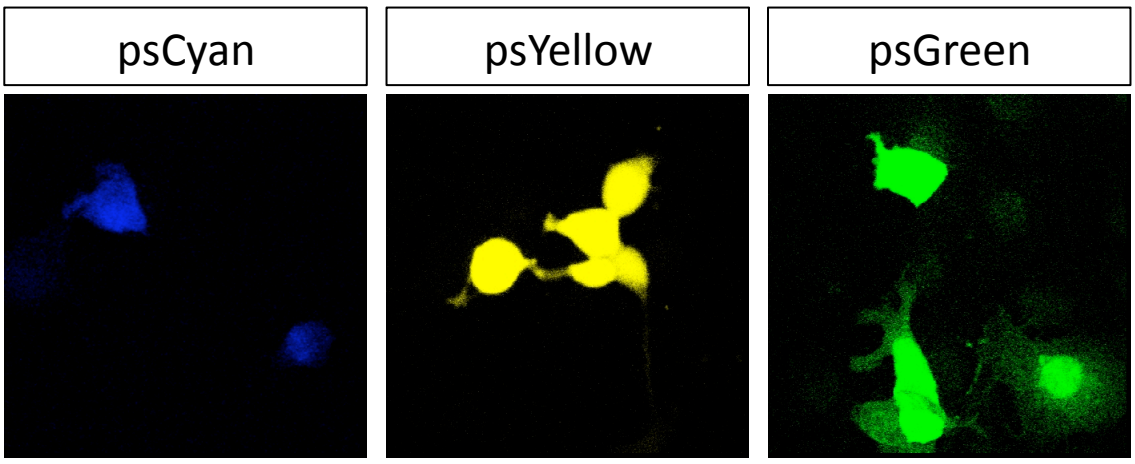
Academic Year 2008-2009

BSc VETERINARY SCIENCES YEAR 2 TIMETABLE



Printed 25\06\09

A



B

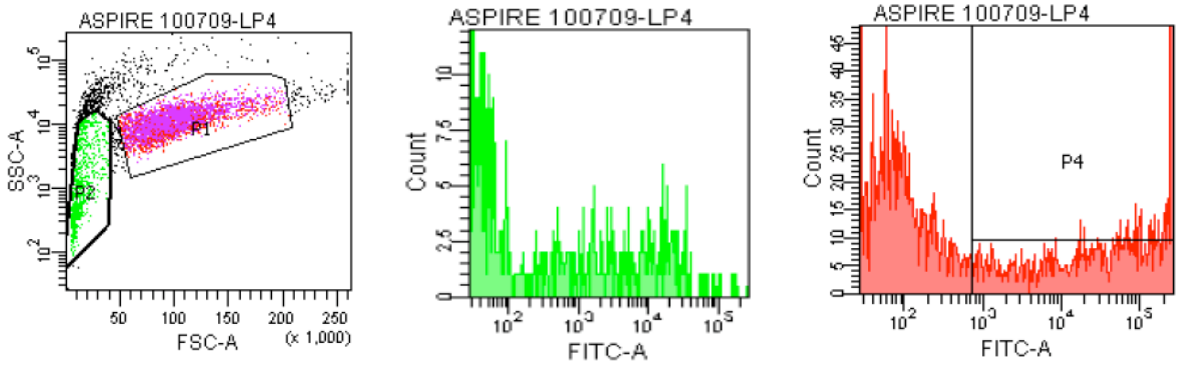


Figure 2 A and B. Representative data generated by students on the *Cell & Molecular Biology Workshop* (July 7th-11th, 2009). A) Confocal microscopy of COS7 cells transiently transfected with fluorescent vectors generated previously in the course. B) An example of FACS data acquired from COS7 cells transiently transfected with a psGreen vector.

microbiology, molecular biology and mammalian cell culture. These were introduced on day 1, which led some students to feel that they were unclear as to how the aims of the course would be met. However, by the end of the week, student awareness evolved as they became more aware of the interaction of the key practical approaches, and they became comfortable with the more 'circular' curriculum around which the course was based. The students commented that conventional practical classes do not afford this level of immersion, because of their 'linear' nature. Furthermore, the students identified the fact that they were generating an end-product (a deliberate feature of the course design), which was a very positive experience. This is certainly an aspect of the course that we should consider further and aim to introduce into more of our practical sessions on all undergraduate courses at the RVC, as it is clear that the '*student-as-producer*' concept is one that they themselves identify as being incredibly positive.

