



Simple, but not easy: Opportunities and challenges from teachers' and students' perspectives in the 21st century of veterinary parasitology teaching

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ABSTRACT

One of the main goals in academia is, and has been, high quality education of students to provide theoretical and practical knowledge essential for professional life. Achieving this goal is highly dependent on teaching procedures and, consequently, on a constant adaptation of teaching styles to align to technical advances and cutting-edge topics. Technical advances can strongly influence teaching and learning in the complex subject area of veterinary parasitology. Today's students are provided with extensive, digital lecture notes, and e-learning offers including virtual microscope technology to independently obtain intensified theoretical knowledge and understanding. As veterinary parasitology is also highly reliant on proficient practical skills, lectures with integrated diagnostic exercises are mandatory. Nowadays, such practical skills, such as carrying out faecal examination procedures, can be strengthened by having access to clinical skills labs. Advances such as digital lecture notes, e-learning and virtual microscopes do not only provide new, innovative opportunities, but can also comprise challenges. In this context, provision of sufficient relevant studying material may discourage students to take on responsibilities for autonomous gathering of information. Besides technical advances, 'Zeitgeist' changes are shaping teaching contents, which are progressively expanding as zoonoses are increasingly being focused on. With the aim of adopting the one-health concept, students today are expected not only to bear responsibilities for animals, but also for their owners and public health. This article will cast light on some key challenges and opportunities in modern veterinary parasitology teaching from the teachers' and the students' perspectives.

1. Introduction

Teachers in academia are responsible for high quality education to prepare students for their professional life. Particularly the broad topic area of veterinary parasitology requires lecturers to deliver extensive theoretical and practical knowledge to students, requiring optimal teaching approaches including a constant adaptation to technical advances to implement modern teaching and learning practices. At the University of Veterinary Medicine Hannover, Germany, the core parasitology course is predominantly based on a conventional, disciplinary approach, allowing students to easily obtain an overview of general parasite morphology and biology as well as epidemiology, clinical manifestations of diseases, pathology, immunology, diagnostics, therapy and control strategies. This approach is considered to provide a solid basis of parasitological understanding relevant for professional life (Gottstein and Eckert, 2002). Nevertheless, this disciplinary approach does not allow much integration or overlapping between parasitology and other disciplines. Additionally, clinical problems and patients are mostly neglected (Eckert, 2000). We do experience a lack of cross-

disciplinary course offerings, which constitutes an obstacle to effectively linking clinical cases and aetiology. However, the lack of cross-disciplinary course offerings may be attributed to a tightly packed curriculum, requiring us to provide sufficient practical exercises and case-oriented material, in combination with theoretical knowledge. Fortunately, modern teaching offers a variety of possibilities to overcome these disadvantages, each exhibiting distinct strengths and weaknesses. Therefore, opportunities and challenges of modern veterinary parasitology teaching will be discussed here. Clearly, success of teaching approaches does not depend solely on lecturers, but also on students who may perceive varying approaches differently. Thus, we aimed to include both the teachers' and the students' perspectives - the latter via information gathered from a questionnaire on teaching and learning - to elucidate opportunities and challenges of today's veterinary parasitology teaching in Germany.

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2. Opportunities and challenges of modern veterinary parasitology teaching

2.1. Course offerings

In the curriculum of the University of Veterinary Medicine Hannover, limited hours of infection medicine (general and specific infectious diseases, parasitology, microbiology, virology, immunology, animal disease control; total of 280 h in the curriculum) pose a challenge to adequately combine theory and practical exercises to impart essential knowledge. Students are initially exposed to veterinary parasitology during the 5th semester in a mandatory course covering general infection immunology including 2 h of immune responses to parasite infections. During the 6th and 7th semesters, students take the mandatory core parasitology course, which comprises a total of 56 h in the curriculum. In detail, 8 h are assigned to entomology, 10 h to protozoology, 34 h to helminthology (including 10 h of recapitulating different helminths and appropriate control measures according to host species) and 4 h of revision relevant for the practical exam by independent microscopy. Weekly courses comprise lectures, covering parasite morphology and life cycles, epidemiology, pathology, clinical manifestation, immunology, diagnostic options, therapy and control strategies to prevent or control parasitic infections and disease. During individual lectures, different mounted parasite stages, histological sections and faecal sample preparations (e.g., oocysts, eggs or larvae) are distributed to students to provide an opportunity to immediately examine each parasite macroscopically and microscopically, and strengthen their diagnostic skills. Additionally, relevant preparations from the Institute's parasite archive (formalin-fixed parasites, parasitised/diseased organs, etc.) or fresh material from an abattoir are presented as demonstration specimens to reinforce course content. Practical work also includes performing common coproscopical methods; however, only two hours are assigned to such tasks, which is not sufficient to gain competency. Therefore, students have access to a Clinical Skills Lab, where they can learn and hone their skills in carrying out parasitological techniques and the interpretation of results (see Section 2.2 *Technical advances*).

