Theme III:
Incorporation of the Three Rs in Education and Training

Session summaries for Theme III

Session III-1

Innovative Teaching in the Life Sciences

Co-Chairs: David Dewhurst, University of Edinburgh, UK
Pilar Vinardell, University of Barcelona, Spain

This was the opening session of the Education Theme and was well-attended with over 60 attendees. There were five presentations and each was followed by extensive discussion. Three of the presentations (by Dr **D. Dewhurst**, Dr **P. Vinardell**, and Dr **R. Raveendran**) reported on the different experiences with the use of computer-based alternatives in teaching either pharmacology or physiology in universities in the UK, Spain and India. The other two presentations focused on the skills (laboratory, surgical, *in vivo*) which are required for students to pursue careers in research in the pharmaceutical industry (Dr J. Everitt) or academia (Dr D. I. Lewis) and how acquisition of these skills might be addressed.

The take-home messages from this session were:

1. Existing (computer-based) alternatives can meet the learning objectives for many university students and there is good evidence of the educational efficacy of such alternatives from studies in the UK, India, and Spain.
2. There was a reported different degree of acceptance of alternatives such as computer models by students of different countries.
3. Pharmaceutical/academia requires scientists trained in *in vivo* skills. The UK government has expressed concern that UK education systems are failing to produce graduates with these skills and that this might adversely affect science industries.
4. At the moment there are no realistic alternatives to using animals for *in vivo* skills training and these are the skills required by (a small number of) pharmacology/life sciences graduates wishing to pursue animal-based research careers in the pharmaceutical industry or academia.
5. Whether it is necessary to use animals in undergraduate (Bachelor's) education or whether training in such skills would be more appropriate at postgraduate level is questionable. If it is to continue to be at undergraduate level then it is important that animals are not used unnecessarily to train students who will not pursue research careers. Thus, there should be a student selection process and highly specialized courses should be offered to those selected. Better collaboration between universities and industry might be another way forward so that some of the more specialized training could take place "on-the-job".

Session III-2

Innovative Teaching in Human and Veterinary Medicine

Co-Chairs: Frauke Ohl, Utrecht University, Netherlands
Doug Morck, University of Calgary, Canada

The goal of both human and veterinary medicine is to promote animal health and welfare. Therefore, the training of students in medicine aims at providing them with knowledge of physiological and pathological processes, clinical competencies such as the diagnosis and treatment of disease, the ability to reason in a scientific manner, a fundamental appreciation of business management, and the development of a professional attitude. The use of (healthy) animals in medical education is mainly directed towards learning (anatomy and physiology) and the development of practical skills, such as animal handling and surgical technique.

This session was directed towards outlining the students' view on medical and veterinary education. The presentations by Dr **Andrew Knight**, **Siaw-Yean Woon**, **Nick Jukes**, and Dr **Anya Yushchenko** emphasized that students are and should be a driving force in implementing 3R-developments and changes in education. Although a variety of 3R-methods for education are available, teaching programmes often rely on well-established training methods, while being hesitant to step over to novel, not extensively validated methods. A proactive attitude of students can be very stimulating in overcoming such hesitations.

In general it was stated that basic knowledge and skills (suturing, etc.) do not need the use of animals but can perfectly be covered by means of replacement methods. In contrast, the validity of alternative training methods provide less clear answers to obtaining practical competences for more complex procedures.

Further it was emphasised that cultural aspects need to be carefully considered, especially when setting up international co-operations on the development of teaching programmes. Both the position of veterinarians and the ethical frames with respect to the use of animals and specific animal species vary to a significant degree between countries. Such differences might demand adjustments in teaching modules and programmes.

Finally it was concluded that ethically based training results in a more ethical attitude in future veterinarians. Such training firstly might help with desensitisation aspects in students, but secondly also might result in avoiding moral dilemmas in the education of these health professionals.

