
















Experiences in Delivering Teaching and Learning Practices in Establishments of Veterinary Education of the Mediterranean Region Under COVID-19 Pandemic: From Crisis to Opportunities

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Abstract

In this study, the impact of coronavirus disease 2019 pandemic crisis on veterinary education in selected members of the Mediterranean Network of Veterinary Education Establishments (Bosnia and Herzegovina, France, Italy, Turkey, Jordan, Morocco, and Tunis) was analyzed. The challenges presented by the pandemic and new approaches and practices adopted by different veterinary education establishments in the Mediterranean region to address the long-term consequences of coronavirus disease 2019 on veterinary education were highlighted. Although countries in this region followed different epidemiological policies, restrictions of access of veterinary students to teaching hospitals, extramural facilities, and laboratories were prolonged over the entire time during 2020 and 2021 in most of the veterinary education establishments. It could be concluded

that strengthening the existing networks of veterinary education establishments in the region by sharing experiences, standardization of curricula (regional and international accreditation), and networking are seen as an opportunity for improvement of the quality of teaching and competence in this digital era. Unfortunately, more work is still required to achieve such an ambitious agenda including galvanization of public demands for quality education, political will to implement changes, and securing financial support and other resources to continue program development across the region.

Keywords: COVID-19, digital transformations, REEV-Med, veterinary education

Introduction

Coronavirus disease 2019 (COVID-19 pandemic), besides its huge and dramatic health consequences, resulted in a variety of social and economic disruptions, still unmeasured, across the globe. In an attempt to prevent or limit the spread of the disease, social and physical distancing was implemented by governments around the world. As a result of this lockdown policy, veterinary teaching hospitals in public universities as well as other educational institutions were closed. Different countries had different policies ranging from complete closure to targeted closure, but the impact extended to over 90% of the world's student population (Nicola et al., 2020). University lecturers, staff, and administrators were challenged by an

immediate demand to act to limit the impact of closures and facilitate the continuity of education through remote or distance learning (RL/DL).

The Network of Veterinary Education Establishments of Mediterranean Countries (REEV-Med www.reev-med.org) is an association that has been created in 2010 as the network of veterinary education establishments (VEEs) from the countries around the Mediterranean under the umbrella and support of the World Organization for Animal Health (OIE). The Mediterranean VEEs face several common issues in the field of animal health and production, animal welfare, and food safety and consequently share many unique challenges in veterinary education. Therefore, the

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main objectives of REEV-Med were to set up a process of harmonization and standardization of the veterinary curriculum in the Mediterranean region in accordance with international standards; to undergo a process of evaluation of member institutions of the REEV-Med similar to the European system of evaluation of veterinary education establishments, with the objective to train competent veterinarians both in public and private fields in accordance with the international standards applied in the fight against animal diseases, including zoonosis and food safety; to encourage the exchange of information, educational and research experiences and the facilitation of academic members and students mobility between the network institutions; and to develop and disseminate educational materials for veterinary education at all levels. Unfortunately, in the 10 years of REEV-Med existence, besides commitments and enthusiasm, the process of revolutionizing veterinary education has been slower than expected mainly due to lack of resources, resistance to change, and lack of political will in some cases.

During the Executive Committee (EC) meeting of REEV-Med held "online" on April 23, 2020, with participants from VEEs from Bosnia and Herzegovina, France, Italy, Turkey, Jordan, Morocco, and Tunisia, a working group was established with mandates to come up with advisory measures on identifying and mitigating educational gaps together with inconsistencies or inadequacies in responses to the pandemic-inflicted closures. Additionally, the EC of REEV-Med has decided to evaluate the impact of the pandemic crisis on veterinary education in selected member's establishments. In this study, an analysis of the current situation, challenges, and mitigation efforts attempted by various VEEs in the Mediterranean region are presented. In addition, innovative, new, and practical approaches to enable VEEs to better address the long-term consequences of COVID-19 on the veterinary profession and veterinary education are discussed. Furthermore, the authors share their perspective based on lessons learned on how the pandemic has changed and will impact not only the way of teaching but also what kind of upgrades are already requested in veterinary curricula.

