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III International Congress of Education in Animal Sciences (ICEAS)

15 - 16 June 2023
Zagreb, Croatia

International Society of Education in Animal Sciences (ISEAS)

ICEAS III PROCEEDINGS BOOK

III International Congress of Education in Animal Sciences

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15 - 16 June 2023
Zagreb, Croatia

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INVITED SPEAKERS

EDUCATION IN SCIENTIFIC ANIMALS: THE CASE OF MICE IN CANCER RESEARCH

Marina Císcar[1-2] and Irene Císcar[3]
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[2]Centro Nacional de Investigaciones Oncológicas, Madrid, Spain
[3]Virgen de la Arrixaca Hospital, Murcia, Spain

ABSTRACT
Currently, there is a lack of education at the institutional level in relation to experimental animals in biological careers such as veterinary or human medicine. Laboratory mice are the most used animal models for cancer research because of their high adaptation to different environments, genetic variability, and physiological similarities with humans. In addition to its similarity in anatomical, genetic (approximately 99% of human genes have synonyms in the mice genome), molecular, and biochemical conditions to a human, also share common behavior features. Although many cancer cell lines have been developed, they do not necessarily reflect the behavior of the original cancer cells in patients. Therefore, patient-derived xenograft (PDX) mouse models have attracted attention recently. PDX mouse models are established by direct engraftment of patient-derived tumor fragments into immunocompromised mice, retaining the original tumor's morphology, architecture, and molecular signatures. This talk summarizes the applications and the main types of mouse models in cancer research, and the importance of giving an education, at least incipient, to researchers in animal models framework.

KEYWORDS: breast cancer, mouse models, NSG mice, RANK-RANKL, PDXs

INTRODUCTION
Breast cancer is a malignant tumor arising from the breast tissue when cells grow out of control. The malignant cells occur in the lining cells (epithelium) of the ducts or lobules in the glandular tissue of the breast. According to the latest World Health Organization (WHO) statistics, breast cancer accounts for 10% of all cancers (Sung et al., 2021) and it is the leading cause of cancer death among women, accounting for 15,5% of cancer deaths in 2020. Breast cancer is a very **heterogeneous disease** and multiple classifications have been made to assess the diagnosis, prognosis, and treatment of patients. The more commonly used grading is the "**Surrogate molecular classification**" which categorizes breast cancer into 5 subtypes depending on immunohistochemical studies of 4 markers: estrogen receptor (ER), progesterone receptor (PR), HER2, and the proliferation marker Ki67. As shown in Table 1, those tumors that lack ER and PR expression show the worse prognosis because of their aggressivity but also, because of the deficiency of effective treatments. Nowadays, although surgery is key for breast cancer treatment, there are complementary systemic or local management options to treat breast cancer patients. However, due to the special phenotype, the **TNBC subtype** is not sensitive to most of the available treatments being chemotherapy the main treatment. Because of it, there is an unmet need to understand the disease, identify new biomarkers, and test new drugs in preclinical models before going ahead with patients. The most common approach used in cancer research to answer all these needs is the **mouse models**. But... why and how a mouse can answer our questions? Mice are small in size, inexpensive to

maintain, and produce rapidly and genetic engineering can be performed easily compared to other animals. Mouse models can closely **mimic human cancer**, greatly expand the in vivo research possibilities, and play a critical role in investigating the initiation and development of cancer and testing new therapeutic approaches. The use of an animal in research is called a "**procedure**" when it leads to a level of pain, suffering, distress, or lasting harm that is equivalent to or higher than an injection with a needle. A procedure cannot begin until an ethical committee has approved it and it must contain a project proposal with the scheduled procedures, a non-technical summary, and include a scientific explanation of why animal research is needed in the project. Those **project proposals** must show the 3Rs and outline the number of animals that will be used and the level of suffering they are expected to experience. The "competent authority" of each EU Member State evaluates and decides whether to grant the license to the group leader/project director.

Subtype	ER	PR	HER2	Ki-67	Histological grade	Clinical Prognosis	Frequency
Luminal A-like	+	+	-	Low	Well-differentiated	Good	40-50%
Luminal B-like HER2$^-$	+	-	-	High	Moderately differentiated	Intermediate	20-30%
Luminal B-like HER2$^+$	+	-/+	+	Low/High	Moderately differentiated	Intermediate	
HER2$^+$	-	-	+	High	Poorly differentiated	Poor	15-20%
TNBC	-	-	-	High	Poorly differentiated	Poor	10-20%

Table 1. Classification of surrogate molecular subtypes of breast cancer, prognosis, and therapies. *TNBC (Triple negative breast cancer).*

MATERIAL AND METHODS

Traditionally, mouse models have been divided into **"immunocompetent models"** and **"immunocompromised models"** depending on the immune response capability. Immunocompetent mice provide a functional immune system (Bareham et al., 2021) and can be subdivided into:

1. **Carcinogen-induced model:** Mouse model generated by certain synthetic compounds that are exposed to the body via ingestion, inhalation, injection, dermal absorption, or other ways.
2. **Genetically engineered model (GEMM):** That model demonstrates the role of specific genes in tumor development. Certain genes which are strongly associated with tumor progression and development are deleted, overexpressed, or mutated, causing spontaneous tumor formation.
3. **Syngeneically transplanted model:** Transplantation model obtained by injecting a recipient of a specific genetic background with cell lines previously established through isolation of tumor cells from a mouse of the same genetic background.

Immunocompromised models present genetic mutations that cause these strains to lack a normal immune system (Okada et al., 2019) and can be subdivided into:

4. **Nude mouse model:** Nude mice lack a normal immune system and thymus gland. The reduction of T cells causes these mice to have a repressed immune system. Nude mouse models are often utilized for tissue and tumor grafts in cancer research because they don't have a rejection response.
5. **NOD/SCID mouse model:** NOD/SCID mice not only lack functional lymphoid cells but also show reduced activation of NK cells and have a less mature macrophage population. Those mice are used to transplant heterologous cells or tissues to establish model systems.
6. **SCID and NGS mouse model:** It is the most immunodeficient model described to date. It allows engraftment with human cells or tissues.

RESULTS AND DISSCUSION

In that talk, we will focus on the results obtained through the use of mouse models, specifically using **NGS mice** as an approach to study the development and progression of human breast cancer as well as the treatment of TNBC subtype with commercial antibodies currently used in the clinics. (Gómez-Aleza et al., 2020; Sanz-Moreno et al., 2021; Ciscar et al., 2023). Previous results of the laboratory indicated that **RANK**, a transmembrane protein involved in the development of the healthy mammary gland, was upregulated in breast cancer, specifically, in HER2+ and TNBC subtypes, the most aggressive types of breast cancer. Moreover, in clinical samples, we performed a survival analysis comparing patients with HER2+ and TNBC breast cancer and high expression of RANK in the tumor with patients with HER2+ and TNBC subtypes and no expression of RANK. Interestingly, we observed that RANK was a biomarker of poor prognosis in aggressive tumors proposing RANK as a potential biomarker in aggressive tumors, but…

1- What is the mechanism through which RANK is contributing to the progression of breast cancer?

In short, we collected patients' samples from the Hospital, and we implanted small pieces of those tumors into the fat pad of the murine mammary gland as xenotransplants. The lack of immune system in NGS mice allowed the growth of those patient-derived xenografts (PDXs). Once the tumors grew up to 10 mm^2, the mice were sacrificed, and the tumors were extracted. Then, we removed murine cells from the tumors (blood cells, stromal cells and others) and tumors were digested until single cells to perform RNA sequencing. From those results, we demonstrate that RANK was activating inflammation pathways (NFKB) and therefore, triggering multiple metabolic pathways making the tumors more aggressive.

2- Can we attenuate the growth of RANK-positive TNBC breast cancer?

To decipher if blocking RANK signaling pathway could be an alternative treatment for TNBC patients, we injected cells from human RANK-positive PDXs into the fat pad of the mammary gland of NGS mice. When the tumors grew up to 3 mm^2, the mice were randomized into control or drug treatments. As a drug treatment we used Denosumab, a monoclonal antibody currently used in the clinics that blocks RANK signaling. The mice were treated 3 times/week intraperitoneally. After 4 weeks of treatment, Denosumab attenuated the growth of RANK+ tumors implanted in NGS discovering a new biomarker, RANK, that can be therapeutically targeted and can be a candidate for clinical studies including breast cancer patients. In summary, the mouse is the foremost mammalian model for studying human disease, especially, cancer. The ability to manipulate the mouse genome is what makes the mouse so relevant today. Thanks to it, we can generate NGS mice, that have an unfunctional immune system, and then allows the implantation of human tissues, such as PDXs. Mice are the model of choice in biomedical research not just because they are strikingly similar to humans at the genomic level, but also, because the pathophysiology of disease in mice is similar to that of humans. Mice are a cost-effective and efficient tool to speed up research and drug testing.

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FIELD SERVICE CLINIC THEN AND NOW

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ABSTRACT

The field service clinic was established 1952 although back in 1935 assistant Rapić took a few students with his private car and went to the field a few times a week to examine and treat the animals. The operation of the Ambulatory Clinic was very simple at that time: a bus full of students, together with the teaching staff went to veterinary clinics in towns near Zagreb where they examined, diagnosed and treated animals. The core of the clinical teaching were patients in the hospital, and at that time they were abundant, and Ambulatory Clinic was planned as an adjunct clinical teaching tool. In the recent history, a lot of changes happened in agriculture, patient profile changed, the farms moved further from the capital, and suddenly we were short of in clinic farm animal patients. Restructuring, procurement of new vehicles and modern diagnostic equipment resulted in the Ambulatory Clinic becoming a Field Service Clinic, a core subject for hands-on work with farm animals.

KEYWORDS: Ambulatory Clinic, farm animals, Field Service Clinic

The Early Days

The Faculty of Veterinary Medicine in Zagreb was founded over 100 years ago and is one of the oldest veterinary schools in this part of Europe. Clinical teaching has always been the core of our faculty, but as in other veterinary schools around the world, things have changed significantly over the years. The biggest change was in the animal species presented at our faculty clinics, which has changed from almost exclusively livestock and work horses to mostly small animals and horses. Lately there has been only a small number of farm animals admitted to our faculty clinics, which presents is a major problem in teaching farm animal clinical practice. Fortunately, we have a Field Service Clinic at our veterinary faculty, which has been a centerpiece of our clinical teaching of farm animals in recent times (Pavičić, 2019).

The Field Service Clinic was established a long time ago. The first field service provided by our faculty clinicians took place between 1935 and 1939, and it all started with helping people in certain areas near Zagreb, and was free of charge for the animal owners. Assistant Stjepan Rapić took a few students with his private car and went to the field a few times a week to examine and treat the animals. Soon he realized that in this way the students were learning a large part of veterinary medicine that was not really taught at the faculty, and he first called it external ambulatory work. During the Second World War these activities were put on hold until 1949, when Professor Rapić was appointed to be a part of a team chosen by the Faculty Council to visit the main European veterinary faculties in order to help design our new faculty campus. During these visits he found that the majority of the schools they visited had field service clinic, at that time it was called an ambulatory clinic. Three years later Faculty of veterinary medicine in Zagreb purchased a bus and new department was founded, the department was named Ambulatory Clinic and was organized in the same manner until five years ago. The operation of the Ambulatory Clinic was very simple at that time: a bus full of students, divided into four groups, together with the teaching staff of the four clinical majors (internal medicine, surgery, reproduction and infectious diseases) went to veterinary clinics in towns near Zagreb, where the owners brought the sick animals

to the town clinic. There students and faculty staff clinically examined, diagnosed and treated them. The field teaching was additional teaching tool to the clinical teaching in the faculty clinics. The treatment of patients in the faculty clinics was much more elaborate, more advanced diagnostic tools were available, the treatment in the clinics was also much more involved and performed according to the latest medical practices. Students had to be made aware that in the field clinic practice they would have to rely on a much simpler diagnostic procedure, and that treatments often had financial and technical limitations. For all of the aforementioned reasons the outpatient clinic was a very important part of veterinary student education, teaching students, among other things, that there is a difference between treating patients in the clinic, what we today call the referral clinic, and treating them in the field clinic, what is today called the first opinion clinic (Carr, 2022).

