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der Freien Universität Berlin

Teaching Evidence-Based Veterinary Medicine –

New insights into critical thinking, implementation of writing of knowledge synthesis and use of mobile devices by students

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Meiner Familie

Ein einzelnes Tier zu retten verändert nicht die Welt,

aber die ganze Welt verändert sich für dieses eine Tier!

Spruch: Herkunft unbekannt

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1. INTRODUCTION

1.1 Evidence-Based Veterinary Medicine

Evidence-Based Veterinary Medicine (EBVM) is a relatively new field[1] in veterinary curricula and veterinary practice[2]. Although the roots of Evidence-Based Medicine (EBM) date back more than 150 years, the modern concepts of EBM have been rapidly and constantly developing in the past two decades[3]. Healthcare has been steadily moving towards EBM since the term was formally introduced in 1992 by a group led by Gordon Guyatt at McMaster University, Canada[4, 5] and continuously developed under the direction of David Sackett[6]. EBM has been defined as the conscientious, explicit and judicious use of current best evidence in making decisions regarding the care of individual patients[7]. During the years a variety of expressions have evolved around the term EBM. Those include, for instance, Evidence-Based Practice (EBP), Evidence-Based Nursing (EBN), or Evidenced-Based Veterinary Medicine (EBVM), each one following the same core concept, namely applying the best evidence in order to make the best decision.

In the field of veterinary medicine, however, the concept of EBM emerged only 10 years later[8, 9] because the concepts developed in human medicine should also be applied to veterinary medicine for scientific, medico-legal, economic and ethical reasons[8, 10]. The aim of EBVM is to base clinical decisions regarding diagnostic procedures and treatments on recent, valid, clinically relevant research data[1, 11]. Consequently, EBVM is primarily of interest and relevance to veterinary practitioners and clinicians[12]. Based on the experiences in the various fields of human medicine, veterinarians should expect that the base of evidence for veterinary treatments is likely to expand rapidly, with positive expectations for improved treatment results[13].

1.2 Teaching Evidence-Based Veterinary Medicine

Veterinary practitioners and clinicians have to use optimal diagnostics, interventions and medications to examine and to treat their patients[11]. This statement is in accordance with claims formulated for human medicine. In that regard, claims, characteristics and approaches concerning teaching EBM and EBVM are combined in the following chapters.

In order to prepare the veterinarian for practicing EBVM, veterinary schools should teach students how to obtain and evaluate the best evidence and to apply it to their own cases, as it is shown by Steele et al.[12]. This means that special courses on EVBM including search, appraisal,

and application of scientific information since traditional teaching methods usually do not address skills such as the ability to critically read research literature[14]. EBVM concepts can and should be incorporated into all preclinical and clinical courses[15]. It has been suggested to present the basics in the first year of study which are then repeated and utilized in for example case based clinical teaching and journal clubs[16]. This approach is in accordance with several authors that have claimed a paradigm shift moving from traditional education to curricula focused on the integration of EBM[14].

One reason that EBM gained popularity is that it can be regarded as a way to better connect medical education and clinical practice[3]. Obstacles to good clinical care are factors such as the explosion of new knowledge and the barriers to translation of new information to the clinician[17]. In that context, EBM is regarded being an approach that helps clinicians to manage the high amount of new scientific information[18]. This means clinicians do not only need skills in observation, empathy with patients, communication with clients and manual dexterity, but also skills of utilizing new knowledge[13].

Some online resources have been published that aim to support teaching and self-learning of EBVM like www.ebvmlearning.org. This open access tutorial has been developed by an international team of experts and contains comprehensive information about the basics and clinical implications of EBVM. It can be used in whole or in part as standalone teaching modules to support EBVM teaching or continuing professional development[19].

1.3 Critical thinking and discussion within veterinary education

Historically, veterinary professional education has relied more on establishing solid foundations in physiology and pathophysiology and providing venues for experiential learning than it has on rigorous analytic training and solving problems[11]. Rather than merely transferring information, however, veterinary education should stimulate and motivate students and encourage them to think[20]. Still, it may be questioned if all lectures, seminars, and elective courses really meet those requirements. Frontal teaching is still applied frequently in veterinary education[21] which only rarely stimulates student interaction[22]. Besides, it does not support independent thinking and critical questioning[23].

An alternative to frontal teaching is working in small groups. Teamwork skills are regarded as essential for graduates[24]. This may be especially be true for curricula such as offered by business schools but surely also for veterinary students. Hence, group learning is an attempt to introduce students to real-world experiences before graduation[25].

1.4 New technology within the veterinary education

The rapid development of new communication technologies has influenced veterinary education already[26, 27]. For example learning management platforms such as Blackboard (www.blackboard.com) which enable lecturers to provide teaching materials online represent such a technological advance. Other well-known advantages of the integration of new technology into education is that it enables students to study independently from location and time[26].

The internet is an exhaustive tool for information search, also including an increasing number of open access resources that may be used by students and practitioners. In that regard it may be advantageous to train searching, accessing and appraising online information. Special attention has to be paid to the fact that the internet provides much information of doubtful validity and applicability.

Moreover, technology has greatly enhanced the ability of patient owners to access scientific literature and become well informed[28]. Also the confrontation with well or false informed patient owners should be addressed in veterinary teaching in future.

According to Cole-Lewis and Kershaw[29] across the world in both developing and developed countries more and more people are gaining access to the Internet via mobile devices. This enables new possibilities of mobile teaching and information access.

The information communication technology (ICT) also provides new pedagogical possibilities for under and postgraduate`s veterinary students including continuous professional education[30], e.g. lifelong learning[31]. In that regard some Apps have been developed for veterinarians that address students and/or practitioners. A list of recently available tools is published online at: https://hsl.lib.umn.edu/vetmed/help/veterinary-medicine-apps or http://www.vettechcolleges.com/blog/20-apps-for-veterinarians. Some of the presented Apps, available for iPhone or Android, are meant to support practitioners as well as students in information access and also decision making concerning diagnosis and treatment. For this purpose several Apps feature calculators to help, for example, determine drug dosages, constant rate infusions or drip rates. Others have note-taking tools, guides for terminology, and news feeds or updates[32]. Another recently tested approach to encourage active learning is via game-based applications. A survey conducted by Boutilier et al.[33] revealed a preponderantly positive response by the test persons regarding applicability and usefulness. Hence, they were also positive about the use of game-based educational applications for mobile devices as part of their

curriculum. However, there are also critical voices concerning medical Apps. According to recent studies, the majority (65 – 86%) of such tools is lacking a medical expert involvement during their development. Moreover, general concerns have come up regarding reliability and accuracy of their the medical content and, hence, potential consequences for patient safety[34].

