Analysis of teaching methods in anaesthesia in the undergraduate curriculum of 4 veterinary universities

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Acknowledgements
The authors would like to thank Noemi Romagnoli for helping to realise the study at UNIBO. The authors are also grateful to the staff and the students of RVC, ENVA, UNIBO, and UBA who participated in the project.

Conflict of interest statement

The authors declare no conflict of interest.

Word Count: 3598

Abstract

Objectives
There are no standardized methods for teaching anaesthesia in veterinary universities. Our aims were 1) design a holistic audit tool to assess anaesthesia teaching strategies in veterinary universities; 2) to apply the tool to 4 veterinary undergraduate core curriculums in different geographical areas.

Study design
Qualitative study using interviews of university staff and students to identify common themes and differences in teaching veterinary anaesthesia.

Methods
A survey was carried out in four veterinary universities (ENVA-France, RVC-UK, UBA-Argentina, UNIBO-Italy). First, an open-question interview of anaesthesia head of services (1h-1h30) identified the pedagogical strategies and items in order to conceive a subsequent semi-directive interview formulated as a SWOT analysis (Strength/Weaknesses/ Opportunity/Threats). Secondly, the SWOT reflection was carried out by a second staff member and focussed on i) general organization, ii) topics for pre-rotation teaching, iii) teaching methods for clinical rotation and iv) assessment methods. Qualitative analysis of the interview responses has been performed with semi-structured interview method. Finally, the students evaluated the teaching they received through a student questionnaire generated from the output of both interviews.

Results
Nine lecturers and 106 students participated in the study over 4 sites. Pre-clinical teaching ranged from 13 to 24 h (median 15 h). Clinical teaching ranged from 4 to 80 h (median 60 h). Overall, all faculties perceived time as a limitation and attempted to design strategies to achieve the curriculum expectations and optimize teaching into more time-efficient exercises. Large animal anaesthesia teaching was found to be also as a common weak area. Internal and specific feedback was delivered to each university, while generalised results were shared globally.

Conclusions
This preliminary study proved the generalisability of the protocol used. Analysis of a larger pool of universities would be beneficial to identify and promote efficient teaching strategies and innovations for training competent new graduates in an ever-expanding curriculum.

Keywords: anesthesiology, questionnaire, SWOT, andragogy, skills, competences

INTRODUCTION

University teaching is nowadays facing a constant evolution of our society and progress (increase in students' numbers in class, scientific and technological advances). The main goal of universities remains to train the students to meet the ever-increasing demand of society.
"The missions of a teacher are not limited to the transmission of updated information, or gestures and techniques to meet a regulatory framework. The teacher must clarify his intentions, define strategies, and choose environments with the aim of developing skills in the face of the complexity of our care situations" (Jaffrelot et al. 2012).[1]
We studied the andragogy in veterinary anaesthesia, which us the method and practice of teaching adult learners. Our aim was to evaluate the andragogy in anaesthesia, and subsequently to help improve students' competency in anaesthesia as future veterinarians. (Mercier-Coubris 2013).