Challenges of Veterinary Education in the 21st Century and Consequences of the Pandemic Conditions

Forming and norming the veterinary profession throughout time was influenced by external societal, economic, and technological changes resulting in wide diversification of clients (from pet owners and farmers to governments and industries (Eyre, 2011) and their specific requests and expectations from veterinary professionals. The learning outcomes of veterinary curricula driven toward omni-competencies are challenging with dynamic and diversity of changes and increasing demands to veterinarians. Feasibility and manner of achieving such standards in quantifiable and uniform fashion is a topic of ongoing and worldwide discussion among educators, administrators, and veterinary employers (Eyre, 2002; Fernandes, 2004, 2005). Nevertheless, it is evident that the gap between all-purpose veterinary education and the actual need of our society and economy continues to widen (Eyre, 2011).

In this modern era, the main drivers of veterinary curricular and schooling changes have been the day one competencies, problem-based learning, science-based decision-making competences, quality control, accreditation of establishments and programs, costs and financing, internationalization, use of information technologies, and digitalization of teaching and learning processes. The search for relevant publications using key words "veterinary education," "reform," "modernization," "information and communications technology," "e learning," and "long distance learning" shows that computerization follows general trends in evolution of veterinary education (Figure 1). Even before the COVID-19 closure, classroom lectures had been conducted using projected presentations which are more and more immersive, tech-enabled, and interactive. Web representation of veterinary faculties worldwide has been expanded from platforms for sharing information to teaching podium with e-learning and long-distance learning as integral segment of regular coursework (Fejzic et al., 2019). Digital technologies had already changed the way we teach and learn, not without challenges, for academics in adapting their teaching methods and students in accepting new ways of learning (Short, 2002).

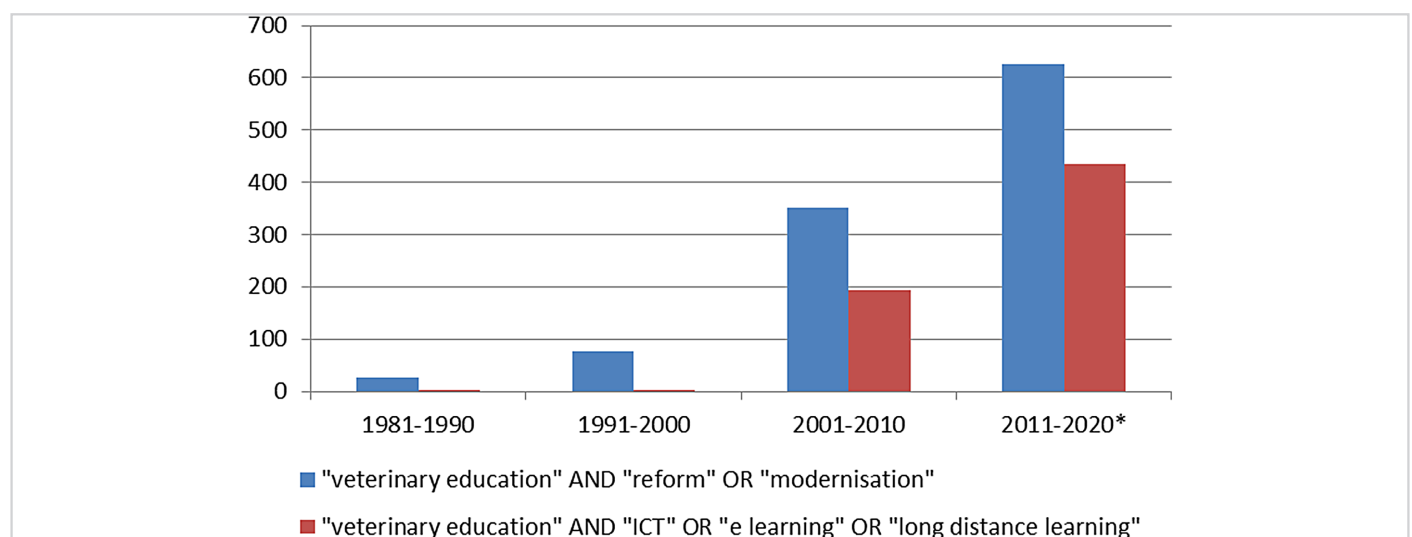


Figure 1

Google Scholar Boolean Operators. Trends in Veterinary Education Evolution and Modernization over the Last 40-Years (1981-2020).