The Problems

Over time, the operation of the field clinics where we took our students changed, and the most important change was the gradual reduction in the number of animals brought to the field clinics. More often the veterinarians went directly to the farms, which meant that we were taking a bus full of students to the farms, which gradually proved to be a problem. The problems with these "home visits" were many; first and foremost, it was much more time consuming for us to visit the farms directly, but it also meant more time per case (driving and all) for the local veterinarian who prepared the cases for us in his area. Because of the way we were and still are organized at the Faculty of Veterinary Medicine in Zagreb (by subject and not by species), this meant a lot of waiting time for the faculty staff, because while the surgeon was working on a surgical case, the other were waiting for their case, and this waiting meant that the veterinarian was also waiting for us, as the owners were reluctant to allow us to deal with the patient without their veterinarian being present. Because of the low acceptance of the owners and the fact that the veterinarians, on the one hand, got little benefit from our work (we treated four patients a day) and, on the other hand, had to take care of the rest of the patients after we left, often working beyond his office hours, we gradually noticed a significant decline in the number of local veterinarians interested in participating in the clinical teaching.

The Change

Then there were political changes, the war, agricultural reform... and so the farms got bigger and big farms started to have their own veterinary service and management often turned down visits of such large groups of students.The number of cattle was plummeting nationwide, the number of working horses was minimal, and the number of sport and pleasure horses was not increasing as rapidly as it should have. And to make the problem even bigger, the number of working animals and horses being admitted to the faculty clinics was declining rapidly, partly because of the statewide decline in cattle numbers and partly because of the rapid urbanization of the area within 50 km of the veterinary faculty. So, for a while we really struggled to find enough farm animal and equine patients to teach. Although the faculty clinics have a small number of large animal patients, we managed to get a sufficient number of the above-mentioned patients, often due to the personal efforts of faculty from the Ambulatory Clinic. Things changed for the better about 5 years ago when 4 minivans were purchased that allowed 4 teams to be formed, one for each subject, and each team drove directly to the farm agreed upon with the field clinic veterinarians.

The new term the Field Service Clinic was introduced with the beginning of the study program in English, because the term Ambulatory Clinic is no longer appropriate, because realistically we are doing field service. After the purchase of the minivans, some EU funds were awarded to us that allowed us to purchase equipment that we did not poses before, such as a mobile digital X-ray machine, a portable ultrasound machine with multiple probes that allows us to do orthopedic, abdominal and cardiac echography, a repro-ultrasound machine, a mobile centrifuge, a mobile cow crush for orthopedic work and a video endoscope; basically, we are now able to treat both first-opinion patients and referral patients directly on the farm.

Present Day

The teaching process has greatly improved as we are able to teach more hands-on topics on the farm with the new equipment. Since majority of the results are available immediately, students are also involved in making diagnoses and solving problems.
So, in summary, clinical teaching in large animals has improved significantly since the purchase of the new minivans and modern diagnostic equipment. Students during the Field Service Clinic visits to farms get see patients as first opinion patients as well as patients that require on referral workup. Unfortunately, students very rarely see the inpatient care, management, and critical care of large animal patients. We are aware that this is a problem and we have a plan to address this problem in the future, but for now we are very fortunate to have the field service clinic, which has gone from an adjunct teaching tool to a core subject for hands-on work with farm animals.

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OVERCOMING COMMUNICATION BARRIERS

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ABSTRACT
Effective communication between students and faculty staff, as well as between students themselves, is crucial for student success. However, the Z generation of students (born from 1996 to 2012), who are the first generation to have grown up with the internet, prefer social media and concise information. This study aims to identify communication barriers and preferred communication channels among Z generation students to improve communication with faculty staff. The study has two major goals: firstly, to detect possible noise in oral communication through a practical part and secondly, to reveal Z generation's preferred communication channels with their respective sources of misunderstanding. Data was collected through a quantitative survey administered to 86 first-year students at the Faculty of Veterinary Medicine University of Zagreb, Croatia in January 2023. The results of the study show that Z generation students face various communication barriers, including noise in digital communication channels. To overcome these barriers, the study recommends: (1) improving the organization and timely publication of information on the Faculty's website, (2) enhancing campus Wi-Fi coverage, and (3) encouraging students to pay greater attention to official communication via the official email address. In conclusion, this study highlights the need for effective communication strategies that consider the preferences and communication styles of the Z generation of students. By implementing the recommendations provided, faculty staff can improve communication with students and enhance the overall learning experience.

KEYWORDS: Z generation, social media, communication noises

INTRODUCTION AND OBJECTIVES
There is no profession, relationship or life situation where effective communication is not helpful. Good interpersonal relations are not the result of chance, but of knowing certain elements essential for successful communication and applying those elements in a specific situation. Good communication is the ability to convey our ideas and thoughts fully and clearly, and to receive/understand someone else's message. One of the most important skills in communication is the ability to recognize different types of noise and develop ways to deal with them. The purpose of this presentation is twofold. Firstly, to show how practicing active listening, speaking and understanding helps us to recognize all forms of behavior and skills that can contribute to a good mutual relationship. This includes establishing a relationship, showing genuine interest in the other person, listening skills, speaking skills, and developing mutual trust and cooperation. Secondly, to investigate how members of generation Z (born from 1996 to 2012, who are the first generation to have grown up with the internet, prefer social media and concise information), who have enrolled in the first year of Integrated study of Veterinary medicine at University of Zagreb, communicate and are they aware of possible challenges in the chosen method of communication. Furthermore, we asked them which channels they use for written communication to detect possible noises associated with the chosen channel.

MATERIAL AND METHODS

In January 2023, a survey was conducted among first-year students at Faculty of Veterinary medicine at University of Zagreb with the aim of gathering information about channels and methods of communication. The survey consisted of 15 structured questions and students filled it out through Microsoft office Forms. Thirteen questions were close ended with graduation or multiple answers, while three questions were open-ended. The survey was completed by 73 female and 13 male students, 86 in total. In this paper only descriptive data will be presented.

FINDINGS AND ARGUMENT

During high school, out of the 5 applications offered (Facebook, Instagram, TikTok, WhatsApp, Viber), students used Instagram most often for private purposes (51 %). At the same time, they mostly used WhatsApp to get information (74 %) while TikTok was on third place (10 %). This is in line with the general opinion that members of the Z generation are “true digital natives” (Francis and Hoefel, 2018), they want information as soon as possible and in as concise a form as possible (Seemiller and Grace, 2019). Most of the students (96 %) looked for information about the Faculty on the Faculty’s website. They were mostly satisfied (45 %) or partially satisfied (51 %) with the information they found. Three students were not satisfied with the information they received on the Faculty's website. After entering college, in the list from 1 (totally unsatisfied) to 5 (totally satisfied) all students gave a passing grade to websites ranging from 2 to 5.

After enrollment at the Faculty, WhatsApp became the main channel for gathering information (91 %). The claim is supported by confirmation of organized groups on WhatsApp, both for the whole year and for individual courses. Instagram changed place with WhatsApp, and TikTok is in third place. Four students stated that they still use other applications most often. It is interesting to note that no one has chosen Facebook (Messenger) as the most common channel for communication or gathering information. The results of the survey showed that today's students have changed their habits after entering Faculty. A possible cause is the influence of the new environment and/or the development of digital technology in general. Liu (2010) states that in 2010 between students of Educational Technology and University Outreach, Houston, Facebook was in first place, followed by Wikipedia and YouTube.

According to Latif et al. (2019) medical students use the mobile application for online textbooks (70%), medical podcasts (60%), medical calculator (75%), online lecture (50%) and notes taking (45%). It is like first year students in Zagreb where students mostly (84 %) use their own mobile data to access the Internet during their stay on campus (for private as well as official purposes, e.g., exams). The reason for this is dissatisfaction with the quality of the network infrastructure.

Upon enrollment at the Faculty, all students are given an email address with a vef domain. At the same time, students are informed that official communication with the institution should take place via that email address. Despite knowing that their messages, seminars and other papers or inquiries can go to junk, the majority of students still use other email addresses (e.g., Gmail, 92 %). At the same time the official vef email is rarely checked: 12 % of students check it every day, 42 %once a week, 36 %once a month, and 10 % of students never.

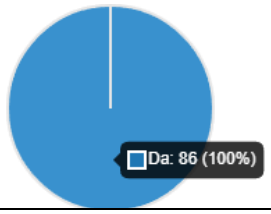
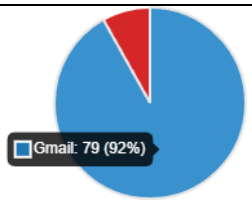
1a	1b
	

Figure 1: 100% of students confirmed vef email domain (1a) but 92% are using Gmail (1b).

CONCLUSION AND SUGGESTIONS

Verbal communication, oral or written, is subject to various noises. To overcomes communication barrier in written communication between Z generation students and Faculty staff three facts should be pointed out:

1. Faculty's web page should be well organized and up to date.
2. The Faculty must improve the campus wi-fi coverage (eduroam).
3. Students must accept the vef email as official and use it in communication with the Faculty or at least check more often.

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SAMPLE SIZE ESTIMATION FOR DIFFERENT STUDY DESIGNS IN BIOMEDICAL RESEARCH

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ABSTRACT
The sample size is an important part of research planning. Unfortunately, it is often not reported, and even when reported in journals, it is done erroneously. In addition, there is still confusion about the procedure because there is no direct, simple, universal way of calculating the sample size. However, all calculations are based on the same theory and, other than the hypothesis and study design, use the *P* level, effect size and power as a starting point. Understanding the relationship between these factors facilitates choosing the adequate calculation method, thus, avoiding negative results due to a sample not being big enough or wasting resources due to a sample being too big.

KEYWORDS: sample size, research, study design, power analysis, effect size

INTRODUCTION
Most studies use samples to estimate the influence (effect size) of the researched variable in a population. If the study included the entire population, there would be no need to estimate the effect because the effect size would be directly known. On the other side, no sensible researcher would try to predict the effect of something on a population of millions by sampling one individual, as it is well-known that very small sample sizes are unreliable estimators of a population parameter. The logical puzzle arising from these premises is what sample size is needed to detect an effect if it exists in the population (McHugh, 2008). This sample must be 'big enough' that the effect is statistically detectable but, at the same time, not 'too big' where an effect of little scientific importance is nevertheless statistically noticeable. Very often, it is important for economic reasons: an under-sized study can waste resources since the results may not be reliable, while an over-sized study uses more resources than necessary. In an experiment involving human or animal subjects, the sample size is also a critical ethical issue (Suresh and Chandrashekara, 2012). Among various potential statistical errors that might occur in any scientific research, one of the most frequently encountered is the inadequate sample size (Serdar et al., 2021). Even when reported in journals, the details or the elements for sample size calculation are inconsistent. In addition, sample size calculations reported do not match with replication of sample size in many studies. Many trials with negative results might have had different outputs if a large enough sample size had been used (Das et al., 2016). Even though the sample size justification is required for most studies, many researchers admit they lack adequate knowledge about statistical concepts and principles (Serdar et al., 2021). Although much statistical software has been developed to calculate sample sizes, researchers still seek statisticians' help. When statisticians ask them for the parameters needed for sample size calculations, they often need additional explanations to understand the need for such information and how to provide it (Zheng et al., 2017).

Factors affecting the sample size
Calculating an appropriate sample size relies on the following factors - *P* level, effect size and power. Even though each factor influences the sample size independently, it

is important to combine them to arrive at an appropriate conclusion (Suresh and Chandrashekara, 2012).

P level

The *P* level, significance level or alpha (α) value is typically set by scientific convention. The values used in most academic research studies are either 0.05 or 0.01. It represents the likelihood of a Type I error (false-positive) – the claiming that a significant effect has been found when there is no effect in the population. The lower the P level, the larger the sample size is required in a study (McHugh, 2008; Suresh and Chandrashekara, 2012).

Effect size

Effect size represents the difference between the observed groups. It refers to the minimum difference the researcher wants to detect between the groups, which would be clinically significant. The effect size could be obtained from previous studies or a pilot study. Where no previous or pilot study exists, it is determined from a literature review, expert opinions, personal experience and educated guesses. The smaller the effect size, the larger the sample size requisite (McHugh, 2008; Suresh and Chandrashekara, 2012; Das et al., 2016).

Some ways of calculating the sample size ask for the standardised effect size or Cohen *d*. It is calculated by dividing the effect size by the data's standard deviation. The variance or standard deviation is obtained the same as the effect size, from previous studies or a pilot study. The larger the standard deviation, the larger the sample size required in a study (Suresh and Chandrashekara, 2012; Zheng et al., 2017).

Power

Power refers to the likelihood that a study will find a significant result (an effect/a difference) between groups if it exists, and, likewise, if the study demonstrates no difference between the groups, the researcher can be reasonably confident in concluding that none exists. It ranges from 0.0 to 1.0 (ß). These values cannot be interpreted directly, but a Type II error (false-negative) probability is calculated as 1 - ß. Conventionally, power is often set at 0.80 (80%), giving a Type II error probability of 1 – 0.80 or 0.20 (20%). It positively correlates with the sample size, meaning greater power requires a larger sample size (McHugh, 2008; Suresh and Chandrashekara, 2012; Das et al., 2016).