Session III-3

Development of Non-Animal Teaching/Training Models

Co-Chairs: Nick Jukes, InterNICHE, UK
Ramasamy Raveendran, Jawaharlal Institute of Post Graduate Medical Education and Research, India

Addressing the development of non-animal teaching and training models provided an opportunity to explore new directions, challenges, and opportunities within design and technology in the field, as well as to address issues of fidelity and assessment.

Invited speaker Dr **Siri Martinsen** explained how the new concept and practice of an ethical scoring system that InterNICHE is developing can play a role in adding transparency and depth to the process of assessing alternatives. This includes the potential to replace harmful animal use and to address ethical issues that are often overlooked: the source and experience of animals that might have been used in the production process, along with broader ethical issues presented by content and design. The scoring system, therefore, can encourage the humane production of alternatives and enhance the pedagogical and other impacts of these learning and training tools.

Dr **Jody Gastrich** spoke about a Trans-Anal Rectal Resection (STARR) laparoscopic device created as an alternative for product development and surgical training on a procedure for a specific human medical condition. The presentation explored the process of development and testing and reported on the 67% replacement achieved in one location through the implementation of the device; it also enhanced the quality of training. Questions on formal assessment and on the relationship between teaching objectives and the degree of fidelity needed for this procedure were discussed by the speaker and congress delegates. The availability and potential use of human rather than animal tissue within the device was discussed, along with the question of whether this could bring the degree of replacement to 100%.

Blood collection is an important and commonly used practice – and a skill that professionals need to master. The alternative described by Dr **Maria Streber** involved the plastination and preparation of the rat skull to allow practice in bleeding from the retro-orbital sinus and facial veins. Replacement of animal experiments was achieved, and students were able to train better than before through repeated practice and avoidance of stress. Some discussion revolved around the perceived need for *in vivo* practice of this technique, the banning of the *in vivo* method in some parts of the world, and the associated value of its simulation.

The combination of software, mannekin, and chemical sensors in Dr **Chandragouda Patil**'s SimuRat model demonstrated how an interactive, innovative simulator for demonstrating the effects of drugs on blood pressure and heart rate has great potential for replacement in pharmacology and pharmacy training. The speaker explained how the device can replace experiments performed on rats and dogs to teach surgical techniques, dose administration, preparation of drug solutions, and recording of biological responses. Feedback on the presentation centred on the clear value of linking mannekin to software, and the associated pedagogical advantages in terms of knowledge and skills acquisition. Questions addressed the process of drug identification by the sensors and the potential to extend the functionality of the simulator to go beyond the training of experimental procedures to support skills acquisition for clinical procedures as well.

For each alternative, the meeting provided an opportunity for discussion about how to enhance its pedagogical, ethical, and economic potential. Exploring the ethical scoring system helped link these issues together across the different presentations in the session. Demonstrations of SimuRat and opportunities for further discussion were made available in the Multimedia Exhibition.

Session III-4

Replacement Alternatives and Teaching Objectives – Determine If and When Student Learning Objectives Require the Use of an Animal

Co-Chairs: Merel Ritskes-Hoitinga, Radboud University Nijmegen Medical Centre, Netherlands
David Dewhurst, University of Edinburgh, UK

Marlies Leenaars et al.: *New innovative elements in the FELASA Category C courses for researchers designing experiments*
Systematic reviews should be part of any scientific training for researchers who will use animals, as they contribute to (1) scientific quality, (2) the implementation of the 3Rs, and (3) translational transparency. Systematic reviews involve a thorough analysis of all relevant studies with a critical evaluation of all available data. This process encompasses the following steps: define research question, search for other studies, assess methodologies, extract data, and synthesize data. Within evidence-based medicine, systematic reviews have been common practice for decades, whereas for animal studies this method has been introduced only recently. For animal studies we have developed new tools to assist with the first steps in performing systematic reviews and in facilitating an effective literature search: search filters for Pubmed (Hooijmans et al., 2010) and Embase (De Vries et al., 2011), and a step-by-step search guide (Leenaars et al., 2011). New educational elements on systematic reviews, including comprehensive literature search strategy workshops, have been successfully incorporated within our FELASA category C courses over the last two or three years. Education on systematic reviews should be incorporated into all FELASA Category C courses. The intention of the proposed Montreal Declaration is to follow the good example of the clinic.