1.5 Critically Appraised Topic

One helpful tool to facilitate the implementation of EBM by practitioners is summaries of recent knowledge like Critically Appraised Topics (CATs)[4]. CATs were first developed by three residents working with David Sackett in an effort to create a method to efficiently summarize the results of a research article[35]. Being nowadays one of the main formats for sharing information in EBP[35], a CAT is a standardized summary of research evidence organized around a clinical question[17, 35, 36], generated from a specific patient situation or problem[15]. Usually the development of a CAT comprises the following steps[15, 36-38]:

1. Development of a clinical question considering the recommendations of the PICO approach (addressing the items: patient or problem, intervention, comparison intervention and outcome)[39],
2. Searching for relevant literature and documentation of search strategies and results,
3. Retrieving the most promising articles, book chapters or other information from the library or the internet,
4. Careful reading and assessing the quality of the information,
5. Assembling the information, and formulating an answer (conclusion) to the initially formulated question.

The results can be published in journals or online databases. This way, CATs can provide easy access to the scientific literature for practitioners and clinicians who do not have either the time or specialized training to critically appraise and draw conclusions from the scientific literature[35].

Online sources such as CAT- and literature databases can be easily integrated in the education, enhancing the implementation of EBVM. According to Ismach et al.[16] letting students produce CATs is an excellent approach for teaching EBM. In addition, the authors expect that if the

topic is drawn from a patient of the students, the motivation and learning success of the exercise will be much greater. Also in veterinary education the writing of CATs by students has been successfully implemented in previous projects[1, 15]. Evaluation of a previous project revealed that students were able to find, retrieve, appraise and interpret the results of published scientific studies[15].

2. RESEARCH PAPERS

The papers are formatted according to the guidelines for authors of the respective Journal.

2.1 Do veterinary students see a need for more in-course discussion? A survey

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2.2 The use of mobile devices and online services by German veterinary students

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2.2.1 Summary

Objective: The research question of our study was to determine adoption and use of mobile devices and online services of veterinary students.

Background: New technologies support learning, communication and information transfer during the pre-professional years and the professional lifetime. Hence, mobile devices may also be a feasible tool for information access for the practitioner at any place and any time, and consequently may support better informed clinical decision making.

Evidentiary value: We conducted a survey among 124 German veterinary medical students in their third year with a median age of 23.0 years.

Methods: The survey was conducted during a lecture and contained 10 questions with preset answers to be ticked and a free text comment section. Participation was voluntary and data procession was performed anonymously.

Results: According to the answers of surveyed third year students 84.7% used a smartphone as a mobile device. The vast majority of the veterinary students used Google, Facebook and WhatsApp besides other applications.

Conclusion: Most students are familiar with mobile devices and the use of social media and information tools. Thus, new learning strategies could be developed and applied that encompasses mobile online learning and information access. These strategies could help to better address different learning types, provide sufficient interactivity and feedback and to enable veterinarians to seek and share information via the internet. However, despite promising results reporting a positive educational effect, these perceptions need to be validated in further research. In addition, it should be assessed in future surveys if veterinarians would use mobile online access to scientific data or Knowledge Summaries for better informed decision making in practice.

Application: Veterinary students and thus the next generation of veterinary practitioners are using mobile devices to a high extent. This paves the way to refine existing and to develop new education strategies. New information tools for mobile devices may help veterinarians to seek and share information. In addition, it might be worthwhile to teach veterinary students and practitioners search and appraisal of online scientific information.

2.2.2 Keywords

education, mobile devices, mobile learning, technology, veterinary education

2.2.3 Introduction

Students frequently use mobile devices for everyday activities such as talking and texting (Applegate, 2010). In 2013, more than 60 billion instant-messages and SMS were communicated every day (Informa, 2013), mostly by teenagers and adolescents (Goodarzi, Ebrahimzadeh, 2012, Herman, 2007). It is expected that this amount will be doubled by 2017 (Juniper Research; eMarketer, 2013). The rapid development of new communication technologies also has a major influence on veterinary education (Short, 2002, Valliyate, Robinson, 2012). Already now, veterinary teaching has profited considerably from advances in information communication technology (Simões, 2010). For example, computerised testing has made significant inroads into veterinary education (Folk, March, 2006). Also, learning management platforms such as Blackboard (www.blackboard.com), which enables lecturers to provide teaching materials online, and information tools like wiki systems (Kolski, Heuwieser, 2015) represent such a technological advance. A well-known advantage of the integration of new technology into education is that it enables students to study independently from location and time (Short, 2002).

Furthermore, technological advance allows the usage of virtual patients as an educational aid, as suggested by Trace et al. (2012) or Schaper et al. (2011). The most important prerequisite for this type of communication is the availability and actual use of adequate technology. According to Cole-Lewis and Kershaw (2010), across the world (in both developing and developed countries) more and more people are gaining access to the Internet via mobile phones. Consequently, more and more people do have access to current medical knowledge. Since this potentially facilitates clinical decision making, it in turn supports the implementation of Evidence-Based Veterinary Medicine. However, this means that students need to gain competence in information search and retrieval via the Internet. Little research has been published on how veterinary students actually use mobile devices (Gikas and Grant, 2013). Hence, the research question of our study was to determine adoption and use of mobile devices and online services by veterinary students.

2.2.4 Material and Methods

In March 2014, we conducted a survey among veterinary medical students in their third year. In this term of education the students participate in lectures and seminars offered by the Clinic for Animal Reproduction, Berlin, Germany. At the beginning of a lecture we asked the students

to participate in the survey. We developed the questionnaire according to statements and suggestions made by students that participated in earlier courses and seminars. Participation was voluntary. Students declared informed consent by completing the survey. The project was reviewed and approved by the Ethical Commission of the Charité Hospital associated with Freie Universität Berlin (EA 1/126/16). The students had 15 minutes to answer the questionnaire which contained 10 questions with preset answers to be ticked and a free text comment section (Figure 1). After a short introduction to the study and demographic questions (i.e. age, semester, and gender) three questions addressed the use of mobile devices. The second part dealt with the students' habits and preferences concerning the application of mobile devices. We performed descriptive statistical analysis anonymously using the statistic program SPSS for Windows (Version 22.0; SPSS Inc., Munich, Germany). We performed frequency analysis on the obtained quantitative data. Furthermore, we used cross tables to analyse the students' answers considering both genders. Finally, we analysed the quantitative data using the two tailed Fisher's Exact Test and the Pearson-Chi2-Test. We set the significance level as $\alpha = 0.05$. For a statistical analysis of free text comments we considered them as qualitative data.