How to calculate the sample size

The study design and hypothesis are other factors that will influence the approach of sample size calculation. Whether there is just one single group mean, or the study is comparing two means or two proportions or is using correlation coefficient, prevalence or odds ratio, the researcher needs to provide additional information other than the three main factors, such as prevalence or proportion, precision (or margin of error), standard deviation, the accuracy of estimate (or how close to the true mean), the ratio of the sample size required for two groups (1 - if the groups are equal), whether the variable is continuous, and others (McHugh, 2008; Suresh and Chandrashekara, 2012; Charan and Biswas, 2013; Das et al., 2016; Zheng et al., 2017; Serdar et al., 2021; Naing et al., 2022). The standard normal variate for the level of significance (*P* level) or for power are constants (according to the values of α and ß) and can be obtained from tables (Suresh and Chandrashekara, 2012; Das et al., 2016).

Once the main three factors are fixed, and all additional information is obtained, there are more options for estimating the optimal sample size: formulae, nomograms, tables and software. The formulae are quite easy to use, but many sample-size calculators are currently available as online or downloadable software (McHugh, 2008; Charan and Biswas, 2013; Das et al., 2016; Naing et al., 2022).
Adequate sample size will result in more reliable, valid and generalisable results. However, researchers may be forced to use an inadequate sample size for practical reasons like budget, time, personnel, and other resource limitations. If so, the researchers should report both the appropriate sample size and sample size used, alongside the reasons for using inadequate sample sizes. They should also be careful when discussing the results and drawing conclusions due to the insufficient sample size potential effect on them (Suresh and Chandrashekara, 2012).

Conclusion

The sample size justification is nowadays required for most studies. There is no direct, simple, universal way of calculating the sample size; it depends on the hypothesis and study design. However, all calculations are based on the same theory and use the following factors as a starting point: *P* level, effect size and power. This presentation will be focused on explaining the relationship between these factors and choosing the adequate calculation method according to the study design.

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LIFE SKILLS IN VETERINARY EDUCATION – HOW TO GET THEM? LESSONS FROM THE SOFTVETS PROJECT

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ABSTRACT
Life skills are essential for an effective and satisfying performance and continuous modernization of veterinary profession while deriving new forms of employability, flexibility and security for veterinarians. Recent studies have demonstrated that life skills are becoming as important as hard skills when searching for a job in veterinary medicine. At present, on numerous establishments for veterinary education curricula are heavily focused on developing Day 1 skills of students, with “hard” skills being the most important ones. However, facing the challenges of an ever-changing world raises the question: Is medical expertise sufficient to become a good veterinarian? What competences does the student of the future need for their everyday work? Moreover, what does this mean for veterinary education and to what extent should the curricula be changed? The SOFTVETS project offered options for re-imagining veterinary undergraduate curricula. By establishing recommendations of life skills competences, building a suggestion of a life skills curriculum in three competence areas, designing a training concept for teachers and evaluation methods, the SOFTVETS project has made a critical starting point for implementation of life skills into veterinary curricula.

KEYWORDS: life skills, veterinary education, communication, entrepreneurship, digital competences

INTRODUCTION
Recent research and surveys amongst veterinarians show an increasing need for the integration of life skills training in veterinary education (FVE, 2018). The World Health Organization has defined life skills as, "the abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life" (WHO,1996). According to many surveys (FVE, 2017), a number of areas that indicate ‘either a lack of awareness or a lack of understanding of the importance of core business, legal and financial matters’ impact veterinary profession(als). Public expectations and perceptions need to be understood and managed, and veterinarians need to improve their communication skills in all areas of their business. The online presence and participation in the virtual market seems to be also underutilized by the profession. Research review made by Pun (2020) suggests that veterinary practitioners are not equipped with specific communication skills to address different agendas in veterinary communication. The veterinary curriculum should include a

component on communication training that can help veterinary students acquire necessary communication skills that allow them to effectively communicate with clients and other professionals. Qualities such as ethics and moral responsibility, critical thinking, self-development and lifelong learning, as well as interpersonal skills and good communication seem to have become qualities required by employers of early career veterinarians (Perrin, 2019). The goal of SOFTVETS project was to create a framework, and produce an ideal version of the new life skills curriculum that would be applicable in veterinary higher education throughout Europe.

METHODS

The project team focused on three areas outside the medical expertise that we deducted students need training in: communication, digital and entrepreneurial skills. The team worked highly interdisciplinary, involving veterinarians, psychologists, communication, educational and entrepreneurship experts as well as veterinary students. The project team extracted the positive aspects of various veterinary curricula throughout Europe, which vary considerably, emphasizing the most common topics and competences that should enter future competencies curricula. Competence model was derived after an iterative consultation process including veterinary experts, as well as experts within the field of the addressed competence areas. The curriculum part is theory-based and data based (literature on life skills in biomedical sciences, surveys among teachers, practitioners and students, reviews of existing curricula in veterinary establishments of Europe). It was also based on recent developments in the European higher education area, European Qualifications Framework, as well as FVE and EAEVE position papers. The training concept is a result of three training courses held over three days by experts in each of the mentioned areas, and summarized as a handbook for training.

RESULTS

Intellectual output 1 „Recommendations of life skills competences for veterinary students“ provides recommendations of life skills competences for veterinary students in three key areas: communication, digital skills and entrepreneurial skills. The list of competences applies to higher education in veterinary medicine and can be integrated in whole or in part into existing curricula. The established SOFTVETS competence model includes 10 communication competences, 8 digital competences, and 9 entrepreneurship competences addressing cognitive and practical aspects in 4 levels (Foundation, Intermediate, Advanced, Expert). The SOFTVETS project creates a framework for continuous innovative advancement of veterinary undergraduate curricula in Europe by introducing a competence training program. The SOFTVETS competence model should help educators to be able to integrate the training of key competence training into the veterinary curriculum. The detailed list of competences can also be used as a tool to identify existing deficiencies and thus enable further curricular changes. Intellectual output 2 „Life skills curriculum for implementation in veterinary higher education“ provides a suggestion of a wholesome life skills curriculum that can be implemented as a whole or using a modular approach. The Curriculum includes three courses syllabi in three sections: Communication skills, Entrepreneurship skills and Digital skills. It is prepared for veterinary teachers, teacher trainers and students as well as faculty management and regulating bodies. The aim of this document is to aid implementation or integration of proposed syllabi in existing curricula. Curriculum is competency based, focused on student learning outcomes, it is flexible (includes ideal version but also core components for reduced version) and

the structure of the Curriculum is clear and easy to comprehend for all included stakeholders (management, teachers, students and staff included in Curriculum implementation). Intellectual output 3 „Training concept for education of teachers involved in life skills teaching" provides training concepts for education of veterinary teachers involved in life skills teaching in 3 areas: Communication, Digital skills, Entrepreneurial skills. Training concepts are also suitable for teachers of any veterinary subject wishing to upgrade their teaching techniques. The training ensures that teachers acquire new knowledge on topic of specific life skills, gain an insight how these topics are taught elsewhere and obtain ideas they can include in their everyday teaching. The templates of training concepts need to be adapted to local circumstances, facilities and possibilities. They contain competences recommendations for teachers, intended learning outcomes, recommendations of teaching tools, techniques for adapting teaching methods for different scenarios, settings and outcomes and help to encourage the use of new teaching techniques of soft skills in effective communication with students. Intellectual output 4 „Evaluation tool for pilot implementation" consists of the SOFTVETS Evaluation Questionnaire for Students and the SOFTVETS Reflection Questionnaire for Teachers. The Questionnaires were developed for higher education institutions that aim at evaluating competence based courses. The SOFTVETS Reflection Questionnaire for Teachers can be used in two different ways, either as an additional feedback to the management or as individual reflection for teachers.

Conclusions

Through SOFTVETS project, a quality starting point was made to make better use of the time students spend in their veterinary schools, and the results might help teachers, as well as management to equip both teachers and students with the new skills they need. It should also enable decision makers to help young veterinarians to find quality jobs and improve their life chances. The general conclusion of the project might be that equipping veterinary students and professionals with tools for advancing their life skills should be one of the main steps of advancing the veterinary profession in Europe.

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COMPUTER BASED PRACTICALS IN DOMESTIC ANIMALS PHYSIOLOGY EDUCATION

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ABSTRACT
Modern teaching methods starting from the elementary schooling systems to High education focuses on cognitive thinking and the development of new patterns of learning. This teaching emphasises students ability to solve problems themselves. In short, teacher become more an advisor and supervisor in acquiring the knowledge. In Animal Sciences, there are a wide variety of teaching methodologies but in some subjects, such as Veterinary Physiology, it is necessary to complement the theoretical lessons with practical work and many of them would require the use of live animals. Due to raising ethical and moral concerns, European society does not accept the unjustified use of animals. Furthermore, the legislation limits the use of laboratory animals for teaching and research purposes. Additionally, some of practical work would be costly, long lasting with ever present problems of ensuring biosafety protocols. Regarding all mentioned, the use of computer simulations is increasing and is highly welcomed. In physiology teachings computer simulations are providing the possibility of self-learning and better understanding of physiological processes by replacing or reducing the use of animals in vivo, organic materials, reagents, etc. In courses Physiology of domestic animals, I and II, on Faculty of Veterinary Medicine, University of Zagreb we are using one such software – PhysioExTM 10.0. This software provides easy-to-use laboratory simulation activities which, allows students to understand more easily complex physiological processes. We also use Biopac Student Lab system, an integrated set of software and hardware and guided physiology lessons which students use to record physiological data. Both methods will be further discussed in this lecture. Using of computer based practical have some great advantages – they are without the risk of harming animals or students and all at an affordable cost with minimal necessities. However, this type of tools can have disadvantages such as the lack of manipulation of equipment, animals or samples, which should be compensated in other types of practical work. In conclusion, computer-based practicals in Veterinary Physiology are valuable tool but should not replace practical work in total.

KEYWORDS: simulations, computer-based learning, physiology of domestic animals

INTRODUCTION

Modern teaching methods starting from the elementary schooling systems to High education focuses on cognitive thinking and the development of new patterns of learning. This teaching emphasises students ability to solve problems themselves. In short, teacher become more an advisor and supervisor in acquiring the knowledge. In Higher Education, especially in Biomedical Sciences, there is a wide variety of teaching methodologies, such as lectures, seminars, tutorials, directed work and laboratory practices (García-Vázquez et al., 2018). In Veterinary Physiology, for a better understanding of the processes, many exercises or practical lessons require the use of live animals. While this is clear to everyone, Croatian and European legislation limits or forbids the use of live animals for teaching and research purposes (Directive

2010/63/EU, 2010). Even though the use of live animals would be permitted, some of these exercises would be costly, involve a large number of animals or require prior experience in the handling of animals and therefore biosecurity problems. Because of all mentioned, the use of computer simulators is increasing in replacing or reducing the use of animals *in vivo*, organic materials, reagents, etc. (Rawson & Quinlan, 2002; Ruiz et al., 2009; García-Vázquez et al., 2011). The use of simulators as an educational tool is showing a high acceptance among students and professors (Abraham et al., 2018; Grupta et al., 2018; Sawatsky et al., 2017). Universities and other institutions all around Europe have incorporated this kind of learning and teaching tools to help training health care professionals. This type of self-learning method can be used as teaching tool but is also motivating students to be more active or included, providing them deeper understanding of a given subject but also will add to development of critical thinking, communication and problem solving. The learning through simulators in which they have to understand and solve situations in a collaborative way with their colleagues improves the training of good professional skills to face future situations. Although necessary, computer simulations can have disadvantages such as the lack of manipulation of equipment, animals or samples, which should be provided in different types of practical exercises.

PhysioExTM

In Physiology of domestic animals I and II first implementation of PhysioExTM simulator were carried out during the academic year 2003-2004, and the newest version, PhysioExTM 10.0, during the 2022-2023 academic year by using the computer classroom of the Faculty of Veterinary Medicine, University of Zagreb. During the simulation practical, students are divided in groups of 10. Each student have a computer to carry out the practice and discuss collaboratively the results with their colleagues. After the completion of the practical, the results are discussed with a teacher. PhysioExTM 10.0 software consists of 13 modules containing a total of 40 physiology laboratory simulations that can be used to complement and/or replace laboratory practices. On the Physiology of domestic animals I we are using of PhysioExTM in the practices of the subjects: Transports across the cell membrane, Muscle System Physiology, Nerve System Physiology, Endocrine physiology – replacement therapy and on the course Physiology of Domestic Animals II of Cardiovascular and Renal Systems. This simulations allowed us to complement the theoretical and practical contents previously taught in lectures which would be impossible to conduct *in vivo* without previous extensive laboratory (transports across membranes), surgical (neural transmission) or animal handling knowledge. Some of them would be financial or time costly, or would require animal sacrifice (physiology of cardiovascular system) (Piršljin et al., 2004). In this type of learning sessions the students could distribute the time dedicated to each exercise as their wish, repetition and redoing the experiment until total comprehension and at the end, comment it with the leading professor and with a colleagues. In addition, the software is developed in English, which allows non-native English speakers students to practice and learn the specific terminology and also laboratory protocols. To aid in the progress of the practice and its understanding, the students were provided with a detailed protocol in Croatian consisting of an introduction on the aspects to deal with, the basic concepts that would be handled and how to perform each exercise step by step. Finally, the students were individually evaluated about the comprehension of the subject by performing an oral questioning.