Teaching veterinary disciplines is university-specific and includes a wide range of teaching methods. In the past 25 years, knowledge of veterinary anaesthesia has been expanding and this topic became a separate teaching module in several places. In human medicine, anaesthesia is most of the time related to a surgical operation, whereas, in veterinary medicine, anaesthesia is needed for the large majority of procedures (surgery but also internal medicine, imaging, etc.). It is essential for veterinary students to master this discipline in order to work as successful clinicians.
There are no standardized, worldwide-accepted anaesthesiology pedagogical methods for veterinary universities. In this study, we focused on undergraduate anaesthesia teaching.
While there is no defined ideal curriculum for undergraduate anaesthesia, the AVMA (American Veterinary Medical Association), the RCVS (Royal College of Veterinary Surgeons), EAEVE (European Association of Establishments for Veterinary Education) and the AVBC (Australian Veterinary Boards Council) proposed a set of aims and learning objectives required for accreditation ("Day one skills", see appendix 1).
The "Day one skills" contains a list of competencies but without guidelines on how to teach them; the process to achieve these is not standardised worldwide, only the skills are assessed by inspectors to grant accreditation. This could lead to discrepancies of teaching methods between schools regulated by the same regulating body. This led us to investigate the different curriculums, in regard to teaching conditions (number of hours, balance practical versus theoretical) and assessment. We wanted to know if pedagogical methods are standardized and if there are differences in how anaesthesia is taught in different universities. To answer these questions, we performed a survey in four universities.
Our hypotheses were: 1) volumes of teaching and methods are different between universities; 2) Universities face common issues and limitation in anaesthesia teaching; and 3) Students assessment/perception of anaesthesia teaching differs between vet schools.
This preliminary study is the first of its kind in the field of veterinary education. Our aims were to 1) design a holistic audit tool to assess anaesthesia teaching strategies in veterinary universities; 2) apply the tool to 4 veterinary undergraduate core curriculums in different geographical areas.

[1] Translated from French: "Les missions d'un enseignant ne se cantonnent pas à la transmission d'informations actualisées, ou de gestes et de techniques pour répondre à un cadre réglementaire. L'enseignant doit clarifier ses intentions, définir des stratégies, et choisir des environnements visant à développer des compétences face à la complexité de nos situations de soins". (Jaffrelot *et al.*, 2012)

MATERIALS AND METHODS

In order to study this wide-ranging topic, we focussed on the methods to teach anaesthesia in four universities (ENVA-France, RVC-UK, UBA-Argentina, UNIBO-Italy). We used a qualitative approach; therefore, universities were considered as entities on their own. (Mucchielli 2009; Denzin & Lincoln 2000; Berg BL & Lune H 2012). The study was approved by the Ethical Committee of the RVC (URN SR2017-1384).
The study, based on a survey, was divided into successive stages that we applied consistently in each participating university (see below figure 1).

Figure 1 here

The participants were:

- heads of anaesthesia of each university and a consultant anaesthetist at the four university teaching hospitals (interviews).
- students in their clinical rotation (student survey), fourth year for ENVA and RVC, fifth year for UNIBO and fifth/sixth year for UBA.

Three types of questionnaires were elaborated for this study in this order:

1) General interview of the head of anaesthesia

This open-question interview provided an opportunity for the heads of anaesthesia to talk broadly about the teaching methods used in their service (Miller & Crabtree 1999; Harris 2002). The interviews took between 1h and 1h30, and they were audio-recorded with the consent of participants. The goal was to highlight the pedagogical strategies in teaching veterinary anaesthesia.

2) Interview of a member of the teaching team

The second questionnaire was an interview of a different member of the teaching team in order to build a SWOT analysis (figure 2). The SWOT analysis "(strengths, weaknesses, opportunities and threats analysis) is a framework for identifying and analysing the internal and external factors that can have an impact on the viability of a project, product, place or person"(International Society for Performance Improvement, et al. 2010). The goal was to critically analyse the pedagogical strategies from the teachers' point of view. In order to build the SWOT, qualitative analysis of the interview responses has been performed with semi-structured interview method (Imbert 2010; Dicicco-Bloom & Crabtree 2006).

Figure 2 here

The SWOT reflection was applied for:

i) General organisation,
ii) Topics for pre-rotation teaching,
iii) Pedagogical methods for clinical rotation,
iv) Assessment methods.

3) Students Questionnaire (see appendix 2)

The output of both interviews was used to generate a student questionnaire. It was a survey submitted to the students at the end of their anaesthesia rotation or lectures in order to have a complete evaluation of students' perception of teaching. The purpose of this questionnaire is to obtain the students' evaluation of how they are taught. The analysis of this survey served as feedback to the teachers on their pedagogical methods.
The questionnaire included 12 Likert scale questions to evaluate:

i) General organisation,
ii) Theoretical component of teaching,
iii) Practical component of teaching,
iv) Number of contact hours,
v) Assessment process,
vi) Their clinical rotation overall,
vii) two or three open questions about positive and negative aspects of teaching.