2.2.5 Results

In total, 124 of 130 students (101 female and 22 male) completed the questionnaire. One participant did not specify gender, age or semester. Median age of participating students was 23.0 (IQR 22.0 – 25.0). The majority of the students (84.7%) stated to use a smartphone as a mobile device (Table 1).

Table 1: Use of mobile devices and operating systems by third year veterinary students (n = 124)

Use of mobile devices	n	%[2]
Smartphone	108	84.7
Smartphone and other electronic devices[1]	47	37.9
Conventional cell phone	18	14.5
Conventional cell phone and other electronic devices[1]	9	7.2
Operating systems	**n**	**%[2]**
Android	55	44.1
IOS	51	41.1
Android and Windows	15	12.1
IOS and Windows	12	9.7

[1] other electronic devices: tablet, E-book-reader, laptop

[2] multiple selection was possible; not all questions were answered by all participants

About one fourth of the students (23.4%) additionally utilised tablets, while 8.1% employed a laptop in addition. The given answers revealed that, regarding operating systems, students preferred IOS (41.1%) and Android (44.3%). The majority of students (78.2%) stated to have an Internet flat rate for their mobile device. Concerning online services used via mobile devices, most of the participating students (78.2%) used Google. Moreover, 62.9% of the students accessed the e-learning platform of the FU Berlin (Blackboard) via mobile devices. Similarly, the majority of students (54.0%) frequently used Google maps. Most of the respondents (61.3%) used online dictionaries occasionally while, respectively, 50.8% and 42.7% stated to consult the information platform Wikipedia often and occasionally. In addition to the suggested online services, six students (4.8%) added further options (e.g. veterinary dictionary DocCheck) as free text comments. While 15 students (12.1%) reported to have a Quick response (QR) - code reader, 18 stated to use such a tool, either often (n = 1) or occasionally (n = 17). With 74.2% and 70.2%, respectively, WhatsApp and Facebook turned out to be the most frequently used social media services (Table 2).

Table 2: Use of social media by third year veterinary students (n = 124)

	Facebook[1]	WhatsApp[1]	Telegram[1]	Skype[1]	Twitter[1]
Often	70.2 %	74.2%	1.6%	12.9%	0.8%
Occasional	18.5%	2.4%	8.9%	53.2%	0.0%
Never	8.9%	19.4%	83.1%	31.5%	92.7%

[1] multiple selection was possible; not all questions were answered by all participants

In line with that, 44.3% of the students referred to WhatsApp as their favorite application software. This was also supported by comments in the free text comment section. Moreover, more than half of the students (53.2%) occasionally used Skype; a software allowing free instant messaging and voice or video calls. On the contrary, only few students indicated a frequent or occasional use of social media like Viber (3.2%), Talk (1.6%), Twitter (0.8%), Instagram (8.9%), Telegram (8.9%) or Snapchat (2.4%). More than one-third of the students spent 2 to 4 hours per day online via mobile devices. The majority of the students (68.5%) indicated that they answer incoming messages only when they find time to do this. Veterinary online applications wished for by the responding students included a "laboratory data App" (4.8%) or learning Apps (4.8%), that were not further specified.

2.2.6 Discussion

Mobile learning and information retrieval has been growing internationally in visibility and significance (Traxler, 2007, 2010, 2012). Therefore, we wanted to investigate if German students of veterinary medicine have adopted the use of mobile devices as well. Current mobile devices are designed to allow users to enter and access data like contacts and memos, to send and receive messages, to view documents and pictures, or to access the web (Kukulska-Hulme, 2005). In 2013, 96% of people in Germany aged between 12 and 19 owned a smartphone (Kutscher, 2014). In our survey, the share of veterinary students who stated to use a smartphone regularly resembled those findings (84.7%). Moreover, the fact that the majority of the participants (78.2%) had an internet flat rate was in accordance with the findings of Wallace et al. (2012). The finding that the vast majority has mobile access to the internet indicates that online professional tools designed for mobile devices have a great potential to reach the majority of veterinary students and also presumably a growing proportion of practitioners and clinicians in Germany.

Regarding online education, the concept of 'anytime' and 'anyplace' offered by mobile learning may be an important pedagogical aspect (Bidin and Ziden, 2012). As emphasized by Smith

(2003), e-learning should accommodate different learning styles and provide sufficient interactivity, testing, and feedback to engage the user. Personalised learning can recognise diversity and individuality of the students and account for different learning styles and approaches (Traxler, 2007). One way this can be accomplished is by an assortment of tools that learners can combine to best suit their individual learning styles to increase their academic success (Rodriguez, 2011). A more recent interview-based survey showed that 90% of the participants used mobile computing devices and that this usage was believed to have a positive educational effect (Wallace, Clark, 2012). Since an interview allows face to face communication and immediate feed-back for both interviewer and interviewee, such an approach might be beneficial for further research in this area.

According to our findings, the vast majority of the veterinary students used the search engine Google (96.7%), either frequently (78.2%) or occasionally (18.5%). Those data deviate from Wallace et al. (2012), who found that 50% of those participating in their survey stated to use Google. However, their study was conducted in 2012 and the growing popularity of Google might at least partly account for these differences. Furthermore, the authors did not only interview students in their survey, but also residents and members of the faculty. Hence, as shown previously we can assume that the resulting higher average age explains for the lower usage of online media (Wolff, 2006) like the search engine (Pew Research Center. n.d., 2011). Those two aspects might also explain why only 15% of their participants used the encyclopedia Wikipedia, whereas more than half of our participants (50.8%) stated to do so. Since Wikipedia is not specific for veterinary medicine, a wiki-system designed for veterinary purposes may be advantageous (Kolski, Heuwieser, 2015). A special issue connected with this topic is the quality of provided information. It is essential to train students to critically assess information, especially if it is found on webpages or wiki systems with unknown expertise of the author. Clinical decisions based on false, incomplete or outdated data may be highly detrimental for the health and well-being of the animals.