Although it is understandable that the use of the simulator requires a greater effort by the students to understand and simultaneously integrate the concepts of physiology, it is used within the hours of practices previously established in the teaching program.

BIOPAC StudentsLab

Along with a simulations, in courses of PDA I and II we are using computer Biopac students lab. **The Biopac Student Lab (BSL)** system is an integrated life science teaching solution that includes hardware, software and that students use in practicals/exercise to record data from their own bodies or animals. In our course we are using Biopac mostly on students. The BSL system includes over sixty-five complete lessons that can as part of practical lab courses. In BSL lessons, students are fully engaged through all of the exercise – as a subject of a research, assistant, and doctor and we could say, it is a great example of active learning. So BSL is more like practice tool for real life, clinical diagnostic procedures as electrocardiography, electromiography, electroencephalography and spirometry then a simulator.

In PDA I we are using the BSL in two lessons EEG and EMG, and in PDAII we are using it for ECG and spirometry.

BSL software guides students through BSL lessons with full-color onscreen instructions, a detailed lab manual, and embedded procedure videos and data samples. Once students collect data, together with a teacher they use included software tools to measure the amplitude and frequency, plus a wide range of other values from the electrical signals. At the begging of the exercise professor familiarize the students with procedures, hardware and software. During the second part, students under the supervision record data from other student's body. Each experiment is designed so that every student has the opportunity participate equally as Recorder, Subject, and Director. So not only the students understand the physiology behind diagnostic procedure (action potential transmission) but they also acquire the experience of diagnostician. This will deepen their knowledge about electric impulses conduction through different tissues but also, help them understand the importance of thorough understanding of basic physiology knowledge in clinics and diagnostic. Additionally, they will see the importance of correct electrode placement, adherence of the electrode and all other per-measuring steps and their effect on data quality. After the measures students can compare their results to published normal values, or the values before and after a subject performed a specified task. They can even compare their results with other students in the lab, and completed data reports can be saved. This option will give them an opportunity of understanding physiological intervals or that every subject is different although healthy which will contribute to acquire Day One Competences.

CONCLUSION

Using of computer based practical have some great advantages – they are without the risk of harming animals or students and all at an affordable cost with minimal necessities. However, this type of tools can have disadvantages such as the lack of manipulation of equipment, animals or samples, which should be compensated in other types of practical work. In conclusion, computer-based practicals in Veterinary Physiology are valuable tool but should not replace practical work in total.

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CLINICAL SKILLS LAB – A SAFE AND PROTECTED ENVIRONMENT

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ABSTRACT
Studying veterinary medicine is usually exhausting and demanding, and acquiring some of the professional skills can be challenging and stressful for the student. The European Association of Establishments for Veterinary Education (EAEVE) defines basic professional competences. Learning on simulation models in skills lab combines previously acquired theory that can be deepen, and practice and it can provide realistic but protected environment. Exercise in a stress-free environment, as well as the possibility of transferring knowledge from student to student, is the basis of quality acquisition of knowledge and skills.

KEYWORDS: education, students, clinical skills lab

INTRODUCTION
Studying veterinary medicine is usually exhausting and demanding, and acquiring some of the professional skills can be challenging and stressful for the student. Students of veterinary medicine should achieve basic professional competences required to work in their profession, and acquisition of these competences is a fundamental goal of the study of veterinary medicine, the main focus being the development clinical skills. Acquiring clinical knowledge and skills in veterinary medicine is often related to stress because of the desire for the patient's well-being and the student's fear of harming the patient (Braid, 2022). Also, there is often the pressure of the owner, as well. The European Association of Establishments for Veterinary Education (EAEVE) defines basic professional competences. Graduates of veterinary medicine at day one after finishing their studies should know and be able to perform those skills.
Traditional education systems did not provide students with sufficient support in acquiring some of the skills, such as theoretical knowledge, manual skills, professional attitude, communication skills and critical thinking. Learning on simulation models in skills lab combines previously acquired theory that can be deepen, and practice and it can provide realistic but protected environment. Introduction of skills laboratories in education system started in early 1970s when medical universities in Maastricht (Netherlands) and in Illinois (the United States of America) introduced clinical skills labs and since then the idea of forming a skills lab has been spreading and developing (Brombacher-Steiert et al. 2021; Grevemeyer, 2018).

CLINICAL SKILLS LAB (CLS) ON FACULTY OF VETERINARY MEDICINE
The Faculty of Veterinary Medicine, University of Zagreb started working on the Clinical Skills Lab (CLS) establishment in 2019 by purchasing training models with the financial assistance of two large projects. But the founding of such an establishment is not as simple as just acquiring models. With the delay caused by the earthquake and the pandemic, it took 3 years to adapt the old premises and open the Clinical Skills Lab in 2022. At the University of Veterinary Medicine Zagreb students of 6th and later semesters can use the CSL both with supervision of teachers and other students in practical of some subjects and on their own, with opportunities to practice repeatedly.

Repeated practical lessons on living animals are often not possible for ethical reasons and the Clinical Skills Lab therefore provides students with a safe environment to learn, practice and be observed performing skills. Also, CSL helps teachers change their pedagogy from theory-based to competence-based.
Our CSL extends to 80 m^2 and includes several dog mannequins for CPR training, general examination training, two models for bitch ovariohysterectomy, models for blood collection, horse intestines and horse model for rectal examination, horse head for blood collection, ultrasound and endoscope for examination on models etc. Besides commercial mannequins students and teachers are encouraged to make simple but effective models, text and video materials for practice that promote joint effort, constructiveness and togetherness.

CONCLUSION

Exercise in a stress-free environment, as well as the possibility of transferring knowledge from student to student, is the basis of quality acquisition of knowledge and skills.

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SUSTAINABLE MANNEQUINS FOR TEACHING VETERINARY STUDENTS BASIC CLINICAL SKILLS

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ABSTRACT
Mannequins are an excellent tool for teaching students clinical skills as comply with the 3R-principle (Replacement, Reduction, Refinement). However, the main disadvantage of commercial mannequins is their cost. To overcome this obstacle, Do-It-Yourself (DIY) mannequins are being designed and used for student teaching purposes. This approach not only helps care for the animal's welfare but also helps students acquire basic practical skills in a sustainable way.

KEYWORDS: affordable, education, mannequin, simulator, veterinary

What are the advantages of using mannequins?

To familiarize students with animal handling and clinical and diagnostic procedures, live animals are used in Veterinary Schools. The use of live animals should be considered a "gold standard" of this type of teaching since it allows to teach future specialists how to approach the animal, its subjection, interpretation of reactions, the type of care that must be taken with each species and how it should be treated without causing additional stress and/or pain, among many other issues. However, many teaching centers have a limited number of animals for these purposes, mainly due to space and economic issues. Therefore, the repeated handling of the same animals for different procedures (especially invasive such as blood sampling) by a number of inexperienced students can affect the well-being of these animals. For this reason, different teaching associations of Veterinary Schools currently recommend that students practice different procedures (even if they are minimally invasive or that could compromise the animal's welfare in some way) with simulators before working with live animals. In this way, when approaching a live animal even for the first time, the students already have the basic skills, minimizing the possible harm and/or stress of the animal, accidents and stress of students (Tvarijonaviciute et al., 2022). Furthermore, the use of mannequins contributes to the 3R principle and improves ethical, curricular, financial, and logistical factors (Martinsen and Jukes, 2005; Noyes et al., 2021).

Do-It-Yourself (DIY) mannequins- Why and How?

Currently, different commercial mannequins have appeared on the market designed to teach different clinical procedures such as blood collection, intubation, and rectal examination. However, commercial solutions are often expensive and therefore unaffordable to many schools, or at best, schools must select the most necessary model and leave others aside. To improve this situation, different open-source DIY solutions have been developed (Capil'e et al., 2015; Anciuti et al., 2021; Silva et al., 2021; Tvarijonaviciute et al., 2022). DIY mannequins offer the same or similar benefits as the commercial ones, are well accepted by students and professionals, and are more environmentally friendly and sustainable (Tvarijonaviciute et al., 2022), since they can be constructed on-site, and from recycled materials.

The materials required to manufacture the mannequin can vary greatly depending on the training technique for which they are designed (Tables 1-3). The following examples of low-cost DIY mannequins can be used to train veterinary students different procedures:

1. **Mannequin for blood collection** (Tvarijonaviciute et al., 2022)

What needed? The materials needed to make the mannequin are detailed in Table 1.
How? To perform the mannequin, first, the seam that connects the head with the rest of the stuffed dog's body is undone, and a piece of cloth is sutured to prevent the stuffing from coming out of the head. Afterwards, the neck structure has to be performed by cutting to adapt the shape of the floral sponge, which is later covered by two layers of protective roll and the latex (simulating the veins) and plastic ("trachea") tubes are added. Afterwards, the entire block is inserted into the stuffed animal's neck area and the "vein" tubes are exteriorized. At one end of the tube, a Y-shaped connector is incorporated to connect a tube making a loop so that the liquid does not come out and the pressure is maintained. While the second end is connected to the bottle filled with coloured water mimicking blood. Finally, a piece of cloth (similar to the stuffed cape) is sutured on one side of the neck, while on the other side, the Velcro is incorporated permitting easy access to the confectioned neck block.

Table 1. Materials used for mannequin confection.

Mannequin part	**Material**
Body	Stuffed dog (can be recycled)
Prevent stuffing	Piece of cloth (recycled)
Musculature	Protective roll for corners 1m
Trachea	Flexible light grey PVC bend for tube (20x300 mm)
Neck Structure	Floral sponge
Veins	Latex tube (6x9mm)
Connectors	Connectors for latex and plastic tubes (8mm, 8 pieces)
Transparent tube	Flexible PVC tube 3m (7x9mm)
Reservoir	Empty plastic water bottle (recycled)
Neck skin	Piece of cloth like the stuffed dog (recycled)

2. Mannequin for Robert Jones bandage training

This mannequin has been developed to represent the joints of the limbs of dogs and cats so that the student can perform a physical examination by palpation of each joint and placing a Robert Jones bandage, which is useful for patients with limb fractures.
What needed? The materials needed to make the mannequin are detailed in Table 2.
How? To make the mannequin, first, the supporting skeleton is made in accordance with the measurements of the stuffed toy selected, using planed spruce slats to simulate the bones (spine, humerus, radius, ulna, femur, tibia, fibula, carpus, tarsus, metacarpal/tarsal, phalanges) and metal plates to simulate the joints. Next, the seam on the back of the mannequin's body, from head to tail, is undone. The stuffing is then removed from the mannequin, the supporting skeleton is put in place and the stuffing is put back in. Finally, a zipper is sewn permitting the opening of the mannequin in case needed.

Table 2. Materials used for mannequin confection.

Mannequin part	**Material**
Body	Stuffed dog
Bones	Planed spruce slats (18x34 mm x 2.4M)
Joints	Metal plates (x24 pieces; 2 plates per joint)
Mannequin lock	Zipper*

3. Spay simulator (MacArthur et al, 2021):

This simulator allows to practice of each step of the ovariohysterectomy and to commit errors, for example, in the process of making an incision, exteriorising the ovarian artery by breaking the suspensory ligament, exteriorising the uterine corpus and sectioning the uterine corpus.
What needed? The materials needed to make the mannequin are detailed in Table 3.
How? A disposable aluminium baking pan is filled with the material simulating the following abdominal structures: the urinary bladder, omentum, ovary, ovarian artery, suspensory ligament, and uterine horn. The ovarian artery is connected to the reservoir containing coloured water. In this way, the spay simulator allows for errors, as if ovarian artery is not ligated correctly, a simulated haemorrhage occurs. Finally, the baking pan is covered with flannel-backed vinyl, cotton batting and microsuede mimicking the skin and subcutaneous tissues.

Table 3. Materials used in model construction with correlating anatomic structure.