To facilitate students' participation questionnaire was kept short so that the students needed only 5 minutes to answer it,

Analysis

All interviews were audio-taped and fully transcribed and verified by the subject of the interview. The data analysis was based on the following steps (Lingard & Kennedy 2010):

1) Themes/specific aspects/pedagogical methods used from the interviews of the head of anaesthesia were selected and summarized in a table. This allowed us to have an overview of the pedagogical strategies used.

2) The SWOT matrix was elaborated from the interview with the teaching staff.

3) Students' questionnaires were analysed. Percentages were calculated for each question, comments and suggestions were categorized.

From this data analysis, each participating university received a confidential report summarizing the result of their field study.

RESULTS

Results relate to our 3 main hypotheses, mainly the inter-university commonalities/differences in 1) teaching time and methods, 2) issues and limitation in anaesthesia teaching, and 3) students' assessment/perception of anaesthesia teaching.

Hypothesis 1: volumes of teaching and methods are different between universities (figure 3 and table 1)

At the ENVA, the national curriculum consists of 5 years based on the EAEVE criteria. The length of the core curriculum is four years: it is divided into eight semesters where the last two (the fourth year) are mainly dedicated to clinical teaching. During the fifth and last year, the students pick a specialty (small animal, equine, farm animals, industry, etc.) and write their thesis. Defending their thesis reward the students with the diploma of Doctor in Veterinary Medicine, which is mandatory for them in order to work as veterinarians.

At the RVC, the curriculum is accredited by the AVMA (American Veterinary Medical Association), the EAEVE (European Association of Establishments of Veterinary Education), and the RCVS (Royal College of Veterinary Surgeons). The first three and a half years consist of theoretical courses. From the second half of the fourth year, the students start their clinical rotation.
In contrast to ENVA in France, the final semesters at RVC are still part of the general curriculum. There is no intensification year where students have to choose a specialisation. However, students can opt for electives weeks, where they have the opportunity to gain some specialisation.

At the UBA, the curriculum is based on national criteria and at an international level with the MERCOSUR agreement (« Mercado Común del Sur » or South Common Market). The curriculum is organized in:

- A year of an undergraduate program called CBC (for Cycle Basic Common). It is a common year with agronomy studies.
- A second cycle divided into a common core and a mandatory superior cycle (range 6 to 7 years).

The superior cycle is mandatory for every student and is divided into three categories: animal health (small and large animal), industry/animal production and preventive health medicine. At the end of this cycle, the students start an intensification year called PPS (Professional Practice Supervised). The students can choose their specialization in animal production and industry, in small animal, in large animal, or in public health and preventive health medicine.

At the UNIBO, the curriculum is based on the EAEVE criteria. The length of the curriculum is five years and results in a diploma of DVM-Doctor of Veterinary Medicine.
During the first four years of studies, the students have theoretical and practical courses. The fifth year is dedicated to clinical teaching with a six-month intramural rotation.

Figure 3 here

Table 1 describes more precisely how anaesthesia teaching is organised and timetabled in the curriculum of each participating university. The theoretical courses of anaesthesia are taught during the 3rd year at ENVA and RVC and during the 4th year at UNIBO and UBA. During those courses, universities use specific methods (see particularities on table 1 below), like simulation lab, to supplement their teaching. After the theory modules, students have clinical

rotation starting in their 4th at ENVA, RVC, and in their 5th year at UNIBO and UBA. At the end of their curriculum ENVA, RVC and UBA students have an intensification: according to their choice of specialisation, students have the possibility to have extra clinical weeks in anaesthesia.