QR-Code readers, a mobile device tool enabling the scanning of bar codes (Lorenzi, Vaidya, 2014, Ramsden, 2008), were not popular according to our survey. QR-Codes enable a quick uptake of data in a compact fashion (Lorenzi, Vaidya, 2014) or visiting a specific website without typing the address of the webpage. With regard to our survey, only 12.1% of the veterinary students used such a tool. These data correspond with earlier findings where only 2% of students had scanned a QR code with their device (Ramsden, 2008). Different promising recommendations for the use of QR-Codes within a lecture or course have been published. For example, students may easily get access to handouts, additional online presentations or

feedback questions by scanning a QR-Code integrated into a presentation (Ramsden, 2008). Another application may be a direct link to standard operation procedures or specific additional information. Surprisingly, in our survey, there were more students stating to use QR-Codes (14.5%) than having installed a QR code reader on their device. This discrepancy may indicate that some students did not read the question carefully. On the other hand, some students may have used this tool with the device of someone else or have uninstalled the reader.

A majority of the participants stated to frequently use Facebook (70.2%) or WhatsApp (74.2%). Both applications are reported to rank among the most popular ones used by young people in Germany (Kutscher, 2014, Roblyer, McDaniel, 2010). Also, 44.3% of the students referred to WhatsApp as their favorite application software. WhatsApp enables users to send and receive text messages, images, audio and video files (Church and de Oliveira, 2013). Membership of online social networks has recently exploded at an exponential rate (Cheung, Pui-Yee Chiu 2010). According to Facebook reports, they had 1.44 billion users in the first three months of 2015, out of which 1.25 billion additionally and 581 million exclusively used mobile access (Facebook, 2015a, Facebook, 2015b). As reported by Pempek et al. (2009), students use Facebook approximately 30 min per day for study purposes. Via WhatsApp, more than 10 billion messages are sent per day and it is one of the most popular paid Apps across all mobile platforms (Church and de Oliveira, 2013). Concerning possible benefits of integrating online tools into education, Greenhow (2011) emphasised that social utilities do not only have a social effect, but can also have a positive impact on learning outcomes. However, this potential positive impact on learning success should be assessed in future research, especially since current information of practical relevance is increasingly shared via social media. By allowing an almost real-time interaction between students and instructors (Gikas and Grant, 2013), the integration of social tools may promote a more student-centred course (Greenhow, 2011). This live contact with others also allows direct conversations on a topic or issue (Gikas and Grant, 2013, Traxler, 2007), and by that may support the concept of collective learning and critical discussion (Levy, 2001). Furthermore, using the highly interactive knowledge sharing features of a virtual community can increase the student's learning motivation (Wasko and Faraj, 2005). According to a study by Wu et al. (2014), the diverse resources provided in virtual communities promoted critical thinking, problem analysis, and problem-solving skills of the researched nursing students. With regard to our survey, more than one-third of the students (36.3%) spent two to four hours per day online with their mobile devices.

Some students stated that they would like to have a "laboratory data App" or other learning Apps. That circumstance that only a small proportion of surveyed students suggested new tools

may be due to the fact that only few Apps already exist for veterinary purposes or that they are rarely used. Therefore, the students may not be aware of the possibilities such Apps may provide. This issue should be surveyed in a future project. We assume that the development of such tools together with the involvement of students in the creative process might foster their motivation and consequently increase their learning outcome (Bidin and Ziden, 2012), and at the same time increase the number of applicable learning and information tools. Overall, the use of the new technology may offer the possibility to consider new learning strategies (Bidin and Ziden, 2012, Short, 2002). However, studies which attempted to systematically assess the learning success of online and mobile teaching compared to the traditional approach have hardly been published. In addition, it has to be assessed if information tools would be accepted and used by practitioners. However, it sounds plausible that a practitioner may see benefits in an App that provides dosages or other information and is accessible on-site by a mobile phone while examining the patient. In addition, online tools offering current and easily accessible research syntheses may support transfer of new knowledge into practice and enable a just in time information search. In that regard, it might be worthwhile to train the search and appraisal of online scientific information.

In spite of various interesting findings, we are aware of limitations of our survey. The small number of male students, for example, caused an uneven gender distribution (22 male vs. 101 female). Furthermore, only veterinary students of the Free University of Berlin in their third year were included. Also, the fact that many questions offered the possibility to tick more than one answer may have led to bias. However, the objective of the study was to research the distribution and use of mobile devices, and a survey is likely to be one of the best methods to acquire valuable and evaluable data. Considering that objective, we inevitably had to face the uneven gender distribution typical for veterinary schools worldwide (Kostelnik, 2010).

To sum it up, mobile devices have found its way into the everyday life of veterinary students. As shown in our survey students valued the new possibilities of online communication. Hence, the development of online learning tools and information platforms meeting the specific demands of veterinary medicine should be promoted. However, some authors criticise that mobile learning should only represent a supplement since it might imply learning across contexts and at different times, resulting in fragmented knowledge and incomplete schemata (Gikas and Grant, 2013, Tella, 2003, Traxler, 2010). Overall, the integration of mobile devices in education may assist most students in their learning (Gikas and Grant, 2013).

In conclusion, veterinary students (equivalent to the next generation of veterinary practitioners) are using mobile devices to a high extent. This paves the way to refine already existing and to develop new education and information tools for mobile devices. However, conflicts may arise since not every teacher and student is able or willing to handle mobile devices or other new technologies (Gikas and Grant, 2013). Hence, augmenting the importance of new technologies within education might lead to isolation of those not having access to mobile devices. Most importantly, although it is difficult to evaluate mobile learning (Traxler, 2007), further studies are warranted to examine the learning success. In addition, courses at universities should address skills in searching and assessing online information. Finally, it should be assessed in future surveys if veterinarians would use mobile online access to scientific data or Knowledge Summaries for better informed decision making in practice.