Mannequin part	**Material**
Abdominal cavity	Disposable aluminum baking pan
Uterus	Silicone penrose drains (18¨x0,5¨, 2 pieces)
Ovarian artery, Uterine vessels	Butterfly catheter (18g, 2 pieces)
Ovary	Capacity blinder clip (1¨)
Suspensory ligament	Rubber band (1/2¨, 2 pieces)
Urinary bladder	Latex water balloon
Omentum	Disposable examination gloves (3 pieces)
Rectus abdominus	Flannel backed vinyl (9¨x12¨)
Subcutaneous tissue	Cotton batting (9¨x12¨)
Skin	Microsuede (9¨x12¨)
Reservoir	IV fluid bag and line (500 ml)

Overall, the low-cost DIY mannequins are easy to make, affordable, sustainable and allow veterinary students to acquire basic clinical skills of different procedures according to the 3R principles.

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ORAL PRESENTATIONS

ACTIVE LEARNING METHODOLOGIES AND DIGITAL ASSISTING TOOLS: A PARTICULAR EXPERIENCE WITH DREAMSHAPER®

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ABSTRACT

Under Bologna Process, student-centred learning considers a set of elements, including an inspiring learning environment, based on pedagogical innovation and digital technology. Digital education is thus the result of the combination of the technology used, the digital content proposed and the teacher's tutoring throughout the resolution of the challenges or projects proposed to the student (Kokotsaki, 2016; Wood, 2003).

In order to extend the learning process to other methods than the classical strict transmission of information by the teacher, the use of interactive and flexible (adaptable to different activities) software makes it easy for the student to learn, following their own style, which seems to boost academic success (Torralba, 2020).

The use of active learning methodologies enables a wide development of competencies (soft skills included) and a deep construction of knowledge. In this context, digital resources can assume a facilitating role in the teaching-learning complex process, equipping students for educational and training success. Digital education is a facilitator for the application of Project Based Learning (PBL), promoting the construction of learning through group discussion of a problem/project (Kokotsaki, 2016; Wood, 2003; Torralba, 2020).

Although PBL is a recognized strategy for increasing student engagement and success, it is complex to organize and benefits from being tailored to each student or group of students. In this context, the simultaneous use of pedagogical digital platforms and PBL is advantageous and enables us, as teachers, to apply and systematize good practices in PBL implementation.

Our Veterinary Medicine program is based on a strong active learning methodologies component. Our aim with this communication is to share some of our experience, using the example of DreamShaper® as an online tool to assist in the PBL application in veterinary medicine classes.

KEYWORDS: problem based-learning, active learning methodologies, digital tools, veterinary medicine

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EDUCATION AS THE ROLE OF VETERINARIANS IN WILDLIFE PROTECTION

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ABSTRACT
Wildlife protection plays a crucial role in preserving biodiversity and ensuring animal welfare, especially in urban and suburban areas. One effective strategy for improving wildlife care involves the establishment of rescue and rehabilitation centers. These centers rely on the expertise of veterinary technicians and veterinarians who possess specialized diagnostic, therapeutic, and caregiving skills for different wildlife species.
The Faculty of Veterinary Medicine at the University of Zagreb has made significant contributions to wildlife care and rehabilitation through the "Improvement and Increasing of the Wildlife Rescue Centre Capacities – WildRescueVEF" project. Education was one of the primary goals of this project. The focus was on training staff members in wildlife rescue centers to enhance their abilities in animal rehabilitation. Additionally, the project aimed to educate the general population, other veterinarians, volunteers, and students.
The veterinarians and veterinary technicians on the project team received education and training through workshops, conferences, and online courses specifically designed for wildlife rehabilitators. They also shared their expertise with national and international rescue centers, fostering knowledge exchange. The next step following the training of the project team is to educate the general population, particularly young people, through interactive workshops, public events, festivals, popular lectures, and social media platforms. The education of veterinarians during workshops and direct training sessions focuses on field work, animal handling and transport, emergency and critical care, and emphasizes the importance of biosafety measures in all educational activities.
The success of investing in the development of veterinarians' wildlife-related skills can be measured by the increasing number of calls received for wildlife rescue and the growing number of successfully rehabilitated animals reintroduced into their natural habitats.

KEYWORDS: wildlife, protection, education, veterinarian skills

CASE REPORT AND SOAP NOTES: EOSINOPHILIC BRONCHOPNEUMOPATHY IN TWO DOGS

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ABSTRACT
The goal of this case report is to describe an uncommon disease in dogs in the manner of SOAP (Subjective, Objective, Assessment and Plan) method to mark the importance of appropriate case presentation in reaching a final diagnosis (especially for students) (Sol et al. 2021). The case report describes two patients with the diagnosis of eosinophilic bronchopneumopathy. Eosinophilic bronchopneumopathy (EBP) is a disease entity characterized by inflammatory lung and bronchial mucosa disease in which the eosinophils are the predominant infiltrating cells (Podder et al.2023). The disease is considered a hypersensitivity response (Clercx and Peeters, 2007). Two dogs, a golden retriever (1 and a half years old) and a doberman pinscher (2 years old) presented with the previous diagnosis of pneumonia not respoding to antibiotic treatment. S (subjective) problems were coughing, history of pneumonia, vomiting, inappetence and fever. O (objective) findings included increased lung sounds during physical examination, fever and respiratory distress in both dogs, while the doberman pinscher's tongue was slightly cyanotic. Review of the previous diagnostic results revealed pneumonia diagnosed by x – ray, leukocytosis and increase of CRP concentration. A (assesment) led us to the following differential diagnosis: pneumonia (bacterial, parasitary or mycotic), eosinophilic bronchopneumopathy, pulmonary fibrosis or granuloma, and neoplasia. P (plan) included the following diagnostics: physical examination, blood examination, diagnostic imaging, bronchoscopy, blind bronchoalveolar lavage, and examination of the collected fluid samples from the respiratory system. Diagnosis of eosinophilic bronchopneumopathy was reached by combining the findings of all tests. Both patients responded to corticosteroid therapy. The SOAP method enables us to approach the clinical cases in a structured and organized way. The following note method should be implemented in clinical case presentation for healthcare workers and students to improve clinical reasoning.

KEYWORDS: SOAP, eosinophilic bronchopneumopathy, dog

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LEARNING ABOUT VETERINARY EMERGENCY - CENTRAL VENOUS CATHETER

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ABSTRACT

Due to the increased interest and demand for knowledge of veterinary emergency and critical care, central venous catheterization is starting to be one of the most important procedures undertaken in the hospital setting. Our teaching stuff at the Clinic for Surgery, Orthopaedics and Ophthalmology at the Faculty of Veterinary Medicine in Zagreb tried to bring it closer to us through practical skills. The central venous catheter (CVC) is a large-diameter catheter that can be placed in the jugular vein or can be inserted into the caudal vena cava via the lateral saphenous vein in the dog or the medial saphenous vein in the cat (PICC – peripherally inserted central catheter). It is commonly used in emergency and intensive care patients who need frequent blood sampling, fluid therapy, multiple medication administration, central venous pressure monitoring, and administration of total parenteral nutrition or other hyperosmotic fluids. General anaesthesia or sedation with local anaesthetics is required for the CVC placement. The most commonly used technique for CVC placement is the over-the-wire (Seldinger) technique. The animal is placed in lateral recumbency, the fur is clipped, and the catheter insertion site is aseptically prepared. An introduction catheter is inserted into the vein, followed by a guidewire or J-wire introduction through the catheter. The introduction catheter is then removed and a vessel dilator is placed over the wire for skin and subcutaneous tissue expansion, to allow smoother CVC passage. After dilatation, CVC is inserted over the guidewire which is removed through the CVC. Once the CVC is sutured to the skin, radiographical confirmation is needed to ensure the correct positioning of the catheter (in the first intercostal space, cranial to the right atrium). Some contraindications for the CVC placement include thromboembolic disease, significant hemostatic abnormality, coagulopathies and traumatic brain injury. Complications associated with CVC placement include embolism, thrombosis, infection, migration or loss of the guidewire, and bending and fracturing of the catheter. The most common types of bacteria associated with catheter infections are Streptococcus spp, Staphylococcus spp, Escherichia coli, and Enterobacter spp. That is why appropriate maintenance of the CVC is crucial and should include daily inspection of the catheter for signs of thrombosis, catheter leakage, oedema and infection. In our opinion, CVC placement has become more frequent in veterinary medicine and that is the main reason it should be included regularly in faculty education.

KEYWORDS: central venous catheter, Seldinger technique, over-the-wire technique, intravenous access. veterinary emergency

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LEADERVET PROJECT: SOFT SKILLS IN VETERINARY EDUCATION AND BEYOND

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ABSTRACT
The European Commission has determined that for a veterinary degree, the "first day competencies" are the minimum standard required and are the starting point for various roles in the veterinary profession worldwide. A new graduate who achieves the "first day competencies" must be able to independently perform the appropriate tasks and duties of the veterinary profession and be confident enough to independently practice veterinary medicine at the primary care level. "Day one competencies" also include competencies in communication, management, and digital skills, such as: communicating effectively with clients, the public, professional colleagues and relevant authorities in an appropriate manner for different types of audiences, while fully respecting confidentiality and privacy. Furthermore, effective teamwork in the delivery of services; clear communication and collaboration with referral and diagnostic services, including providing an appropriate medical history, conducting a complete clinical examination (which is only possible based on effective communication), knowledge of the principles of effective interpersonal interaction, including communication, leadership, management, governance and teamwork, and many others are important.
At the Veterinary faculty in Ljubljana, we participate with students in the multidisciplinary project LeaderVet to improve the competencies of veterinary students in collaboration with various mentors from other faculties or from the corporate environment.
In the proposed project, we are working primarily on increasing students' life skills in three modules: (a) communication and empathy, (b) digital strategy, and (c) sustainable management, with the aim that students gain concrete and practical experience during their training. Our goal is to integrate the content into the course in a long-term and creative way, contributing to the increase of innovative pedagogical practices, especially during the epidemic of coronavirus diseases that further complicate the processes of study and work and require additional skills.

KEYWORDS: soft skills, communication, leadership, digital skills

SYSTEMATIC METHODOLOGY FOR CONDUCTING A PHARMACOKINETIC STUDY: AN APPLICATION ON THE DISPOSITION KINETICS OF ROBENACOXIB IN GEESE

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ABSTRACT
A pharmacokinetic (PK) research is a systematic evaluation of a drug's systemic absorption, distribution, metabolism, and excretion over time. The basics of PK are taught in most degrees related to both human and animal health. Nonetheless, it is important that the methodology is always adjusted to the target species. Here we describe the proposed methodology of Conducting a Pharmacokinetic Study, based on an example of robenacoxib in Geese. First, the research objectives must be defined, which includes defining the appropriate animal sample size, choosing a drug and its posology, and developing a theory of the study's outcome. Picking a suitable study design with a sample collection protocol would be the next step. This involves the mode of administering the drug, to a determined number of individuals, as well as collecting the biological samples at designated time points. The sample size should be sufficient to guarantee the study's acceptable statistical power (> 0.8). Following the development of a validated analytical method, the next step would be to quantify the therapeutic compound in the collected matrices in order to determine its concentrations at each time point. Several analytical techniques, including the HPLC used in this research, can be used to achieve this. Sample cleanup, chromatographic separation, and detection—such as UV in this study—are all steps in the HPLC quantification process, after standardization and calibration. With the obtained data, the PK parameters, such as terminal half-life (t1/2λz), area under the curve, clearance, and volume of distribution, among others, are computed. This is possible with a PK software, such as Thothopro™ in this trial. Finally, the obtained PK parameters must be interpreted in light of the research objectives, and any potential conclusions or recommendations must be made based on the data analysis. In the present study, it was concluded that the administration of robenacoxib might not be suitable for geese, due to its short t1/2λz; more research would be needed eventually to confirm this point.

KEYWORDS: analytical method, coxib, geese, NSAIDs, pharmacokinetics

3D PRINTED MODELS AS ALTERNATIVE IN ANATOMY EDUCATION

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ABSTRACT

Throughout history, the study of anatomy has heavily relied on cadaveric material as the primary means of education. However, with changes in curriculum, costs, availability, and ethical considerations, many veterinary schools have sought alternative resources, such as plastinated prosections, plastic models, digital models as well as new technological improvement like augmented and virtual reality (Iwanaga et al., 2021). While ongoing debates continue to examine the qualities and limitations of these alternatives, we propose that three-dimensional printed (3DP) models have the potential to not only replace but also improve upon existing resources for anatomical education. The previous study showed positive impact of utilizing 3DP brain models and that they should be considered as a viable alternative to formalized specimens (Hadžiomerović et al., 2022). The aim of this study was to assess the effectiveness of using 3DP models in neuroanatomy course and to evaluate the level of student satisfaction with the use of these models. A total of 35 models were prepared for this purpose. The study was carried out among first-year students enrolled in the study programme at the University of Sarajevo - Veterinary Faculty. During the summer semester of the academic year 2022/23, the complete neuroanatomical course was organized using 3D printed models. The students' performance was evaluated using a standardized questionnaire administered through Moodle platform and compared to that of the previous two cohorts. A total score of the 3DP group was 67.6%, which was higher from the previous academic years, for 2021/22 – 63% and for 2020/21 – 60.6%. All the students agreed/strongly agreed that anatomical features in the given 3DP models are accurate (mean 4.52 out of 5). The 88% of students felt that 3DP models improved their understanding and learning of anatomy (4.46±0.7). Positive effects of the 3DP models suggest that they should be used as alternative to formalized specimens.