Timo Nevalainen et al.: *Replacement and in vivo learning objectives in European competence training*
An important question for the FELASA Accreditation Board for Teaching and Training is whether the use of live animals in teaching is indicated. For FELASA category C persons who design and oversee experiments, the discussion concerns how important it is it to teach animal skills when many students have not yet decided on career paths. According to the Accreditation Board and the FELASA guidelines, teaching animal skills in FELASA Category C courses is necessary, as the evidence of practical skills needs to be examined, and this cannot be totally mirrored by alternatives. The FELASA accreditation board assesses whether there is a good mix of appropriate teaching methods in a course and evaluates the assessment methodologies for practical skills and theoretical knowledge. For Category C courses, a minimum of 10 hours practical training is required. Currently, the evaluations of the 11 FELASA-accredited courses (there are more than 100 across Europe) show that negative feedback by the accreditation board is a rare event.

Klas Abelson: *Reducing the number of animals used in teaching and training of graduate students and scientists – possibilities and limitations*
When using live animals in teaching, it is necessary to identify the cases in which the use of live animals is really necessary and the cases in which it is not. Handling animals, for example, can be supplemented by the use of mannequins. At the University of Copenhagen, video-based exercises in anesthesia and behavior have replaced the use of live animals. Animals used for making the videos were anesthetized by experts and so experienced less stress than if they had been handled by students. These videos have resulted in better educational outcomes, and they provide the opportunity to replay the video and to make standardized observations. They also have resulted in a reduction in the number of animals used in teaching.

D. Dewhurst and **A. Hemmi**: *A survey of animal use and alternatives in higher education in Europe*
A survey of universities in 10 European countries (six in Western Europe, four in Eastern Europe) was conducted in 2010 to determine the extent to which animals were still being used or had been replaced by computer-based alternatives for teaching physiology and pharmacology. Computer-based alternatives were used to some extent by all countries. Major factors that persuaded academic staff to introduce alternatives were "published evidence of effectiveness" and "recommendation from a colleague." In Western European institutions, student objections to the use of animals in teaching also served as an important driver.

L. Ruiz Torres: *Alternatives to animal testing in the faculty of veterinary medicine of the National Autonomous University of Mexico*
The talk provided an overview of the use of Alternatives to animal testing in UNAM, a top university in Mexico, with 30,000 students. The university uses 10,000 animals per year, 700 of which are used in the Vet School. Animals are used across

many disciplines, e.g., to improve knowledge and psychomotor skills. InterNiche has provided support for replacing animal use with alternative methods. The use of animals for teaching purposes continues, even though teachers have become more interested in alternatives and increasing numbers of students oppose using animals.

Conclusions

Before starting new animal studies, it is important to make an analysis of already published data/knowledge in order to prevent unnecessary duplication. Systematic reviews, a scientific method from the clinic that is currently being transferred to the field of animal studies, is included in the education of future researchers. This has great potential for improving the implementation the 3Rs, as well as enhancing scientific quality and providing more translational transparency.

Some practical training on live animals is essential for those who will perform animal experiments. It is important to effectively evaluate skills and competencies. Courses should be accredited by recognized bodies, as this stimulates international harmonization. It is important to keep focusing on reducing animal use in teaching, e.g., by the use of videos on anesthesia and animal behavior and assessing the effect on skills and competencies.