2.2.7 Figures and tables

Table 1: Questionnaire to assess the use of mobile devices by German veterinary students

Personal data:
Age: _____ Semester: _____ Sex: _____

Please tick the boxes

1. Which mobile devices do you use?
   ☐ Conventional cell phone
   ☐ Smartphone
   ☐ Tablet
   ☐ E-Book-Reader
   ☐ Other_____

2. Which operating system do you use?

   ☐ Android
   ☐ IOS (Apple)
   ☐ BlackBerry
   ☐ Windows
   ☐ Other_____

3. Do you have an Internet flat rate for your mobile device?

   ☐ yes
   ☐ no

4. Which online services do you use via your mobile device?

	often	occasionally	never		often	occasionally	never
Google	☐	☐	☐	Google Maps	☐	☐	☐
Dictionary	☐	☐	☐	Blackboard	☐	☐	☐
Wikipedia	☐	☐	☐				

   Other_____

5. Do you have a QR code reader?

   ☐ yes
   ☐ no

   …if yes, how often do you use a QR code?

often	occasionally	never
☐	☐	☐

6. Which social media do you use? Please indicate for all that apply!

	often	occasionally	never		often	occasionally	never
Facebook	☐	☐	☐	Twitter	☐	☐	☐
WhatsApp	☐	☐	☐	Threema	☐	☐	☐
Skype	☐	☐	☐	Viber	☐	☐	☐
Tango	☐	☐	☐	Talk	☐	☐	☐
Snapchat	☐	☐	☐	Instagram	☐	☐	☐
Telegram	☐	☐	☐				

Other_____

7. How much time per day do you spend online with your mobile devices?

Less than 1 h	1 – 2 h	2 – 4 h	more than 4 h
☐	☐	☐	☐

8. In average, after what time interval do you answer a received message?

Immediately	within 5 min	when I have time
☐	☐	☐

9. What is your favorite App?

_____

10. Which veterinary online tools would you like to have?

_____

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The manuscript, or parts of it, have not been and will not be submitted elsewhere for publication.

None of the authors have any financial or personal relationships that could inappropriately influence or bias the content of the paper.

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2.3 Evaluation of a CAT-database and expert appraisal of CATs developed by students

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3. DISCUSSION

3.1 Teaching Evidence –Based Veterinary Medicine

Generally, medical teachers are used to traditional teaching models in which they share their knowledge with the students through lectures[21]. However, many authors see a need to develop new teaching strategies in which the student is a more central element of the learning process[40] and also develops skills in discussion and critical thinking[41]. For successful teaching in general, as well as teaching EBVM in particular, teachers should not forget about a student focus. This includes to be able to respond to students' learning needs, the ability to identify exactly what students know and can do[42]. It is well accepted by most educationalists that university education does not produce the "omnicompetent veterinarian"[43, 44] and that on day one after graduation a new veterinarian does not have all the competences and skills in all areas involved in the veterinary profession[45]. This means clinicians need skills in observation, empathy with patients and clients, manual dexterity, and also other skills of utilizing new knowledge[13]. These skills need to be trained during veterinary education. In addition, it might be postulated that every graduate should be skilled in applying EBVM in order to be able to achieve the necessary information and/or competences on his or her own in cases a lack of knowledge is identified. This is a prerequisite for lifelong learning and good clinical decision making. EBVM is an important approach to stimulate critical thinking. The five steps of applying EBVM in the specific case management have been outlined in the web resource www.ebvmlearning.org [26th August 2016][46]:

1. Ask – defining a clinical question that is of interest for a special clinical care
2. Acquire – finding the best available evidence to answer the question
3. Appraise – assessing the quality of the relevant evidence found
4. Apply – implementing the evidence into clinical practice where appropriate
5. Assess – evaluating the impact of the implementation and changes in clinical practice

Applying these five steps enables the integration of specific and valid knowledge into clinical reasoning.

At the moment several countries have developed policy initiatives that require health care to be evidence-based and health science students to follow a curriculum that encompasses training of

evidence-based decision making[14]. In fact, many veterinary schools do not yet teach EBM as a required course[1], and only few offer this topic as an elective[1].

3.2 Barriers to teaching and applying EBVM

To provide best available care for the animals, each veterinarian should assess the quality of information before implementing results into practice[47]. In fact the practice of evidence-based medicine is a process of life-long and self-directed learning[5, 48]. In human medicine the need to substantiate medical decisions with scientific evidence and to integrate new knowledge into medical practice was already recognized as early as in the 1970s[5]. However, students and practitioners need also to understand that good evidence may not be available for all decisions they will make in practice[15].

Several barriers to the use, learning and teaching of EBM concepts have been identified by various authors[49-51]. Those barriers include lack of understanding the core concepts of EBVM or several personal aspects such as low motivation or lack of time or interest[51]. Also, a lack of opportunity to practice EBM as a student, and negative teacher attitudes towards EBM have been reported[50]. Lam et al[50]. also identified that students tend to learn examination oriented without a critical approach to information. Besides, often textbooks or clinical practice guidelines are used for learning and some authors stated that teachers hardly encourage students to focus EBM approaches[50].

One possibility to address these barriers is to encourage discussion within the veterinary education, rather than only relying on frontal teaching and the use of textbooks. Discussion of specific or even delicate topics may be implemented to foster students to express their opinions. As stated earlier this may lead to better knowledge retention rates, better communication skills and critical thinking.

One of the main obstacles to the application of EBVM in practice might be the lack of time in everyday practice[50, 51]. Vandeweerd et al[8]. argue that this fact might rather be due to poor veterinary practice management and possibly poor training of veterinarians, than it is criticism of EBVM itself. That means if veterinarians were better skilled in work with scientific information and tools supporting the implementation of EBVM were available these barriers would lose significance.

3.3 Critical thinking and discussion in veterinary education

As emphasized by Steinert[52], the training in critical thinking as well as case and content discussion among students and with lecturers may foster the practice of EBVM. Based on this hypothesis, the first study was conducted to learn more about the students' perception concerning discussion within veterinary medicine. Main question was if discussion is considered useful for a successful learning and if students see sufficient opportunity for discussion within seminars and elective courses or if they would welcome more opportunities to discuss specific topics. The results show that the majority of students supported discussion of clinical topics in class. Frequently given reasons were an expected improvement of learning success and the opportunity to look at one topic from different perspectives. This means that students are aware of the possibility that for example several treatment options may exist that have to be weighed against each other in terms of decision making. In contrast, the statement that ''Students are encouraged in recent courses and lectures to discuss topics critically'', was affirmed by only 24.7%. This means that critical discussion is hardly fostered by lecturers.

Multiple reasons for encouraging discussion within education have been discussed earlier by different authors. Teaching with help of discussion groups is believed to result in a high knowledge retention rates[53, 54]. This is mainly achieved because discussing certain topics is believed to encourage better integration of new information into existing knowledge[55]. In addition, discussion can be used in collaborative learning. According to Gokhale[56], in turn all sorts of collaborative learning enhance critical thinking.

Also, it is to advocate that training communication skills, especially in small groups[57], should be integrated in the education of veterinary medicine, as it is already done in human medical education[58]. The conducted study revealed a considerable dearth of and request for discussion within the veterinary education. Hence, we need new teaching strategies that promote critical communication in order to increase educational success and facilitate the implementation of EBVM.