KEYWORDS: 3D printed models, alternative, evaluation

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THE INTEREST OF STUDENTS OF THE FACULTY OF VETERINARY MEDICINE IN ZAGREB FOR REPTILES AND AMPHIBIANS

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ABSTRACT

During the last decade, reptiles and amphibians are becoming more frequent pets resulting in an increase of their number as patients in veterinary practices. Consequently, students of the Faculty of Veterinary Medicine, University of Zagreb (FVMUZ) are showing more interest in learning about that group of animals. For more than 20 years, at the FVMUZ exists an enclosure for reptiles and amphibians, located within the Department of Physiology and Radiobiology where only students (under supervision) take care of the animals. There are currently over 40 animals kept there, 7 different species of reptiles and amphibians, which are all kept in proper conditions thanks to the students. In 2021, a group of five 3rd year students submitted a project which purpose was remodelling and improving the enclosure. As a part of faculty study program, the subjects "Reptile morphology" and "Physiology of amphibians and reptiles" can be enrolled as elective courses. During the 11th semester, students who have chosen the Small Companion Animals track attend the compulsory elective course “Diseases of Pet birds, Exotic and Laboratory animals”. In the last 5 years, the student's enrolment in all the mentioned courses has been increasing. Among the student's extracurricular activities, it is worth mentioning the exhibition of reptiles and amphibians, organized since 2012 by the student association "Equus", "Reptilomania+", in which increasing number of registered volunteers have also been recorded. The Welfare Education Project organized the lecture "The most common mistakes in keeping reptiles", which of all the lectures was the most attended by students compared to the other lectures that were held. In conclusion, as the general population's interest in keeping reptiles and amphibians as pets grows, so veterinary students have an increasing interest in learning about them both curricular and extracurricular.

KEYWORDS: reptile, amphibians, students, interest

LIVE ANIMAL-BASED TEACHING

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ABSTRACT

The aim of this work was to share experiences and outcomes of using live animal-based teaching and training of veterinary students. Student interaction with live animals is effective method of achieving goals such as acquisition of skills in observation *in situ* physiological process, animal behaviour and handling of animals prior sampling. Department of Physiology and Radiobiology (UFR) of Faculty of Veterinary Medicine of the University of Zagreb (FVM) started using live animal-based teaching and training since academic year 2019/2020 mostly with dogs, rats, and mice. We issued a consent from the Committee for Ethics in Veterinary Medicine of FVM on the ethical acceptability of the use of live animals, in the teaching of the Physiology of Domestic Animals I and II in Croatian and English programme. The live animals-based teaching and training is used for demonstration of venepuncture sites, palpation of subcutaneous lymph nodes, as models for electrocardiography and electromyography recording, auscultation of heart sounds and palpation of superficial arteries regarding heart rate determination, observation and auscultation of breathing, observation of feeding behaviour, auscultation of rumination, and observation of behaviour in memory and learning. This method of teaching was welcomed by students and proved effective in connecting physiology course objectives and learning outcomes. Students expressed content of being able to see and pet live animals as well as better understand physiology in visualisation of theory. Students also were more excited and more interested when using live animals compared to using of models for palpation or demonstration of venepuncture sites. In conclusion, live animals-based teaching and training have a pedagogical merit but it also teaches students to balance the ethical and responsible animal care with their educational value. Live animals-based teaching and training provide observation and comparison skills that instil in students a respect for the value of life and the importance of responsible animal care.

KEYWORDS: teaching method, live-animals based teaching, training of students

FROM VOLUNTEERING IN THE FACULTY CLINICS TO THE INTERNSHIP PROGRAM

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ABSTRACT
The aim of this lecture is to introduce students/colleges with volunteering as well as internship program and all the opportunities they provide.
Faculty of Veterinary Medicine, University of Zagreb (FVMUZ), provides their students (once they fulfill the necessary conditions requested from each clinic) with an opportunity to volunteer in the FVM clinics (Clinic for Internal medicine, Clinic for Surgery, Orthopedics and Ophthalmology, The Reproduction and Obstetrics Clinic, Clinic for Infectious Diseases and The Department of Radiology and Physical Therapy). Volunteers have many responsibilities through which they further deepen their practical and clinical knowledge acquired through regular studies. With supervision of teaching staff they participate in history taking, clinical examination, blood sampling and therapy of out and inpatients. They are educated on how to perform basic laboratory tests on point-of-care devices. After gathering basic data on the patient, volunteers are also involved in creating and discussing a further plan for the patient. Large and important part of a veterinarian's daily work is communication with the owners and volunteering provides an ideal opportunity for practicing it. Volunteering is an exceptional opportunity to acquire knowledge for the future.
After graduation there is another great opportunity to further improve knowledge: Rotational internship program at the FVMUZ which provides extensive knowledge in all areas of veterinary medicine for small animals. Internship gives its participants several advantages: it improves their knowledge and clinical skills, helps them decide which field of veterinary medicine to choose for themselves in the future and gives them an opportunity to apply for a residency program.
In conclusion, it is important to introduce students with opportunities offered by their faculty which will facilitate their daily learning and help them in making a further plan for themselves.

KEYWORDS: volunteering, internship program, opportunities

LIZARDS AS A MODEL FOR BEHAVIORAL AND NEUROPHYSIOLOGICAL RESEARCH

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ABSTRACT

Working on animal models in physiological research is often unavoidable, especially when trying to investigate the neurophysiological basis of a behavior. When animal models are used in research, it is important to use the best model for the desired observation and to apply the 3R rules. The most used animal models are mammals – mice and rats that have been bred for generations in controlled conditions. However, this standardized environment in behavioral research fails to provide a true representation of behaviors present in wild populations, thus prompting the exploration of unconventional vertebrate models with the associated advantages and challenges (Zilkha, 2016).

Reptiles, birds, and mammals have a common amniotic ancestor, making them valuable for comparative, evolutionary, and neurophysiological studies (Kis et al. 2015). Lizards have a simpler brain structure, well-suited for investigating the fundamental mechanisms of primal behavior (Naumann et al. 2015). The insights gained from studying lizards could potentially be applied to other amniotic vertebrates. In our study we used lizards from the family Lacertidae as a model species (Dawnes and Bauwens, 2002). Here, capturing lizards from the wild, transportation to housing facilities and ensuring their proper care pose challenges. Factors such as cage size, substrate, temperature, and humidity are not standardized, and a specialized lighting-temperature system is necessary. Diet in captivity consists of live food, which needs to be obtained from a certified supplier and maintained, along with calcium and vitamin supplementation. Additionally, there are no standardized methods in behavioral research and specific reagents for molecular studies may not be available. On the other hand, students may be involved in research - fieldwork and labwork. Recordings gained during behavioral testing can serve generations of students as a source for practical tasks, student practice and creation of master theses. Despite the obstacles, our objective is to share our experience of incorporating an unconventional animal model into research and education.

KEYWORDS: animal models, lizards, physiological research, behavioral research, education

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OPINIONS OF VETERINARY STUDENTS TOWARDS THE ERR FRAMEWORK SYSTEM IN THE TEACHING OF HORSE BREEDING

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ABSTRACT

Active learning is a classroom approach focusing on how students learn, not just what they learn. The benefit of active learning is that it keeps students engaged; they interact with the topic by working on activities that help reinforce knowledge, concept and skill (Michael, 2006). One of the best ways of achieving active learning is by using the ERR framework system. This is a process that consists of three phases. In the evocation (E) phase, the student's prior knowledge is tested, and his curiosity is aroused. The realisation of meaning (Rz) phase is characterised by providing the students with new information, which is internalised in the reflection (R) (Vizek-Vidović, et al. 2005).
This survey included 97 Croatian and 34 International 2nd year students at the Faculty of Veterinary Medicine, University of Zagreb. ERR framework was implemented in the horse breeding practicals. A „term in advance“, INSERT technique and mini-quiz were used for the evocation, realisation of meaning and reflection, respectively. After the practicals, the students were asked to rate the practicals and to answer a 9-question, 5-point Likert scale-type survey (1= I strongly disagree; 5= I strongly agree) about the practicals they participated in. Mann-Whitney U test with a significance level of 0.05 was used to test the differences in opinions of Croatian and International students.
Among all students, 20% of Croatian and 50% of International students had heard about ERR framework system before this class. In both groups, the overall median grade for the class was very good (4). Most Croatian and International students strongly agreed that the teaching materials and time management were appropriate, they felt comfortable answering or commenting during the classroom activities, and that teachers answered their questions clearly. Statistically significant differences were recorded for the clearness of the teacher's instructions, with International students being less satisfied, although the median in both groups was „I strongly agree“. Croatian students were significantly ($p<0.05$) less likely to agree with the statement that they successfully completed all tasks (median = 4; „I agree“) compared to the International students (median = 5; „I strongly agree“). The most important comment from the students was that including video material or similar teaching resources might improve the quality of the class.
This survey proved the positive attitudes of the students towards the ERR framework system in teaching animal breeding. Both Croatian and International students were satisfied with the class and the outcome. Improvement for the next-year class will be made according to the grades and the comments from the students.

KEYWORDS: student, survey, active learning and critical thinking, ERR framework

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PEYTON'S 4-STEP METHOD AS A NEW WAY OF TEACHING THE CLINICAL EXAMINATION OF REPRODUCTIVE TRACT IN ANIMALS

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ABSTRACT
Nowadays, one of educators duties is to search and apply new teaching methodologies to increase knowledge assimilation and needed skill obtaining by the students. It is also one of the main good practices, which could solve lots of problems during normal daily clinical procedures. One of such new method is The Peyton's 4-step (Szumiec, 2010). It is known, the Peyton's teaching approach is a stepwise teaching approach, which consists of the following four steps: demonstration, deconstruction, comprehension and performance (Giakomino et al. 2020). These steps are performed by the educator first (instructor-focused teaching) and only then by the students. It means, that there are clearly defined instructional steps to guide the teacher and the student. A huge advantage of this method is that students work in very small groups, or even a 1:1 teacher-to-student ratio for successful instructional training in skills learning simulators (Nikendei et al. 2014). Such a method can help to teach student how to perform safety and properly clinical examination of phantom first and only then on live animals. It can be useful to show them e.g rectal examination, how to solve the problems during foaling (dystocia) and many other clinical procedures. For example, firstly we show/demonstrate to students unproper positions of foetus and show them how to solve that in real time, then we repeat the whole procedure while describing, next teacher performs under the guidance of the student, and in the end the students carry out the procedure of delivery by themselves.

KEYWORDS: skillslab, Peyton's 4-step method

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THE METHODOLOGY OF ANALYSIS OF DRUGS IN BIOLOGICAL SAMPLES IN THE LABORATORY: A CASE EXAMPLE ON ROBENACOXIB IN GOATS

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ABSTRACT
There are a variety of methods that have been developed to determine the drug concentrations in biological samples, with the selection based on the complexity of the sample and the type of the analytes. Here we present a case example of robenacoxib analysis in goats, that could help educators of different higher education institutions to standartize the protocols for drug analysis in biological samples. The first stage is sample preparation, which involves homogenizing, extracting, and purifying the target drug from the matrix samples and removing any interfering substances. Among the extraction processes that may be required are liquid-liquid extraction, solid-phase extraction, and protein precipitation. The next stage is developing a chromatographic separation technique, such as the high-performance liquid chromatography (HPLC) utilized in this work, which separates the drug from other components in the sample, based on its physical and chemical properties. Depending on the kind of drugs and biological matrix, several HPLC columns and mobile phases may be employed. In this instance, a C18 analytical column was used. Afterwards, the detection methodology will be chosen based on the physico-chemical properties of the compound, such as ultraviolet, fluorescence, or tandem mass spectrometry. Before begining to quantify the drug, standardization, calibration, and a quality control check-up are needed. The spiked samples of the drug are prepared at different concentration levels to allow for the creation of a calibration curve. The quantification of the drug in the biological samples is carried out by comparing the peak area of the drug to the peak area of the drug standard. To account for errors, using an internal standard during HPLC analysis, such as diclofenac sodium with robenacoxib in this study, is a common procedure in quantitative analytical chemistry. Quality control procedures are carried out as well to ensure the reliability and repeatability of the results. These may include internal and external standards, precision, accuracy, and specificity studies. The final step would be to analyze the chromatogram generated by the instrument, and interpret the results.

