



The University of
Nottingham

TRAINING SCHOOL IN EXPERIMENTAL DESIGN & STATISTICAL ANALYSIS OF BIOSCIENCE AND BIOMEDICAL EXPERIMENTS REPORT

ACCREDITED BY:



9-11 January 2019

University of Nottingham, UK

SUPPORTED BY:



FRAME in partnership with universities, NGOs and projects delivers regular training schools in experimental design and statistics to increase awareness among scientists about the need to reduce animal numbers in experiments and to refine procedures. Participants gain a better understanding of how to properly design and effectively analyse their experimental programmes so that they can go on to produce higher quality science, which has made the most efficient use of a minimum number of animals.

Training School in Experimental Design & Statistical Analysis of Bioscience and Biomedical Experiments Report

UNIVERSITY OF NOTTINGHAM, UK

INTRODUCTION

The twelfth Training School was hosted by the University of Nottingham and was a collaboration between FRAME and EU H2020 project VetBioNet.

Russell and Burch (1959)¹ identified that reduction in laboratory animal use can most effectively be achieved by rigorous experimental design and appropriate statistical analysis of any results. This Training School is an ideal opportunity to facilitate dialogue and enhance the application of experimental design and statistical analysis to animal experimentation to improve: a) animal welfare; b) the amount of information from a given number of animals involved and c) the quality of biomedical research and testing.

OBJECTIVES

The key 3Rs objectives of the Training School are:

- to provide researchers with an understanding of basic design concepts that they do not seem to be gaining from other sources,
- to give researchers the ability to use more efficient designs for their experiments, and
- to stimulate engagement with the Three Rs and useful discussion between animal users in different sectors, such as industry and academia, on both refinement and reduction.

STRUCTURE

The programme (see appendix 1) was taught by six expert tutors:

- Dr Derek Fry
- Dr Kate Millar
- Dr Michelle Hudson-Shore [also acting as Training School Coordinator]
- Prof. Richard Preziosi
- Dr David Lovell
- Dr Michael Festing

¹ Russell, W.M.S. & Burch, R.L. (1959). *The Principles of Humane Experimental Technique*, 238pp. London, UK: Methuen and Co.

The format included lectures, group discussions, and individual exercises. The programme (appendix 1) was structured to lead the participants from simple experimental design and statistical ideas, through more complex methods and analysis to effective presentation of findings. Participants were also able to discuss their own research problems/experiences with the Training School tutors. This interactive approach strengthens and supplements the information given in the more traditional lectures. The School also fosters networking and dissemination of information between participants.

PARTICIPANTS

The Training School is aimed at those who are at postgraduate level or above. This course attracted participants from across Europe.

Table 1 lists the number of participants and their country of origin. As the host country the UK had the most representatives, but these were geographically spread from 17 different cities. The majority of participants were postgraduate or postdoctoral researchers, but the School also attracted senior members of staff, veterinarians and named persons among others (see table 2).

Table 1: Origin of participants who attended the Training School, January 2019

Country	Number of Participants
UK (17 Cities)	33
Croatia	3
Denmark	2
France	2
Italy	2
Finland	1
Norway	1
Portugal	1
Total	45

Table 2: Scientific roles represented among participants, January 2019

Scientific Position/Role
PhD Student
Post Doc Researcher
Scientist/Scientific Officer
Senior Scientist/Researcher
Researcher/Research Assistant
Named Veterinary Surgeon
Head of Department
Deputy Study Director
DVM
Investigator
Biosciences Business Development Manager
Technical Developer
Scientific Manager
Veterinarian
Named Training and Competency Officer
Research Associate/Research Fellow
Director
Resident
Animal Welfare Officer

OUTCOMES

Key Outcome

The main outcome is an increased awareness and understanding among participants of the need to reduce animal numbers in experiments and to refine procedures undertaken on them. Therefore, it is intended that this will translate into a reduction in the number of laboratory animals used and the suffering they may encounter.

In addition, with a better understanding of how to properly design experimental programmes and effectively analyse results, participants will go on to produce higher quality science, which has made most efficient use of resultant improved data.