3.4 New Technology in veterinary education

During the last decades, different new technologies have been introduced. But what is the status quo concerning those technologies within veterinary education in Germany? And is it possible to use new technologies to overcome existing barriers to use and teach EBVM? To investigate these questions, a second study was realized with a survey of focusing on the adoption and use

of mobile devices and online services by veterinary students. Currently, little research has been published on how mobile devices are actually being used by veterinary students[59]. Findings of this survey, such as the use of smartphones as mobile devices by most students and the possession of flat rate internet access indicate a certain competence of German veterinary students regarding the application of technology for mobile devices. In line with those findings, Kutscher[60] found 96% of the German population aged between twelve and nineteen owning a smartphone in the year 2013. Moreover, the fact that the majority of the participants had an internet flat rate was in accordance with the findings by Wallace et al.[61]. In addition, Traxler[62] pointed out that mobile learning has internationally been growing in visibility and significance in higher education[62]. Collectively, those findings indicate that online educational tools designed for mobile devices have a great potential to reach the majority of veterinary students in Germany. It has been recommended that the concept of 'anytime' and 'anyplace' mobile learning should be utilized to enhance the pedagogical activities in delivering lessons[63]. Concerning the choice of social media services applied by the surveyed students, WhatsApp and Facebook were stated most often, both reported to rank among the most popular ones used by young people[64] in Germany[60]. These tools may not be applications of choice for teaching. However, these results show that students are familiar with several social media applications and future learning tools may profit from these skills. As reported by Pempek et al.[65], students use Facebook approximately 30 min per day for study purposes. Concerning possible benefits of integrating online tools into education, Greenhow[66] emphasized that social utilities do not only have a social effect, but can also have a positive impact on learning outcome. By allowing an almost real-time interaction between students and instructor[59], the integration of social tools may promote a more student-centered course[66]. This live contact with others also allows direct discussion of a topic or issue[59, 62], and may support the concept of collective learning[67]. Furthermore, using the highly interactive knowledge sharing features of a virtual community can increase student learning motivation[68]. According to a study by Wu et al.[69], the diverse resources provided in virtual communities promoted critical thinking, problem analysis, and problem-solving skills of the nursing students. Overall, the use of the new technology may offer the possibility of new learning strategies[26, 63]. At this time, studies attempting to systematically assess the learning success of online and mobile teaching compared to the traditional approach have hardly been published. In conclusion technologies like mobile devices have found their way into the everyday life of veterinary students. For example, those technologies might help to overcome the barrier of time shortage within veterinary practice and education. Currently,

some instructors are developing and improving online learning tools, such as more than 9,000 faculties from 118 countries have contributed to an online library of more than 700 lectures[70].

After all, the use of mobile devices can complement the traditional learning environment, and encourage students' confidence and active participation in the learning process[69]. However, some authors emphasize that mobile learning should only represent a supplement since it might imply learning across contexts and at different times, resulting in fragmented knowledge and incomplete schemata[59, 71, 72]. Overall, the integration of mobile devices in education may assist students in their learning[59] but not completely replace lectures and practical training.

3.5 Critically Appraised Topics

The limited time to keep up to date with the current literature is not an adequate argument against the usefulness of EBM[8]. Moreover searching, accessing and reading literature is not just a fundamental component of EBM, but a fundamental component of being a good veterinarian[8].

CATs provide easy and quick access to the scientific literature for practitioners and clinicians[35]. Therefore, a research project was conducted on the preparation of CATs, their application within veterinary education and their collection and publication in a CAT- database. In this context, the developed German language CAT-database was meant to function as a tool for teaching EBVM and also - in future - as an information tool for German-speaking veterinary practitioners. In order to learn more about the attitude towards several aspects of EBVM, a second objective was to survey students´ perceptions of group work, CAT development and quality, teaching EBVM, and the quality and usefulness of the database. Finally, to also know more about the usefulness of this approach, experts in the respective field were asked to appraise the quality of CATs developed by the students.

Developing of a CAT by veterinary students

The results of the third study show that, the majority of the students support a more intense integration of critical appraisal of information into the veterinary curriculum. Gillies[24] showed that children were more willing to work with others on the assigned tasks in structured groups and they provided more elaborated help and assistance to each other than their peers in the unstructured groups[24]. Similarly, the students included in the presented study approved to like

working in groups on the development of CATs and being able to exchange opinions and discuss critical topics.

With regard to these findings, writing CATs is a good possibility to train searching and reading of literature and also already existent CATs. To facilitate and through that maybe promote critical appraisal of literature developed checklists can be used. According to these findings, the participating students considered the provided checklists to be useful[28].

To conclude, reading and developing knowledge summaries like CATs can foster the understanding and practical application of EBP.

CAT-database and the evaluation by experts

With the use of resources on the World Wide Web becoming common practice, several academic and healthcare organizations have built online CAT libraries[4]. Such databases allow a quick and easy provision with evidence-based medical information[73]. Thus, after the development of CATs by veterinary students, a next step in this research project was the collection of the CATs in a database. In particular, the objective was the development and evaluation of a German language CAT-database that could be used as a tool for teaching EBVM and also as an information source for German-speaking veterinary practitioners.

The majority of the students and experts (strongly) agreed that the developed CAT database is well structured and user-friendly. This is, among other reasons, presumably due to the fact that it is also accessible via handheld computers (PDAs), tablets or smartphones[74]. Consequently, it has the potential to provide practitioners with ready access to up to date, high-quality evidence at the point of care[74]. To further improve the databases user-friendliness, a registration routine that enables also practitioners and clinicians to access the database is recently under development.

Most experts found the formulated clinical questions to be relevant. 9 out of 13 CATs were graded as “good”. This means that students have the ability to write CATs of adequate quality. Because of the significance of medical information regarding clinical decisions and patient care, several limitations of CATs, however, have to be considered. To avoid false, biased or outdated results, students supported that CATs should be revised by experts. This claim is also supported by the majority of the experts who stated “that each CAT should be subjected to a peer review process before publication”.

In order to ensure a constant topicality, the CAT-database offers the possibility to update the developed CATs every time new literature is published. On these grounds, this task certainly is a time consuming one and must be distributed among numerous experts.