Table 1 here

Hypothesis 2: Universities face common issues and limitation in teaching anaesthesia.
The results from the teaching team's interviews highlighted common weak points between the participating universities:

- **Time:** 100% of the faculties perceived time as a limitation.

- **Anaesthesia of Large Animals**: Anaesthesia teaching is small animal-oriented, at the expense of large animals.

- **Simulation Lab:** Simulation platform provides training on mannequins and models that enhances clinical skills. It is good additional teaching complementing the theoretical class. Teachers using this support noticed a reduction of stress in students as they start their clinical rotation, and they seemed more comfortable in taking care of the patient and realizing clinical features/trends.

- **Tutorial Classes with a small number of students:** Tutorial classes provide an interactive and stimulating learning environment for students. With a small number of students, these classes facilitate the assimilation of clinical skills. This format of teaching coupled with theoretical sessions allows the students to put theory into practice.

- **Rotation in the university hospital:** Having rotations carried out in the university hospital is a strong advantage. It provides access to a wide and diverse range of clinical cases. The clinical rotation appears to be one of the best pedagogical strategies to put theory into practice. It empowers the students. Regarding the clinical cases given to the students, the clinicians try to select basic cases like castrations. Teaching rounds at the end of the day is an additional feature that promotes learning. It is an opportunity for students to discuss protocols and clinical cases. The teaching teams consider that oral presentation of cases during rotation could enhance knowledge and also train the students for oral communication.

- **2-week clinical rotation**: according to all the anaesthesia teachers at the four participating universities, a two-week rotation is ideal:
    - The first week is an adjustment period for the students,
    - The second week allows an improvement of clinical skills and knowledge.

Constant guidance and supervision of the students would be the ideal organization of a rotation. However, the reality of the operating theatre can be a limitation: emergencies interfere in the pedagogical organization and the availability of the teaching members.

- **Continued Assessment:** Teachers promoted continued assessment. However, for a majority of universities, the organisation of the curriculum makes it difficult to perform it (limited time allowed, exams' organisational constraints, etc). During the theoretical assessment, teaching teams considered the emphasis on multimedia support to provide clinical scenarios to the students. The ideal assessment of a clinical rotation would be successful completion of the rotation by the students: the teaching team would verify/evaluate if students are able to

anaesthetize a patient competently. Individual, personalised feedback to the students would provide the opportunity for discussion and optimal learning outcome.

Hypothesis 3: Students assessment/perception of anaesthesia teaching differs between the vet schools.

The students' questionnaire allowed feedback on how they perceived their teaching.
Total student replies were 106 (range 2 to 43). Data were used to compare the inter-university teaching methods (see below figure 4). In one of the participating universities, only 2 students replied to the questionnaire and the results were not included in figure 4.

Figure 4 here

Common trends can be identified:

- More than 80% of the students in the 3 universities considered the organisation of the clinical rotation (80.5% in A, 87.5% in B and 90% in C) adequate
- General organisation of the anaesthesia curriculum was by and large perceived as adequate or partially adequate by the students.
- Number of contact hours, in theory, was considered inadequate for 17% in university A, 16% in B and 30% in C.

However, students' evaluation diverged between universities for the methods of assessment of the theory and the clinical rotation:

- In universities A and B, students evaluated globally adequate or partially adequate the methods of assessment of the theory, whereas in the university C 15% of the students considered it inadequate.
- In universities A and C, students evaluated globally adequate or partially adequate the methods of assessment of the clinical rotation, while in B 21% of the students reported inadequate the way they were assessed during their clinical rotation.

This student questionnaire emphasized efficient and weak pedagogical methods. Students free-text comments and suggestions were used to identify new tracks for improvements reinforcing the efficiency of anaesthesia teaching.
The analysis of the comments and suggestions identified three common grounds/aspects of the students' vision:

- large animal anaesthesia teaching was unsatisfactory; (18,8% of the comments in B, 24% of the comments in A were about….)
- clinical anaesthesia rotations were judged as a superior technique to understand and complete the theoretical knowledge; (100% in A, B, and C)
- anaesthesia pharmacology was perceived as a tough topic necessitating much more teaching time. (67% in B and 50% in C of the comments).