A survey of European universities showed that many animals are still being used for teaching purposes in the life sciences, particularly in pharmacology. This is variable across European countries and, in general, is higher in Eastern than in Western European universities. Teachers and students interested in using alternatives are mostly persuaded by evidence of effectiveness. The introduction of alternatives in teaching has already shown a significant impact at a Mexican university, and it is important to keep the focus on these efforts.

Session III-5

Introducing Multimedia to the Curriculum

Co-Chairs: Laura Ducceschi, Animalearn, US
René Remie, René Remie Surgical Skills Centre, EU

This session covered topics relevant to the implementation of the Three Rs in research and teaching from a global perspective, focusing on the utilization of multimedia learning. Following the session, panelists provided training in The Multi-Media Exhibition on a variety of alternatives, including animal training models, virtual dissection software, virtual reality platforms, interactive manikins, and computer simulations.

The following themes were pervasive among presenters, situations, and institutions.

Cultural Shift
Implementation of the Three Rs in teaching and training involves more than technological tools. A cultural shift is occurring that encourages the use of multimedia methods in the classroom. Panelists stressed the importance of creating and sustaining dialogue between administration, faculty, and students/trainees as a critical component to multimedia planning. It was indicated that learners are at the forefront of development and curricular change, with students playing an active and engaged role. Buy-in from faculty, administrations, organizations, and students plays an important role as a catalyst for cultural change.

Benefit to students, careers, and various disciplines
Multimedia efforts have increased student confidence and skills acquisition, and training rooms allow for active participation and personalized learning. The use of multimedia in a core skills-related curriculum has further facilitated a "hit the ground running approach" for students beginning their careers.

Curricular innovation and continuous access
Sophisticated multimedia tools currently are enhancing and transforming curricula. University commitments to providing lifelong resources to students are prevalent. Harnessing a variety of disciplines – from biology to engineering to computer science – is integral to developing the most efficacious learning methods.

Efficient use of resources
The use of multimedia in the classroom makes economic sense. Benefits include conserving faculty time, re-using materials, minimizing the consumptive use of animals, and offering opportunities for collaboration and the sharing of resources. Databases and free loan programs such as Animalearn's The Science Bank, InterNICHE, and NORINA provide access to the most technologically advanced alternatives to using animals in teaching at no cost to schools, colleges, and universities.

Improvement to animal welfare / ethics
Society's increased awareness of the intrinsic value of animals, their use in education and training, and the impact to curricular change, was discussed. Options considered included a 90% reduction in the use of animals through implementation of microsurgery alternatives, refined skill levels of students through use of multimedia, and replacement of the use of animals in education and training through the implementation of multimedia.

Accessibility
Multimedia teaching tools are available worldwide for all teaching categories, from pre-college education to University and graduate level surgical skills training. Panelists stressed the importance of overcoming language barriers to encourage global access to resources. Database platform design is also critical to encourage accessibility through decentralized participation, with 'Wiki-based' capacities helping to facilitate sharing, input, collaboration, and, in turn, Replacement.

Recommendations for the future

Customer-centric model of delivery
The use of audience feedback in consideration of teaching/learning needs is critical to the continual improvement of future multimedia delivery and implementation. As factors converge, a continuous increase in the use of multimedia in all disciplines and at all educational levels is likely, as well as an impact on curriculum and implementation of the Three Rs.

Relevance of methodology to learning outcomes
Many animal lives are wasted in surgery or experimental techniques due to weak methodology descriptions that focus more on the results component than on how researchers can repeat techniques. This affects the 3Rs. Animals deserve their own place in scientific journals and should not merely be grouped in the materials and methods sections.

Session III-6

Workshop Educating the Animal Scientist

Chair: Jan van der Valk, Netherlands Centre for Alternatives, The Netherlands

From the panel members' introductions it appeared that only a few countries have regulations in place explicitly demanding education on laboratory animal science for persons working with animals. In other areas there is either no legislation or legislation that mentions education only in very general terms. Guidelines from international societies assist in establishing educational standards on laboratory animal science.