Ideally, a next step would be involving practitioners in the further development of the CAT-database. For example, they could suggest new clinical questions which in turn could be edited by students. Also practitioners would benefit from training EBVM strategies including systematic literature search, critical appraisal skills and answering clinical questions by developing a CAT. Finally, by offering a quick and easy access to high-quality literature, for example via online services or mobile devices, CAT-databases hold the potential to create valuable help for veterinary practice, research and education. Moreover, by an exchange of knowledge and expertise between the developed German CAT-database and existing international CAT-databases the coverage and quality of available information could be increased further. Essential prerequisite is that veterinary medicine has to become more responsive to the integration of recent literature and to a critical approach of information.

All in all for further studies on discussion, new technology in German veterinary education or the use of CAT-databases and the EBVM concept within the veterinary curriculum, it is recommended to use a greater number of surveyed students and experts, moreover to use more students from different veterinary schools and different study classes. In future research the practical use of the database should be evaluated by practitioners and clinicians. In addition, it would be interesting to learn more about possible limitations of CAT-databases and the reasons why some experts did not consistently agree with the statement that the CAT may be important for decision making in practice. To enhance practical usability of the different CAT-databases, projects that either enable an exchange of CATs or the combination of different databases may foster accessibility of this kind of knowledge summaries.

4. SUMMARY

Cindy Kasch: Teaching Evidence-Based Veterinary Medicine – New insights into critical thinking, implementation of writing of knowledge synthesis and use of mobile devices by students

Evidence-Based Veterinary Medicine (EBVM) is a relatively new field in veterinary curricula and veterinary practice. The aim of EBVM is to base clinical decisions regarding diagnostic procedures and treatments on recent, valid, clinically relevant research data.

Veterinary practitioners and clinicians should use optimal diagnostics, interventions and medications to examine and to treat their patients. Therefore, they should assess the topicality of their procedures and therapies to treat their patients as best as possible. This means clinicians need skills in observation, manual dexterity, and also other skills such as communication and empathy for patients and owners. Specifically, the EBVM concepts should be incorporated into preclinical and clinical courses.

For the realization of an evidence-based patient care, it is important to know core concepts of EBVM and to be skilled in five steps: formulation of a clinical question, searching for literature, assessing the validity and applicability, the implementation into practice and finally an assessment of whether the new findings have improved clinical practice.

Rather than merely transferring information, veterinary education should stimulate and motivate students and let them think critically. Frontal teaching, however, is still applied frequently in veterinary education which only rarely stimulates student interaction, besides it does not support independent thinking and critical questioning. In addition to the concept of EBVM, the critical thinking, and also the rapid development of new communication technologies has influenced veterinary education already.

One helpful tool to facilitate the access to research results and thereby the implementation of Evidence-Based Medicine (EBM) is a Critically Appraised Topic (CAT). A CAT is a standardized summary of research evidence evolved around a clinical question, generated from a specific patient situation or problem.

The overall objective of the conducted studies was to survey possibilities to include EBVM concepts in veterinary education.

For this purpose three studies were conducted:

1. In the first study the research question was, if fourth-year students consider in-course discussion useful and if sufficient possibilities for discussion are provided and supported by their lecturers. The majority agreed or strongly agreed that clinical topics should be discussed during class time. Frequently stated reasons were improved learning and the opportunity to look at topics from different perspectives. In conclusion, a considerable absence of and request for discussion within veterinary education was found. In light of these findings, we emphasize the need for new teaching strategies that promote independent thinking and critical questioning. That suggested the implementation of more discussion opportunities in well considered and moderated settings in veterinary teaching.

2. The research question of the second study was to determine adoption and use of mobile devices and online services of veterinary students. According to their answers the majority used a smartphone as mobile device. The data suggested, that most students are familiar with mobile devices and the use of social media, so that new learning strategies could be developed and applied that encompass mobile online learning. These strategies could help to better address different learning types, provide sufficient interactivity and feedback. However, despite promising results reporting a positive educational effect, these perceptions need to be validated in further research.

3. The objective of the third study was the development, the use and an evaluation of a German language database for Critically Appraised Topics (CATs). Experts of the European Board of Veterinary Specialization were asked to appraise CATs written by students. A total of 153 veterinary medicine students in their fifth year developed 21 CATs. The majority of the students stated that writing CATs is a good exercise and that it is important to train the assessment of scientific information. Nine out of 13 CATs were graded as ´good`.

In conclusion veterinary medicine should in general be more responsive to the integration of recent literature and to a critical approach of information. Specifically, the development of a CAT by students is a good approach to teach the concepts of EBVM. In consideration of new technologies, the CAT-database can be used by German veterinary students and in the future by practitioners.

5. ZUSAMMENFASSUNG

Cindy Kasch: Evidenz-basierte Veterinärmedizin in der Lehre: Neue Ansätze, um kritisches Denken zu fördern, das Zusammenfassen aktuellen Wissens zu üben und Einsichten in die Nutzung mobiler Endgeräte durch Studierende

Evidenz-basierte Veterinärmedizin (EBVM) ist ein relativ neues Gebiet, welches im Studium der Veterinärmedizin und der tierärztlichen Praxis immer mehr Beachtung findet. Das Ziel der Evidenz-basierten Veterinärmedizin ist, klinische Entscheidungen in Bezug auf diagnostische Verfahren und Behandlungen auf aktuelle, hochwertige und klinisch relevante Forschungsergebnisse zu stützen.

Tiermediziner sollten auf die optimalen Diagnostika, Medikamente und Eingriffe zurückgreifen, dabei sollten sie diese Eingriffe und Therapien auch auf ihre Aktualität prüfen können, um ihre Patienten bestmöglich zu behandeln.

Neben Fähigkeiten wie einer guten Beobachtungsgabe und manueller Geschicklichkeit sollten Tiermediziner auch gute Kommunikationsstrategien beherrschen sowie Empathie gegenüber Patienten und Besitzer zeigen können. Um dies zu unterstützen, sollten die Konzepte der EBVM frühzeitig im veterinärmedizinischen Studium unterrichtet werden.

Zur Realisierung einer evidenz-basierten Patientenversorgung ist es wichtig, die Grundidee der EBVM zu verstehen und fünf folgende Arbeitsschritte zu üben: die Formulierung einer klinischen Frage, die Suche nach Literatur, die Bewertung der Validität und Anwendbarkeit von Informationen, die Umsetzung in die Praxis und schließlich eine Beurteilung, ob die neuen Erkenntnisse zu einer verbesserten Situation in der Praxis geführt haben.