Participant Feedback

The Training School was very well received with participant's providing very positive feedback. The majority of participants who provided feedback said that they would recommend the course to colleagues, that the instructors provided helpful assistance and agreed that the course had exposed them to new knowledge and practices (see appendix 2 for a full summary of responses). Many participants made additional comments, such as:

Course even better than expected. Course material was great with the books and website. Really great help from tutors. Best course I've been on for a long time. Learned a lot and will definitely conduct better experiments in the future! (P2)

This has been a FANTASTIC course in many ways. The topics covered 100% relevant to anyone doing experimental sciences, whether using animal models or not. It has been quite an eye-opening experience after nearly 20 years of scientific career due to the clarity of the concepts discussed here. (P13)

I would definitely recommend this course to colleagues and I would actually make it compulsory. (P15)

I think that this course should be undertaken by all research students. I wish I had done it during my PhD! (P39)

Knowledge Acquisition

To gain insight in to how successful training of this nature is the Training School tutors designed a set of questions, which were given to the participants at the start and end of the course. The answers to these questions were collated and analysed to determine the participants' existing knowledge on the subject and then to establish if and what they had learned as a consequence of the training. In line with previous events, there was an increase in understanding for all the areas tested (figure 1) and the participants overall scores also increased after the training (figure 2).

Figure 1: Comparison of the overall understanding by area of experimental design, before and after training by participants in the Nottingham Training School 2019.

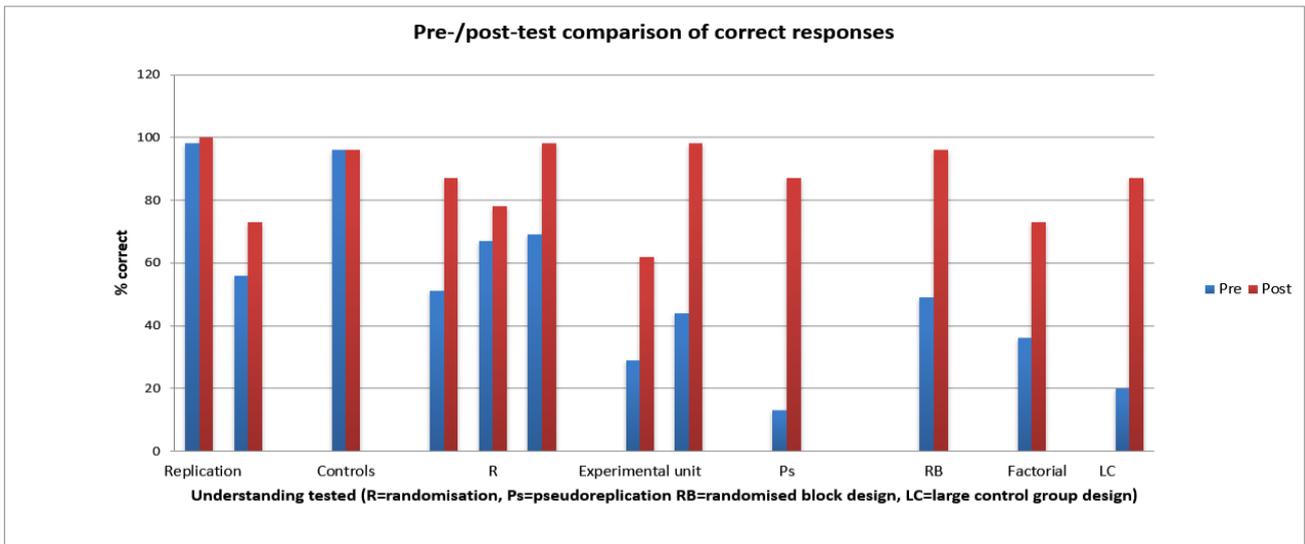
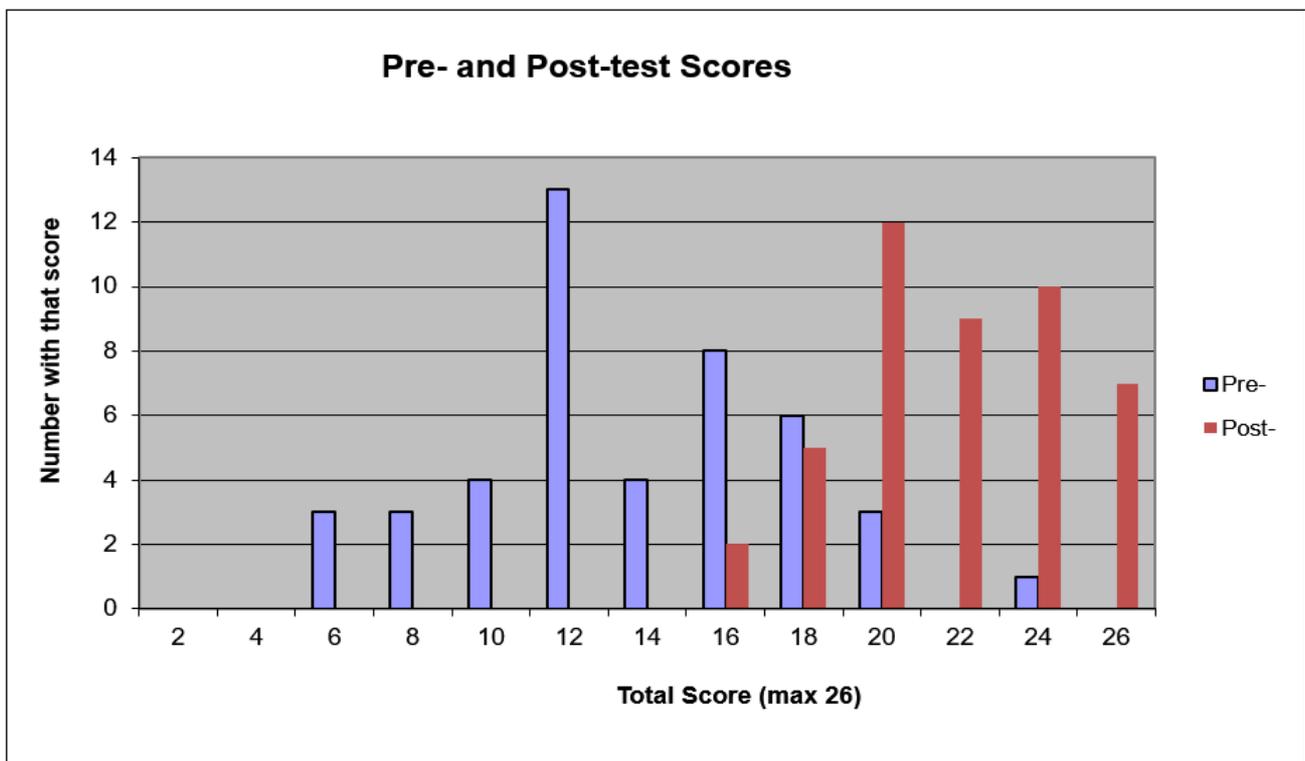