DISCUSSION

According to our knowledge, this is the first study of its kind in the field of veterinary education. Through the years 2017-2018, we tried to identify the teaching strategies that could improve the skills of students (d'Anselme 2018). With our survey we obtained two types of results:

a) the identified pedagogical strategies, and their status given by the teaching team of each university.

b) The students' evaluation of the pedagogical strategies identified and used in the universities.

We indeed verified two hypotheses. First, we demonstrated that teaching methods are not standardized between universities, which followed their day one skills lists established by their relevant regulating bodies. We also verified that universities face common issues and limitation in anaesthesia teaching. The results from the teaching team's interviews highlighted time as a common limiting factor. All the participating faculties attempted to design strategies to fulfill the curriculum requirements and optimize teaching into a time-efficient exercise. It could be interesting to imagine a system where the time is assigned based on the pedagogical need and objectives. This organization would allow optimizing the achievement of the pedagogical objectives. The current system (have a fixed amount of time and then adapt the content of the teaching) had limitations and the curriculum's objectives are sometimes partially reached.
For the third hypothesis, we observed that the majority of the students shared the same vision between universities. The goal of this students' survey was to obtain the most representative perception possible and compare it with the teachers' perception: the two visions were actually in agreement most of the time.

We design an audit tool to assess anaesthesia teaching strategies in veterinary universities and applied it to 4 veterinary undergraduate curriculums in different geographical areas.
First, the design of the teachers' questionnaire was based on the principles of a semi-structured survey. This allowed for a more realistic and up-to-date view of the phenomenon studied and to have the participants' perspective through direct interaction with them (Merriam 2009). The interviews were therefore conducted in the language of the teachers in accordance with their own terms, in order to obtain the necessary information. The field study, requiring a physical attendance on the campus of the university, favoured the realization of the semi-directive interviews. Indeed, to have an exchange allowing a collection of valuable data, it is essential to establish a relationship of trust. The going into schools, with the exception of one, for an average of two weeks, was decisive in carrying out this study. In fact, once there, it was much easier to collect data, to adapt to the organization of each university, for better analysis and interpretation of the information. In one university, the language barrier and the time limit did not allow the on-the-spot survey to be carried out. The exchange with this university was in English and through e-mail. The interviews were conducted only by video conference (Skype), the implementation of the protocol as well as the evaluation of the teaching by the students were thereby reduced.
In conclusion, the arrival on the site of the university allowed a much better application of the protocol and a rigorous collection of the data necessary for our study. This confirms that the "human factor" and the relational are fundamental in carrying out this type of study. The use of technology in communication is not yet able to replicate as effectively the information sharing that can be achieved with a human presence face-to-face. Moreover, as the interviews unfolded, it was easier to conduct the interviews with the teachers. For this reason, there is a significant development in the conduct of the two types of interviews (the interview with the professor in charge and the interview for the construction of the SWOT analysis): the latest interviews are richer in precise information.

For the design of the students-questionnaires, we noticed that the section "comments and suggestion" placed at the beginning of the questionnaire resulted in a higher completion rate of this section. This configuration allowed students to express themselves more calmly, keener to leave more written comments.
The opposite configuration with the comments at the end of the test, deprived the motivation of the candidates and their implication to answer efficiently. The results then were less satisfactory.