The week was an intense experience for students and staff alike, but the success of the workshop was strongly underpinned by the learning environment in which it was delivered. The high staff:student ratio was critical, as was the team aspect of all students working alongside each other, yet independently. The timing of the workshop was also conducive to a more relaxed learning experience (out of term time), and the mix of students from both BSc and BVetMed created an interesting, and positive, group dynamic which should be further explored for implementation to other courses at the RVC. All students claimed to have felt ownership of their learning experience, and of their tangible results as well. Quite often, practical sessions are compromised by time constraints, so the end-point is rarely observed within the timetabled session. On this workshop, the students not only made their own reagents, they then used them experimentally and analysed their data; such an experience can only be delivered in this extremely focused manner, and the immersion of the students in the whole process from the beginning to the end of the course was, again, critical to the overall success of the workshop.

Staff feedback

Given the ambitious scale of the week, it was predictable that some practical issues would be experienced regardless of the level of planning. As such, this was an intense, exhilarating, exhausting (mentally and physically) and highly rewarding teaching experience. Genuine (and common) practical problems were encountered on each day of the workshop, and although the students were initially uncertain of the occasional 'chaos' that followed the discovery of any particular practical problem, they soon realized that this was a real-life laboratory experience during which you are expected the 'fire-fight' in real-time. Team-teaching on this course was incredibly rewarding, but also enlightening; all three of us have used/do use the techniques taught during the course on a regular basis, but it soon became clear that each of us performs these techniques slightly differently. Again, this diversity in approach was clear to the students, and was extremely positive in reinforcing how dynamic and flexible biomedical research is. This represented a high-level team building exercise for the staff, and yielded a high-level learning experience for us as well. None of these outcomes are commonly achievable

in the conventional practical classes that are delivered at the RVC, and as such has been identified as an example of how research involvement and collaboration can actually drive teaching delivery, and vice versa.

In hindsight, this was a high-risk learning experience for both students and staff. It was clear that a dysfunctional teaching team would not have succeeded – the students were fascinated at how quickly apparent chaos turned to calm. Therefore, as an approach, it is clear that appropriate staffing considerations need to be made before embarking on similarly intense programmes. An ability to be open and honest about the issues encountered on the course, specifically showing self awareness of either the limitations of knowledge or practical ability, were again important for the students to see. As such, we can accept that not all staff would be comfortable in 'exposing' themselves in this way within the teaching environment.

IMPROVEMENTS

- ⇒ Each practical component of the workshop was accompanied by detailed protocols provided in a bound handbook. However, several students noted that they would have benefitted from more information regarding the theory of the practical approaches.
- ⇒ Even greater attention to detail regarding provision of reagents is required to minimize some of the technical difficulties that arose.
- ⇒ The design of the course is sound – the problems that were encountered were dealt with, and ingenious 'escape routes' were implemented.

FUTURE DEVELOPMENTS

It was always envisaged that the ASPIRE project would not be a one-off experience, but something that could evolve independently or at least be incorporated within other course structures. To this end, the following options were discussed:

i. Repeat the workshop in the same format.
ii. Develop a half-module for the BSc Bioveterinary Science course.
iii. Provide as post-graduate training as part of the induction process.
iv. Offer as an elective to BVetMed students.
v. Exploit as a commercial enterprise, to offer training for individuals from other institutes or from industry.
vi. Provide as staff-development training.

Of these options, the second is already in place. A new final year half-module (*Practical Investigative Biology*) will be running for the first time in the academic year 2010-11. In order to offer as many of the features of the APSIRE course as possible, the half-module will run out of term time (September) to allow it to be delivered in three-week period without conflict with other modules. In developing this half-module, particular attention has been placed on appropriate methods of assessment and these will include the innovative use of an on-line 'open-book' examination that will assess an integrated theoretical and practical approach to molecular biology. Furthermore, an objective structured practical exam (OSPE) will also be used,

which further assesses relevant skills learnt on the course. All the other development options are in the planning stage – all are deemed to be feasible.

Cost/benefit analysis

We acknowledge and are grateful to the support received from the James Bee Award that allowed the implementation of this course. As a one-off course, the *Cell & Molecular Biology Workshop* would not represent good value for money, mostly down to the huge staffing costs (90 hours of contact time, preparation time of 2h/day). However, this initial work has now been done, and is an investment for the future. As a result of this, the apparent low cost/benefit will be offset and reversed as the course is repeated and developed because much of the background work has been completed. However, even as a 'one-off', the course represented a high cost/benefit to both the students and the RVC alike; a tangible product of the course was a small cohort of highly motivated students, who have subsequently raised the profile of the course by sharing their experiences with their colleagues.

CONCLUSION

We should not be afraid to take risks when teaching, particularly when the potential payoffs are as great as those encountered on the ASPIRE course. High-risk, high-reward research funding has long been the much-coveted prize of many biomedical researchers, yet it is clear that such an approach can invigorate teaching as well and as such, we should encourage some element of risk-taking in the delivery of all courses at the RVC.

March 2010