Figure 2: Comparison of participants' overall test scores before and after the Nottingham Training School, 2019.



FELASA Accreditation

Since 2017, the Training School has been accredited by FELASA (Federation of European Laboratory Animal Science Associations)². Therefore, it was possible to offer the participants the opportunity to take an examination to receive a FELASA certificate. Of the 45 participants, 41 opted to take the examination. All but one participant passed. As part of the accreditation process members of the FELASA Education and Training Board audit training courses. The 2019 event was subject to such an audit and received a positive audit result, with no formal recommendation being required.

FUNDING

The Training School was held in collaboration with VetBioNet and the University of Nottingham. The Training School was coordinated by FRAME and VetBioNet. The external tutors provided their time and expertise free of charge. As the host institution the University of Nottingham supplied the course facilities free of charge. VetBioNet provided facilitation and coordination of the course and covered the tutors' expenses. FRAME covered their administrative support cost. LASA (Laboratory Animals Science Association) and Laboratory Animals Ltd. kindly provided funding to supply all participants with two related text books. Participants were charged a registration fee to cover, course materials, subsistence, accommodation, local transportation (between venue and accommodation), social event and examination fees (for FELASA accreditation). Members of the VetBioNet received additional funding from the project so were offered a limited time reduced fee (to cover accommodation, all other Training School costs were covered by VetBioNet) The Training School was a 'not-for-profit' event.

FUTURE EVENTS

FRAME aims to deliver at least one Training School per year. For further information on the schedule for future events and to sign up for email alerts about the Schools visit the Training School website at: <https://frame.org.uk/training-events/training-school/>.

If you are interested in hosting a Training School at your institution or organisation please contact FRAME at: training@frame.org.uk, in the first instance and the Training School Coordinator will contact you to discuss opportunities and requirements.

² FELASA Website: <http://www.felasa.eu/> (accessed 8/7/19).