KEYWORDS: analytical method, drug analysis, biological sample, goats, NSAIDs

BLOOD GROUPS AND TYPING IN DOGS AND CATS, CROSSMATCHING PROCEDURE IN DOMESTIC ANIMALS PHYSIOLOGY EDUCATION

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ABSTRACT
The safe administration of the blood products in transfusion medicine requires precautionary measures *i.e.* blood typing and crossmatching between donor and recipient. Regarding this, teaching staff of the Department of Physiology and Radiobiology and Clinic for Internal Diseases of the Faculty of Veterinary Medicine, University of Zagreb decided that veterinary students should learn about dog and cat blood groups and crossmatching in extensive details already in the second year of undergraduate study. The main purpose of this report is to describe the objectives, adopted procedures, produced teaching material, and proposed future students activities. The methodological unit "Blood groups and typing in dogs and cats, crossmatching procedure" was incorporated into the existing curricula of obligatory course “Physiology of domestic animals I”. Teaching was prepared as practical work lasting for 3 school hours. First part lasting 1 hour comprised introduction in blood groups when and how transfusion is applied in the clinic, and possible consequences due to transfusion reactions. After explaining step-by-step the protocol of the crossmatching (types, principle, procedure and interpretation), students work in pairs under supervision. Based on results, which are obtained by analysing samples using a microscope, e.g. positive agglutination of red blood cell (irregular/unexpected antibodies in either donor or recipient’s blood) they conclude on blood compatibility between the donor or recipient’s blood. Through objectives, introduction and practical work this methodological unit was designed and performed to provide the deep understanding of blood types and crossmatching procedure for veterinary students. Step-by-step instructions will enable a knowledge for students, which they will further develop in higher years of study. The results of this project could be useful in the improvement of training programs in veterinary transfusion medicine et Faculty of Veterinary Medicine, University of Zagreb.

KEYWORDS: blood groups, training programs, dogs and cats, crossmatching, physiology of domestic animals

POSTER PRESENTATIONS

VARIATIONS IN THE HISTOLOGICAL METHODS OF PROCESSING SAMPLES IN HISTOLOGY AND HISTOPATHOLOGY

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ABSTRACT

The aim of the study was to present and compare the selected methods of processing tissue samples used at the Faculty of Veterinary Medicine, University of Zagreb (FVMUZ). In order to make representative slides for studying the structure, the tissue must undergo several key steps, known as tissue processing.

Taking tissue samples involves removing a piece of tissue from the organ or lesion for investigation. In histology and histopathology, the most widely used fixative is 4% or 10% neutral buffered formalin. After fixation, the tissue is dehydrated with increasingly concentrated ethanol solutions, followed by clearing with xylene and embedding in paraffin wax. The process can be done manually or in a tissue processor. After embedding, the tissue is cut using a microtome, placed on microscope slides, stained with selected methods, and covered with mounting media.

The samples used for routine histology undergo processing using standard histological techniques performed by hand. Slides are stained with hematoxylin and eosin (HE) and other methods, such as Verhoeff-Van Gieson, Mallory trichrome, staining for reticular fibers, Alcian Blue - PAS, and Toluidin Blue (TB). The samples used for histopathological observations are prepared in an automated processor, sectioned into 4-5 µm sections, and stained with HE and other methods which are used to determine different tissue lesions. The most frequently used special staining methods are Gram stain, PAS, Ziehl-Neelsen, Masson trichrome, and TB.

In conclusion, the study demonstrates and compares the various tissue processing methods used at the Faculty of Veterinary Medicine, University of Zagreb (FVMUZ). The use of both routine and special staining techniques allows for accurate identification and analysis of cellular and structural components in histology and their changes in histopathology.

KEYWORDS: tissue processing, histology, histopathology

THE PREANALITICAL PHASE OF LABORATORY DIAGNOSTICS IS BECOMING A PART OF THE EDUCATION PROTOCOL

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ABSTRACT
Veterinary medicine students volunteer in the Clinic for Internal Medicine, Veterinary Faculty, University of Zagreb, Croatia. Part of their job is participating in the preanalytical phase of laboratory diagnostics (labeling the tubes, taking blood and urine samples, preparing blood and urine samples for the analysis and performing analysis on point-of-care analyzers). Mistakes done in the preanalytical phase account for around 75% of laboratory errors. In order to prevent these mistakes, all participants should be familiar with strict rules which are important for accurate results.
Laboratory staff performed questionnaires about the preanalytical phase in laboratory diagnostics among volunteers. The results showed that students were aware of the importance of the preanalytical phase but their knowledge needed to be improved. First step of the improvement was an arranged lecture about the preanalytical phase in laboratory diagnostics. The best ways to prevent mistakes was to show them most common errors through examples (positive and negative) from clinical and laboratory work. Furthermore, we made videos for all quick tests and procedures on point-of-care analyzers and distributed them to our volunteers. For the next generations of volunteers, we developed “permanent education” which means that volunteers can attend monthly workshops where they can improve their laboratory skills. The results of teaching volunteers about the preanalytical phase will be extended to all veterinary students. In agreement with the course leaders of Clinical propedeutics, which is an obligatory subject, laboratory staff will be involved in practicals related to the preanalytical phase of laboratory diagnostics.
In conclusion, awareness of the importance of the preanalytical phase in laboratory diagnostics is gradually developing and finally becoming a part of the education program. Veterinary students will need the knowledge and understanding of the preanalytical phase either as future volunteers or doctors of veterinary medicine.

KEYWORDS: preanalytical phase, volunteers, practical teaching

ILLEGAL TRADE IN ANIMALS IN SLOVENIA AND ITS EFFECT ON ANIMAL WELFARE

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ABSTRACT

Illegal trade in exotic animals is a global problem that affects the illegal trade in wildlife. This illegal trade is driven by demand in several markets, including the pet trade, traditional medicine, and the exotic meat trade. Although illegal, it is a multi-billion-dollar industry that operates across borders and involves organized criminal networks. The environmental impact of the illegal wildlife trade is significant. Animals are often taken from their natural habitats, which can lead to population declines and species extinctions. In addition, animals are sometimes smuggled in cramped and unsanitary conditions, which can lead to disease outbreaks and the spread of zoonotic diseases to humans. The illegal wildlife trade also has a significant impact on local communities. International and national laws have been enacted to combat illegal wildlife trade, but illegal trade continues (Dvojmoč and Kubale, 2023). In addition, corruption and inadequate law enforcement in some countries facilitate traffickers' businesses.

Due to the existence of illegal trade in wildlife and exotic animals, there is a need to educate students about the legislation that regulates the area of trade, transport and care of animals. Through education, students gain knowledge in order to be able to determine/evaluate acceptable care conditions based on recognizing the consequences of management on health and well-being. The area of legislation governing the keeping of exotic animals is not regulated in the same way in all EU member states, which is understandable due to the number of species that are considered exotic.

Therefore, the aim of our study was to determine the current situation of wildlife trafficking in Slovenia, wildlife transit and its impact on animal welfare, especially considering the changes at the Schengen borders. Structured interviews were conducted with leading experts and representatives of leading institutions and companies.

The study showed that illegal trade in wildlife, including endangered wildlife species, is not widespread in Slovenia, but that it is important to recognize, address and raise awareness of the problem. It is equally important to be aware of the possible discrepancies due to the changes at the Schengen borders. Changes are needed in the detection and prevention of this type of crime, and legislation could be tightened from a prevention perspective. Currently, there are not enough experts to identify, detect and investigate this type of trafficking. Weak law enforcement and lack of awareness among the public and authorities remain a challenge.

KEYWORDS: trafficking, animals, welfare

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COMPLEMENTARY MATERIALS IN THEORETICAL LESSONS: STUDENT OPINION

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ABSTRACT

The active student participation during the teaching-learning process was related to several benefits. However, during the theoretical lessons, due to the large number of students and the short period of time, many educators opt for passive transfer of information or, at most, include activities such as online surveys. With the aim to include more variable activities in the theoretical lessons of Veterinary Clinical Propaedeutics and foster students' participation, different complementary materials were incorporated (Tvarijonaviciute et al., 2022). The objective of this study was to assess student opinion on these materials and their usefulness in the learning process. For this, at the end of the course, anonymous online survey was used to gather the feedback from the students that attended the following lessons: L1, in which boxes were used for the palpation and percussion practices; L2, in which a cow shaped plush was used to explain and visualise cow physical examination; and the L3, in which students were asked to complete the drawings with the information that serves as a cheat sheet to do the horse's physical examination. A total of 27 students (34%) participated in the anonymous online survey. Out of them, 25 students had participated in L1; they reported liking the use of boxes (mean ± standard deviation, 8.8± 2.1) and finding it useful (9.0±1.8). Similarly, in L2 (n=20), students enjoyed the use of a toy (9.4±1.3) and found it useful for their learning (9.2±1.3). In the same way, the use of drawing in L3 was considered both enjoyable and useful (9.4±1.0, and 9.2±1.2, respectively) by the 16 respondents. In conclusion, these findings suggest that incorporated new didactic material into theoretical lessons was well accepted by the students and they considered it to be useful for a better understanding of the subject matter.

KEYWORDS: education, simulator, questionnaire, veterinary

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IMPLEMENTATION OF OBJECTIVE STRUCTURED CLINICAL EXAMINATION IN THE VETERINARY MEDICINE STUDY PROGRAMME OF THE LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

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ABSTRACT

The Objective Structured Clinical Examination (OSCE) has been used in medical education for many decades (Harden and Gleeson, 1979) and is also being gradually introduced in some veterinary schools (Davis et al., 2006; Iatridou et al., 2021). The Veterinary Medicine (VM) study programme in the Lithuanian University of Health Sciences (LSMU) is finalized with an OSCE exam since 2020. The OSCE was conducted remotely in 2021. The professional preparation level of the students, the skills required to obtain the qualification of a veterinarian are assessed by the passed OSCE examination. During the exam students rotate through 22 stations. The OSCE stations were selected to reflect the VM curriculum content and course outcomes and are planned using an assessment blueprint. At each station the student was asked to carry out a specific task for eight minutes. All students pass the same stations, are evaluated by the same examiners using the same criteria. Stations were developed to test course outcomes: clinical skills, practical procedures, patient investigations, diagnostic imaging, patient management, veterinary documentation, communication and biosecurity skills etc. The OSCE tasks were prepared by the lecturers coordinating the modules. Each task was evaluated respectively in a standardized way according to the scoring checklist: well-done, partly done, not done/poor attempt (failed). The evaluation results were processed by a specialized computer programme, applying a cumulative assessment. The exam was considered passed if a student accumulated at least 50% of all possible scores, that corresponds to grade 5 of the maximal 10. The average course grade was 7.67; 7.54 and 7.53 in the year 2020, 2021 and 2022, respectively. The feedback from students was 8.29 points and examiners – 8.9 points on average (2020-222). The principle of an OSCE is also applied to assess the colloquiums in several subjects, and it will be implemented throughout VM study program from the 2026 academic year in LSMU.

KEYWORDS: objective, examination, clinical skills, veterinary medicine

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IMPLEMENTATION OF MODELS FOR TEACHING REPRODUCTION AND OBSTETRICS ON FACULTY OF VETERINARY MEDICINE UNIVERSITY OF ZAGREB

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ABSTRACT
Obstetrics and reproduction I and II are obligatory one semester courses at Faculty of Veterinary Medicine University of Zagreb. Courses consist of 60 and 30 hours of lectures and 100 and 45 hours of practicals, respectively. Because of significant amount of knowledge about hormonal regulation of reproduction and species-specific differences in reproductive physiology and pathology there is a high study load in a relatively short period. Therefore, we are constantly looking for new tools to encourage active learning, deeper understanding of the subject and improve practical skills. Use of live animals is obligatory for teaching clinical skills. However, ethical considerations, primarily regarding welfare, related to the use of live animals for educational purposes limit student opportunities to gain experience. Training of students in a skills lab on models and simulators allows students to gain knowledge, skill, and confidence before going to live animals (Jonker, 2022). For teaching obstetric procedures in large animals, we are using obstetrical Dystocia Simulator (Veterinary Simulator Industries Ltd, Canada) that enables recognition and correction of calf's postural defects and allows for assisted vaginal delivery by traction. For rectal examination we are using Breeding Betsy (Brad Pickford, Australia), an artificial training simulator and educational device for artificial insemination, pregnancy diagnosis and embryo transfer in cow. Equine Theriogenology Model (VSI, Canada) allows students to gain practice in rectal examination with focus on reproductive tract. For gaining surgical skills like ovariohysterectomy, we prepared instructional films on surgical techniques, which are followed by practical work on Canine Spay Simulator (Veterinary Simulator Industries Ltd, Canada). These allow students to practice psychomotor skills and procedural steps, which will result with less anxiety and more confidence when performing procedure on live animal (Read et al., 2016). As Obstetrics and Reproduction I and II are clinical courses, gaining both theoretical knowledge and practical skills are crucial to ensure that graduates comply with the Day One Competences. The use of models enables students to attain competence and confidence in performing clinical procedures, complying with biosecurity, ethics and 3R principle.