Darüber hinaus sollte die veterinärmedizinische Lehre nicht nur dem einseitigen Informationstransfer dienen, sondern die Studenten zu selbstständigem Denken motivieren. Bisher wird in der veterinärmedizinischen Lehre vielfach mittels Frontalunterricht gelehrt. Dieser regt die Studenten jedoch weder zur Interaktion an noch unterstützt er das unabhängige Denken und das kritische Hinterfragen. Neben dem EBVM-Konzept und dem kritischen Denken hat auch die rasante Entwicklung der neuen Kommunikationstechnologien die veterinärmedizinische Lehre deutlich beeinflusst.

Ein hilfreiches Mittel für einen besseren Zugang zu Forschungsergebnissen und damit die Umsetzung der Evidenz-basierten Medizin (EBM) stellt ein kritisch bewertetes Thema (Critically Appraised Topic, CAT) dar. Ein CAT ist eine standardisierte Zusammenfassung von

Forschungsergebnissen, basierend auf einer spezifischen klinischen Fragestellung, welche wiederum durch eine spezielle Patientensituation oder Problemstellung entstanden ist.

Anhand der durchgeführten Studien sollten Konzepte geprüft und weiterentwickelt werden, um das EBVM-Konzept vermehrt in die veterinärmedizinische Lehre zu integrieren.

Dazu wurden drei Studien durchgeführt:

1. In der ersten Studie waren die Kernfragen, ob Studenten in ihrem vierten Studienjahr eine Vorlesung mit Diskussionsmöglichkeiten wünschen, ob genügend Möglichkeiten zur Diskussion in bestehenden Vorlesungen zur Verfügung stehen und ob Diskussionen von ihren Dozenten unterstützt werden. Die Mehrheit der Studierenden unterstützte die Aussage, dass klinische Themen in Lehrveranstaltungen stärker diskutiert werden sollten. Die am häufigsten genannten Begründungen waren ein verbessertes Lernen und die Möglichkeit, Themen aus verschiedenen Perspektiven zu betrachten. Das abschließende Ergebnis war, dass zum jetzigen Zeitpunkt in der tiermedizinischen Ausbildung ein erheblicher Mangel an Diskussionen empfunden wird, aber ein gesteigertes Interesse an mehr Interaktion gewünscht wird. Im Hinblick auf diese Erkenntnisse ist die Notwendigkeit für neue Unterrichtsstrategien, die unabhängiges Denken und kritisches Hinterfragen fördern, zu betonen. Dabei ist die Umsetzung von mehr Diskussionsmöglichkeiten in gut durchdachten und moderierten Anteilen in der veterinärmedizinischen Lehre vorzuschlagen.

2. In einer zweiten Studie sollte erfasst werden, inwieweit Studierende der Veterinärmedizin mobile Endgeräte und Online-Dienste nutzen. Die Mehrheit der Studierenden verwendete ein Smartphone als mobiles Endgerät. Dies bedeutet, dass die meisten Teilnehmer mit mobilen Endgeräten und dem Einsatz von sozialen Medien vertraut sind. Hierdurch ergibt sich die Möglichkeit, neue Lernstrategien zu entwickeln und anzuwenden, die das mobile Online-Lernen beinhalten. Inwieweit ein Lernerfolg durch Onlinelehre erreicht werden kann, sollte in weiteren Studien untersucht werden.

3. Das Ziel der dritten Studie war die Entwicklung, der Einsatz und die Evaluation einer deutschsprachigen CAT-Datenbank. Weiterhin sollten Experten des European Boards for Veterinary Specialisation die Qualität von CATs, welche von Studierenden erarbeitet worden sind, bewerten. Insgesamt nahmen 153 Studenten der Veterinärmedizin (in 21 Gruppen) im fünften Studienjahr an der Studie teil. Die Mehrheit der Studenten gab an, dass das Schreiben von CATs eine gute Übung war, um das Beurteilen von wissenschaftlichen Informationen zu trainieren. Neun von 13 Experten bewerteten das CAT, welches ihnen zugeordnet war, als gut.

Zusammenfassend kann festgehalten werden, dass die Arbeit mit aktueller wissenschaftlicher Literatur sowie ein kritischer Umgang mit Informationen in die Lehre der Veterinärmedizin stärker eingebunden werden sollten. Insbesondere die Erstellung von CATs durch Studierende ist ein guter Ansatz, um die Konzepte der EBVM zu vermitteln. Durch Einbeziehung von neuen Technologien kann die CAT-Datenbank von Studierenden der Veterinärmedizin und auch von Praktikern in Zukunft verwendet werden.

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7. INDEX OF PUBLICATIONS

Research articles:

C. Kasch, P. Haimerl, W. Heuwieser and S. Arlt (2015)
Do veterinary students see a need for more in-course discussion? A survey
J Vet Med Educ, Aug 28:1-6.
DOI: http://dx.doi.org/10.3138/jvme.0415-053R

C. Kasch, P. Haimerl, S. Arlt, W. Heuwieser (2016)
The use of mobile devices and online services by German veterinary students
Veterinary Evidence online, Vol. 1, Issue 3
DOI: http://dx.doi.org/10.18849/ve.v1i3.41
URL: https://www.veterinaryevidence.org/index.php/ve/article/view/41/69

C. Kasch, P. Haimerl, S. Arlt, W. Heuwieser
Evaluation of a CAT-database and expert appraisal of CATs developed by students, J Vet Med Educ. (in press, accepted July 2016)
DOI: http://dx.doi.org/10.3138/JVME.0416-083R1

Oral presentation:

Kasch, C.; Heuwieser, W.; Haimerl, P.; Arlt, S. (2014):
The role of discussion in veterinary education.
1st International Evidence-Based Veterinary Medicine Network Conference
Windsor / UK – 23.10.-24.10.2014.

Arlt, S.; Haimerl, P.; Kasch, C.; Heuwieser, W. (2014):
Team-based development of Knowledge Summaries for training evidence-based veterinary medicine.
1st International Evidence-Based Veterinary Medicine Network Conference
Windsor / UK – 23.10.-24.10.2014.

Poster:

German Medical Science GMS Publishing House, 2014: KELDAT
Hamburg, Mehr Diskussionen in der veterinärmedizinischen Lehre gewünscht?

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9. DECLARATION OF INDEPENDENCE

Hiermit bestätige ich, dass ich die vorliegende Arbeit selbstständig angefertigt habe. Ich versichere, dass ich ausschließlich die angegebenen Quellen und Hilfen in Anspruch genommen habe.

Berlin, den 05.04.2017

Cindy Kasch