Appendix 1

Training School Programme, Nottingham 2019

Session	Time	Session Title and Content
Wednesday 9 January		Basic Principles
	08.50-09.15	Registration
1	09.15-09.45	Introduction to course: The 3Rs, legal and ethical aspects of Experimental Design.
2	09.45-10.15	Quiz 1
3	10.15-11.00	Principles of experimental design. Types of experiment (pilot, exploratory, confirmatory), objectives, controls, experimental units, replication, randomization, blinding.
	11.00-11.30	BREAK
4	11.30-12.15	Common failings: unclear objectives, bias, lack of power, failure to randomize/blind, pseudoreplication. Costs of poor design.
5	12.15-13.15	Group Exercise 1: Controls, experimental units.
	13.15-14.15	LUNCH
6	14.15-15.00	Revision of basic statistical inference. Null and alternative hypotheses, SD vs. SE, outliers, type I & type II errors, variables affecting significance, summary statistics.
7	15.00-15.45	Sources of variability in animal studies and how they may be controlled. Need for better design.
	15.45-16.15	BREAK
8	16.15-17.15	Simulating experiments and the importance of controlling variability. Randomisation, sampling, Type 1 and Type 2 errors.
	19.00-21.00	DINNER
Thursday 10 January		Experimental Designs and Statistical Analysis
9	09.00-09.45	The analysis of variance, interactions, post-hoc tests, assumptions, data transformations.
10	09.45-10.30	Group Exercise 2: Finding basic faults.
	10.30-11.00	BREAK
11	11.00-11.45	Completely randomised, randomised block and latin square designs. Power calculations, resource equation.
12	11.45-12.30	Qualitative data, contingency tables, non-parametric tests.
	12.30-13.30	LUNCH
13	13.30-14.15	Factorial "designs".
14	14.15-15.00	Group Exercise 3: Choosing the right design & over-night exercise.

	15.00-15.30	BREAK
15	15.30-16.15	<i>Experiments to test relationship: correlation, regression.</i>
16	16.15-17.30	<i>Power analysis, EDA and the pros and cons of software.</i>
	18.30-22.00	SOCIAL EVENT & DINNER
Friday 11 January		Applied Experimental Design and Important Design Messages
17	09.00-09.45	Discussion of overnight exercise. <i>Planning an experimental programme.</i>
18	09.45-10.30	Group Exercise 4: Analysing and presenting results.
	10.30-11.00	BREAK
19	11.00-12.15	Parallel Session 1: Ask the Experts! Session A: Writing an experimental protocol, ethical review & 3Rs. Session B: Discussion of participants unresolved design problems. Session C: Searching for information on 3Rs and 3Rs resources.
20	12.15-12.45	Quiz 2 and discussion.
	12.45-13.30	LUNCH
21	13.30-14.45	Parallel Session 2: Ask the Experts! FELASA accreditation exam [13.30-14.15] Session A: Writing an experimental protocol, ethical review & 3Rs (cont.). Session B: Discussion of participants unresolved design problems (cont.). Session C: Searching for information on 3Rs and 3Rs resources (cont.).
22	14.45-15.00	<i>Answers to Quiz 2 & take-home messages.</i>
		CLOSE

Appendix 2

 Training School Feedback Summary,
 Nottingham 2019

<i>The Design of the Course</i>													
The objectives of the course were clear to you	Agree	43	No opinion	1	Disagree	1							
The course contents met with your expectations	Agree	45	No opinion	0	Disagree	0							
The lecture sequence was well planned	Agree	41	No opinion	2	Disagree	2							
The contents were illustrated with adequate examples	Too few	7	Enough	35	Too many	3							
The academic level of the course was appropriate	Too low	6	Correct	39	Too high	0							
The course exposed you to new knowledge and practices	Agree	42	No opinion	2	Disagree	1							
You would recommend this course to your colleagues	Agree	44	No opinion	1	Disagree	0							
<i>The Conduct of the Course</i>													
The lectures were clear and easy to understand	Agree	43	No opinion	2	Disagree	0							
The course material provided was adequate	Agree	45	No opinion	0	Disagree	0							
The group sessions were clear and easy to understand	Agree	40	No opinion	4	Disagree	0							
The instructors provided helpful assistance	Agree	44	No opinion	1	Disagree	0							
<i>Background Information</i>													
Rate your confidence in applying the 3Rs when planning an experiment: (1 = no confidence, 10 = very confident)	Decreased by		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	
			0	0	0	0	0	0	0	0	0	0	
	Increased by		[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
			3	9	10	11	4	5	1	2	0	0	0
How did you hear about the School? *some gave >1 answer		Internal Email	14	Colleague	28	FRAME Website	1						
Other, please specify	5	Flyer	0	Direct email	2	Facebook Twitter	1						
<i>Future Training</i>													
I would be interested in further training to be able to teach the topics covered in this course	Definitely	27	Maybe	14	Not at all	4							

Responses: 45/45 (100%)