KEYWORDS: education, skills lab, clinical procedures

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IS A PRACTICAL LESSON ON PHYSICAL EXAMINATION A STRESFUL SITUATION FOR A COW?

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ABSTRACT
Traditionally, in Veterinary Schools, live animals are employed in different courses in order to familiarise students with animal handling, physical evaluation and sampling. However, currently, there is a tendency to reduce the number of animals employed especially due to the fact that their well-being and welfare could be affected. This study analyzes the effect of using a cow in the practical classes of a compulsory subject of Veterinary Medical Propaedeutics on its well-being. During practical lessons (1 h each), students in groups of 2-3 perform a complete physical examination of one cow including percussion, palpation, evaluation of mucous membranes, heart and respiratory rates, temperature and obtaining a saliva sample. The cow employed in this study was not previously used in the works with students. After each lesson, the cow was offered vegetables or green grass as a positive reinforcement. Saliva collected by students as part of the learning activities was used for cortisol determination using an immunoassay system (IMMULITE, Siemens Healthcare Diagnostics, USA) to evaluate the stress of the animal. In the first practical lesson, salivary cortisol levels were higher (Mean±sd; 0.229±0.06 µg/dL) that in the following sessions reaching levels below the limit of detection of the method (<0.05 µg/dL) in the 4th session and the followings (P=0.0002). In the same way, the cow refused to accept the food in the first two sessions but ate it all after the following. Although further studies with more animals and different lessons should be performed, our results suggest a cow not accustomed to handling by a group of students, can present a certain degree of stress during the first sessions, but soon it gets used to this situation and does not present evident signs of stress.

KEYWORDS: cow, practical lessons, saliva, stress, well-being

THE USE OF SIMULATION IN THE EDUCATION OF THE VETERINARY PROFESSION

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ABSTRACT
The alternatives to the use of animals in higher education are discussed for some decades (Valliyate et al., 2012; Braid, 2022). The Veterinary Medicine Simulation Centre (VMSC) of the Lithuanian University of Health Sciences (LSMU) is a simulation training venue where Veterinary Medicine (VM) students and residents develop their skills in practical manipulation of animals – moulages. More than eight percentage of VM studies took place in the VMSC at 2022, and it is increasingly integrated into VM curriculum to at least ten percentage until 2026. VMSC is divided into four different sectors: Large Animals and Ultrasound (5 stations), Internal Medicine and Surgery (19 stations), Propaedeutics and Microscopy (20 stations), and one for the completion of the Objective Structured Clinical Examination tasks (10 stations). The number of stations is steadily increasing. From the first semester, the VM students can use VMSC to continuously train practical skills in VM by using veterinary medical simulation methods, mannequins, and simulators in a safe, stress-free, self-study learning environment without causing risk or harm to animals. They learn the basic techniques to perform the following procedures: blood sampling, injections, fixation, suturing techniques, catheterization, positioning techniques, ultrasound imaging techniques, etc. Then the students apply their acquired skills to the practical training at the veterinary hospital. Students' self-learning and self-assessment tools have been implemented in VMSC. Students are provided with descriptions of practical tasks and necessary work tools enabling student discussions and search for the solutions to problems in the VMSC, they have the opportunity to consult on the performance of self-learning tasks directly or remotely. The online registration form monitors student's access to the VMSC. The use of models, mannequins and simulators not only serves as training tools to gain practical skills and acquire knowledge, but also is the major alternative to harmful animal use in VM teaching.

KEYWORDS: simulation, veterinary, practical skills

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ISEAS IN KNOWLEDGE DISSEMINATION

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ABSTRACT

The aim of this abstract was to share experiences and outcomes of being active in international society of education in dissemination of education methods and knowledge in animal sciences. The International Society of Education in Animal Sciences (ISEAS) is an independent non-profit association founded by employees of higher-educational institutions in Europe being registered in Spain in July 2019 and comprising 89 members. ISEAS was founded with the primary goal of gathering educators who use animals and animal models in their teaching, enabling their close interaction, networking, exchange of knowledge, teaching methodology and experiences. In the academic year 2021/2022 association members designed and held online five workshops and one round table. Workshops were discussing and sharing knowledge on the analysis of biological materials by gas chromatography; the salivary proteome in food acceptance and selection in animals; on drug poisoning of cats and dogs; on fetotomy as well as on communication and dissemination of information in higher education. The round table was focusing on the challenges in teaching veterinary histology during and after the COVID-19 pandemic. Activities in knowledge and experience dissemination continued in academic year 2022/2023 with nine more workshops dealing with fetotomy; preanalytical phase in laboratory diagnostics; the swot matrix to train students' decision-making; histological methods of processing samples in histology and histopathology; salivary proteomics in ingestion and digestion research; endoscopic examinations in a small practice; artificial insemination in dogs; Wild Animal Recovery Project – WildRescueVEF – how it was created and the VEF Community Garden project. Participants of the workshops were scientists, professors and students. The students showed particular interest in the workshops on drug poisoning of dogs and cats and fetotomy. The establishment and activities carried out in one such international association involving scientists, teachers and students is a good example of intertwining of teaching methodology, networking, social activities and experience to apply knowledge for human development.

KEYWORDS: knowledge dissemination, education, international society

PRACTICAL EVALUATION OF ENVIRONMENTAL POLLUTION

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ABSTRACT
Within the framework of the project "Histopathological and hematological biomarkers as a screening tool in assessing the health status of fish from the Lepenec River", a group of students from the Institute of Biology was trained for the practical application of the acquired theoretical knowledge in solving environmental pollution. The main goal was to educate them on a scientific approach of monitoring the health status of the fish, by screening the histopathological and haematological biomarkers in black barbel (*Barbus balcanicus*) as a bioindicator organism. To fulfill this goal, the students acquired skills and practice in field and laboratory work, observe and participate in the overall procedure for obtaining histological preparations, as well as to acquire knowledge for the analysis of the obtained results. In two seasons, electrofishing was carried out on the Lepenec River, in which all the students participated, learning the best position of the participants when catching the target fish. In the laboratory, students were trained in dissection of the fish, isolation of the organs and their processing according to standard histological techniques. They acquired practical knowledge of collecting peripheral blood from the caudal vein and making and staining blood smears. In addition, the students gained basic knowledge from the analysis of histological preparations, familiarization with the detected lesions in the liver and gonadal tissue, as well as the calculation of the prevalence of the lesions. They were also trained in the analysis of blood smears and the detection of micronucleus in erythrocytes. As part of education in data processing, students acquired knowledge in arranging data in statistical programs and their statistical analysis. By participating in this project, the students gained a certain ecological sensibility, skills for cooperation, problem-solving, analysis, finding solutions, making choices and taking action, skills that are invaluable for future biologists and researchers.

KEYWORDS: education, histopathology, micronuclei, biomarkers

BLOOD SMEAR ARTIFACTS REGARDING TO BLOOD PARASITES: VOLUNTEER EXPERIENCE

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ABSTRACT

Veterinary medicine students have the opportunity to volunteer in Laboratory of Clinic for Internal Medicine, Faculty of Veterinary Medicine, University of Zagreb. While volunteering, students become better acquainted with normal blood cell morphology and different variations, inclusions and artifacts. Cytological artifact is defined as an artificial structure or cellular alteration on a prepared microscopic slide as a result of an extraneous factor (Sahay et al., 2013). Several factors can cause inclusions and artifacts in a blood smear, the most common of which are sample contamination, storage, fixation, and staining. It is important to distinguish artifacts from morphological changes caused by pathological processes because they can lead us to an incorrect diagnosis and unnecessary treatment. The aim of the study was to present the causative agents of diseases in animals, seen in blood smears in the hematology laboratory, and artifacts they are most often confused. In blood smears, filament like contamination can be confused with microfilaria, larval stage of *Dirofilaria immitis*, when examining on low magnification (4x or 10x). Smaller refractile artifacts, made by excessive water on the slide or in the stain, present on the surface of the red blood cells sometimes look like *Babesia gibsoni* organisms or can cover it. Occasionally platelets may be seen on top of other blood cells and thus appear to be inclusions such as *Babesia canis* organisms in the red blood cells or *Anaplasma phagocytophilum* morula in the neutrophil. By comparing the platelet on top of these blood cells with those platelets present throughout the rest of the slide, these should be distinguishable from true inclusions or parasites (Reagan et al., 1998). From the position of a volunteer, it can be concluded that the most common causes of artifacts should be pointed out in the education of students, but also that cell morphology should be evaluated under magnification of 100x.

KEYWORDS: blood smear artifacts, blood parasites, volunteer

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EXPLORING MODERN LEARNING PREFERENCES: THE IMPACT OF COMPUTERIZATION ON YOUNGER GENERATION STUDENTS

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ABSTRACT
The aim of this study is to show the impact of computerization on the learning preferences of the younger generation of students. In contrast to previous generations who relied predominantly on books as their primary source of information, today's students are increasingly using alternative sources of information such as lecture notes and presentations.
We distributed a questionnaire to 86 students in the first year of an integrated undergraduate and graduate veterinary medicine program. The questionnaire was distributed at the beginning of the second semester as part of the subject "Histology with General Embryology". The main literature for this subject consists of various books, supplemented by additional materials such as lecture and practical presentations, content from the Instagram page "vef_hista" and quizzes on Wordwall. The questionnaire focused on students' previous experiences with learning resources and inquired about their intended sources for studying histology.
The results of the questionnaire showed that most students (43%) planned to use presentations from lectures and practicals as a source for learning histology. Lecture notes were the preferred source for 28% of the respondents, while a slightly lower percentage (26%) chose books. Very few students (3%) planned to use materials available on the internet. In terms of previous educational experience, 70% of respondents had not yet used Wordwall, and although 97% had an Instagram profile, only 35% were aware of the "vef_hista" page.
In conclusion, this research highlights a shift in the learning preferences of the younger generation of students. The majority of them prefer presentations from lectures and practicals to traditional books as their primary learning resources. In addition, the use of materials from the internet and social media platforms such as Instagram for educational purposes is still limited among these students, indicating an opportunity for growth in the use of such platforms for learning.

KEYWORDS: computerization, learning, teaching materials

WORKSHOP "ARTIFICIAL INSEMINATION IN BITCH" AS AN EXAMPLE OF ONLINE EDUCATION

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ABSTRACT
During the pandemic and worldwide expressed lock-down, there was a sudden need for transition from traditional face-to-face teaching to online education. This was particularly challenging for clinical subjects, where both theory and clinical practice should be included. The workshop with the topic of artificial insemination (AI) in dogs has proven to be a good example of both, giving theoretical knowledge and assessing students' comprehension of given materials. In the first part, students were introduced with endocrinology of estrous cycle of the bitch and clinical application of these findings with the emphasis on exfoliative vaginal cytology and serum progesterone concentration, as methods for detection of ovulation and determination of optimal breeding time. Students were informed by pictures and video materials about vaginal swab collection, smear preparation and dyeing methods, and microscopic sample assessment regarding the phase of estrous cycle. The next topic was semen collection and assessment, where the students were introduced, by video materials and pictures, in semen collection procedure, macroscopic and microscopic evaluation, with special emphasis on sperm motility, viability and morphology. Also, they were introduced with methods of sperm preparation for AI such as chilling and freezing. Finally, students were introduced through lectures and video materials with different methods of AI, pros and cons of each method, and specific timing of insemination regarding the type of semen used. In the second part of workshop, to assess the knowledge of participants, students received several case examples, in which they were required to detect optimal breeding time according to given results of vaginal cytology and progesterone concentration, to assess the sperm quality by given sperm assessment report, and to choose which AI method to use in the given case. In the circumstances of online education, this workshop enabled students to gain both knowledge and experience, needed for their future vocation. Furthermore, thus organized workshop could be used as an example of life-long learning, especially in field of assisted reproduction of companion animals.

KEYWORDS: digital education, clinical application, estrous detection, sperm evaluation, lifelong learning

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