In Europe, the new Directive 2010/63/EU, which must be implemented in national legislation by November 10, 2012 (taking full effect in January 2013), specifically requires demonstrated personal competence in addition to the traditional emphasis on education and training. Education of laboratory animal scientists could be envisaged as composed of a general module complemented by specific modules dealing with national legislation and, in particular, species-specific education and skills based on the specific person's need and the institute's animal research program. In Canada, the training of animal users is mandatory (effective 2003) for the maintenance of the CCAC *Certificate of Good Animal Practice®* by Canadian institutions. The CCAC *National Institutional Animal User Training Program* consists of CCAC guidelines on: institutional animal user training (1999), a *Recommended Syllabus for an Institutional Animal User Training Program* (1999), as well as a series of twelve web-based training modules covering core and non-core topics, and regularly updated species-specific training as supporting resources for institutions.

In Japan, the guidelines for proper conduct of animal experiments of the Science Council of Japan, also named "detailed guidelines" requiring that personnel involved in animal experiments should have appropriate training prior to engaging in animal experiments. Like the USA, Australia has no national legislation with respect to the use of laboratory animals but has published a National Code of Practice that is referenced in state animal protection legislation. The basic principle is that scientists are obliged to have the necessary knowledge and skills before they start animal experiments. Progress is made with respect to establishing courses, preparing web-based materials, and organizing face-to-face courses with reflective learning as a key-element. In the USA, the *Guide for the Care and Use of Laboratory Animals* is the central document that details who must be qualified to work with laboratory animals, but it does not describe how training should be provided.

Several international organizations have developed guidelines for the education of persons working with experimental animals. FELASA guidelines present a detailed curriculum that allows some flexibility, e.g. as to species included, and already can be offered as modules. The FELASA quality assurance body, the Accreditation Board, accredits courses, not persons. If we truly want to extend harmonization to the level of persons, then the options are a fully centralized assessment process or a centralized examination. ICLAS guidelines suggest a flexible education and training based on existing knowledge, skills, and needs of the scientist and the institute's animal research program. It is important that training and assessment of competence should be well documented. ILAR guidelines are more general and require that all persons dealing with animals should be adequately educated, trained, and qualified.

There was also much focus on the recently established chapter 7.8.5 (*Use of animals in research and education*: chapter on "Assurance of training and competency) of the *Terrestrial Animal Health Code* of the World Organization for Animal Health (OIE). This is the international standard to which the 178 Member Countries and Territories should comply. Also, the OIE code requires education and training until the competence and continuous education of relevant staff has been demonstrated.

The responsibility for educating and training scientists differs between guidelines and legislations. The new EU directive requires a person at the establishment level to be responsible for ensuring the competence of its staff. For the CCAC it is the institutional Animal Care Committee, while in the USA and Australia the research institute is responsible. In the OIE and Japan guidelines, the senior management has responsibility, and the ILAR code gives responsibility to the IACUC and the attending veterinary specialist.

The introductions made clear that there are different approaches with respect to training animal-based scientists: some guidelines require fixed courses, while in other areas flexible courses are offered tailored to the needs of the student and/or the facility where the person is employed. All courses are aimed at providing the base for obtaining competence, which involves knowledge, understanding, practical skills, and attitude.

The subsequent discussions focused on competence and attitude. Competence can be best defined as being aware of and capable of applying best practices in a particular research situation with particular experimental animals. Attitude building is culture-dependent but should at least contain the following elements: respect for animals, self-reflection (self-assessment), and taking responsibility. With respect to the countries and institutes that intend to establish a course for animal-based scientists, the audience asked for support. It was proposed that a network be established to help identify experts to assist in setting up courses or particular modules to educate and train the scientists who design and are responsible for animal experiments. The general agreement was that co-operation across borders and among organizations is desirable so that all may benefit from experience and attain a level of harmonization that would facilitate scientific exchange and focus the available resources.