One limitation of this study was the recruitment of students: a wider number of participants would be more interesting. There was a real need to be physically at the university to present the study to the students. We noticed that an oral presentation of the project to the students was appreciated: it triggered their interest and involved them. The oral presentation helped to increase students' participation. In one university, it was not possible to come for the field study and only two students participated in the survey. We could conclude that to carry out correctly this stage of the protocol, the researcher must be physically present.
Moreover, the semi-structured interview method has some limitations: the small sample size does not allow the results to be generalized or recommendations to be drawn from them that can be applied on a large scale. Being immersed in the cultures and experiences of the participants, the researcher may lack perspective. This immersion increases the chances of generating biases in the collection of information, in the analysis of data and in their interpretation (Holden 2001). The amount of information collected from participants can affect its quality and lead to unfounded conclusions (Reeves et al. 2006).
Finally, this methodological data collection and analysis is time-consuming and financially demanding (Denzin & Lincoln 2000; Anderson 2010; Merriam 2009).

In conclusion, we propose a prototype tool to identify common themes and differences in teaching veterinary anaesthesia. It was applied to 4 veterinary schools to support tool generalisability. This work highlighted that in Argentina, United Kingdom, Italy, and France, veterinary anaesthesia teaching showed a common trajectory. Even if the results differ from one university to another, common issues were identified such as time restriction and sub-optimal of large animal exposure. The results showed an enthusiasm and a strong interest from the universities for the development of teaching veterinary anaesthesia. This is enhanced by the commitment of the European and Argentinian students: their voluntary participation in the survey and the quality of their comments and suggestions expressed their involvement and dedication to this study. However, this work was time-consuming in order to have a direct analysis of the universities. The investment of time and money cannot be neglected or underestimated if we want to re-apply properly this protocol and comply with reliable results on a larger scale.

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Figure 1: Diagram representing the protocol of the field study in participating universities.
1) A first interview was conducted with the head of anaesthesia, in order to obtain a general overview of anaesthesia teaching/service in the university, and to identify the pedagogical strategies and methods in teaching this subject.
2) A second interview with a random? member of the teaching team (consultant anaesthetist) consisted of a semi-directed interview in order to build a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis
3) Students were asked to evaluate how they have been taught by filling a questionnaire
4) Each university received a personalized feedback, including a general overview of the strengths, weaknesses, opportunities, and threats. The institute-specific confidential results covered all the recognized positive or negative pedagogical points and their critical analysis.
5) At the end of the study, common issues of methods in anaesthesia teaching were identified.

Figure 2: Diagram of a SWOT (Strength/Weakness/Opportunity/Threat) model approach.
A SWOT matrix is often used to organize items identified under each of these four elements. "A SWOT matrix is usually a square divided into four quadrants, with each quadrant representing one of the specific elements. Decision-makers identify and list specific strengths in the first quadrant, weaknesses in the next, then opportunities and, lastly, threats." (International Society for Performance Improvement, et al., 2010)

Figure 3: Diagram of curriculum in each participating university, presenting the organization of anaesthesia.

Figure 4: Distribution the percentages of students' answers for anaesthesia teaching evaluation from 3 universities.
Only three university (A, B and C) are presented as only 2 replies were collected from the fourth university.

TABLES

Table 1: Differences of curriculum between the four participating universities with their own particularities. Intensification is a period of time where the students have the possibility to have extra clinical weeks in anaesthesia

	Curriculum's Length	Theoretical teaching	Particularities	Clinical Rotation	Intensification
ENVA	5 years	14 hours and 12h of practical activities in 3rd year	VETSIMS: Simulation lab (Models/ Mannequins)	40h in 4th year	2 weeks in 5th year, small animals
RVC	5 years	13 h in 3rd year	10h30 of computer-aided learning sessions LIVE Center: simulation lab	80h in 4-5th year (last 3 semesters)	1 to 2 elective weeks in 5th year
UNIBO	5 years	24h courses and 12h of practical activities in 4th year	Practice on cadavers	80h in 5th year	-
UBA	7 years	Practical activities included in the 16h theoretical courses in 4th or 5th year	Models/Mannequins for practical activities 6h minimum seminars (24h in total)	4h in 5th year 10h in 6th year	Minimum 1 week in 7th year in small or large animals