As mandatory parasitology classes are limited, interested students may take more specialised, elective courses during any semester. We offer an elective on 'Tropical Parasitoses and Zoonoses', which is, to a large extent, taught by guest lecturers as well as an elective on medical entomology, both totalling 28 h in one semester. Unfortunately, these lectures do not necessarily deliver practical classes. One opportunity to obtain more practical insights into diagnosis or research in veterinary parasitology is an internship in the practical year (9th and 10th semesters). Ideally, students spend about 8 weeks or longer at the Institute to broaden their overall understanding of parasitology. During internships, students rotate between the different units of the Institute (diagnostic and molecular laboratories) to experience different aspects of parasitology, such as classical and molecular parasitology by working on their own research projects. However, the practical year is packed with required clinical internships, resulting in mostly short-term (4–8 weeks) enquiries for internships at our institute. In addition to only parasitology courses, cross-disciplinary classes are offered in clinical and paraclinical departments, but, unfortunately, these are restricted to 4 h per semester. Generally, it would be important to extend cross-disciplinary classes to provide sufficient specialised parasitological experience for veterinary students.

Besides offerings in the curriculum for undergraduates, graduates may encounter parasitological teaching in different courses. Firstly, there are several PhD programmes offered at our university, including "Veterinary Research and Animal Biology" and "Animal and Zoonotic Infections", both comprising obligatory continuous lecture series with at least 2 hours dealing with host-parasite interactions. Recently, an extra-occupational Master's programme for veterinarians has been introduced, comprising epidemiological aspects of particularly important

parasites. Similarly, trainee veterinarians for the veterinary inspection office (government department) are trained in specialised topics relevant to their professional focus.

2.2. Technical advances

Technical advances strongly influence teaching and learning in the complex subject area of veterinary parasitology, also with respective opportunities and challenges. Digitalisation provides easy access to extensive and coloured lecture materials, which may be printed or accessed/used on students' digital devices. Therefore, students do not need to take notes continuously and can concentrate on substantial teaching contents instead. As a challenge, students may tend to pay less attention during lectures as notes are already provided for exam preparation. Furthermore, provision of extensive study material may tempt them to neglect autonomous gathering of relevant information, thus discouraging students from taking on responsibilities. In addition to digitally available lecture notes, there are strong interactions between students in social networks where notes, information and exam questions are posted. However, misinformation may rapidly spread, as posted material is not reviewed by lecturers.

A variety of e-learning offerings allow students to independently intensify theoretical knowledge based on individual needs. Currently, we are working on implementing virtual microscope technology in parasitology teaching, to provide students the opportunity to strengthen diagnostic skills outside of course hours. This tool is intended as an additional opportunity for self-learning, but virtual technology cannot replace actual microscopy of original specimens. We observe that students encounter difficulties not only in identifying parasite stages but often also in locating them on the proper plane of the microscope due to inexperienced handling and a lack of skill with a microscope. As some routine skills may not be strengthened online, the university offers access to a Clinical Skills Lab, which allows students to practise veterinary procedures on simulators. Besides clinical techniques like blood sampling on canine foreleg vascular access simulators, rectal palpation on full-size equine palpation/colic simulators, etc., students can practice faecal examination techniques (e.g. sedimentation and flotation techniques). Required equipment as well as faeces with spiked helminth eggs are prepared by our institute, allowing students to develop extensive skills in such tasks and techniques.

2.3. Diagnostic skills

Diagnostic skills are essential in veterinary parasitology and students' practical skills strongly depend on the availability of parasite materials such as faecal specimens, different parasite stages and infected organs during their training. For practical exercises, we aim to continuously prepare fresh faecal specimens, in addition to mounted specimens. Therefore, animals are frequently experimentally infected with relevant parasites to obtain oocysts, eggs or larvae, which are available, either fresh, frozen or fixed, during core classes. Nevertheless, sensitivity towards animal experiments has been increasing and such approaches are frequently questioned. We make an effort to exchange parasites with other universities or use material sent to our diagnostic unit. Nevertheless, it is inevitable to occasionally infect respective host species to ensure ready availability of materials for a quality educational experience. In addition to these parasite materials, further materials are available from abattoirs and infected clinical patients are essential for providing parasite stages not otherwise obtainable. For example, we provide *Fasciola hepatica*- and *Ascaris suum*-infected livers from abattoirs for dissection, so that students can observe and discuss pathological bile duct changes and fluke stages or milk spots, respectively. Unfortunately, we are not able to provide livers for small groups of students, but rather about three bovine and six pork livers for approximately 130 students. Therefore, student access to livers is limited. However, our core course is attended by a total of

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