The lockdown of universities due to the COVID-19 pandemic resulted in an unprecedented increase in the rate of usage of RL/DL and underlined the importance of innovations in veterinary education. However, it remains unclear how these practices will be reflected in learning outcomes and whether *ad hoc* introduced novel approaches such as the competency-based approach (Matthew et al., 2020) will become a new reality subsidizing or even substituting traditional face-to-face classes. Limited time for traditionally structured investigation makes it difficult to assess these issues precisely and quantitatively (Nicola et al., 2020).

Standardization of “Day-One-Competences” of Veterinary Graduates for Purpose of Evaluation and Accreditation

Curriculum reform in many VEEs has been focused mainly on the competency-based approach (Matthew et al., 2020) with self-learning by students, rather than teaching by the teachers, aiming to reach learning outcomes in all competencies and skills defined as “day one competences.” Basic, specific, and advanced competences of veterinary graduates were described in OIE recommendation on the Competencies of graduating veterinarians (“Day 1 graduates”) to assure National Veterinary Services of Quality (OIE, 2012). According to those recommendations, veterinary education is a cornerstone to assure that the graduating veterinarian not only has received a level of education and training that ensures sound overall competencies but also has the required knowledge, skills, attitudes, and aptitudes to understand and be able to perform entry-level national veterinary services tasks that relate to the promotion of animal and public health. Paradigm shift in veterinary education to developing problem-solving skills and practical skills, multidisciplinary approach, and the need for the inclusion of “soft” skills such as communication, leadership, and management were identified as priority in our ever-changing world.

OIE recommendations were intended to serve as a guideline for national-level quality assurance bodies and agencies in charge of accreditation issues. International associations and agencies, such as the European Association of Establishments for Veterinary Education (EAEVE, www.eaeve.org), were mandated to conduct external evaluation and accreditation of its members. The mission of EAEVE is to evaluate VEEs by their teaching quality and standards within, but not limited to the member states of the European Union. Evaluation and accreditation are provided by peer-review principles, assuring full compliance with teaching and learning standards of EU directives and EAEVE/FVE/OIE standards. Other internationally active evaluation agencies for VEEs exist as well. However, evaluation procedures, to check how VEE achieve current standards and learning objectives, were developed assuming traditional way of teaching and learning practices (class lectures, laboratory and animal teaching hospital clinics, extramural practices, etc.), and little was done in terms of evaluation of DL/RL practices in achieving “one day skills” in the virtual teaching environment. Other issues that bring controversy to this “evaluation of compliance with standards” approach are related to the intensity and dynamics of requests made to the veterinary profession in the global economy. Works of VEEs and challenges to veterinary professionals under pandemic conditions revealed some of the many limitations and weaknesses of the current educational process and evaluation and accreditation practices.

Impact of COVID-19 on Distance Learning Practices in Selected Countries of the Mediterranean Region

In the survey completed by 12 participating VEEs belonging to 7 countries of the Mediterranean region (Bosnia and Herzegovina, Italy, Jordan, France, Tunisia, Morocco, Turkey) conducted at the beginning and during COVID-19, data were collected regarding DL methods during three consequent periods:

- before COVID-19 closure of the universities;
- during the closure of universities; and
- after autumn of 2020 (partial opening).

The survey revealed the following findings (Table 1):

- Protection of staff, students, and clients from the epidemic were the priority of university management.
- DL resources existed and were partially applied in most of the VEEs before the pandemic.
- A systematic approach was not in place and a variety of IT platforms were used.
- Internal as well as external support for building IT infrastructure and capacity for digital transformation was limited.
- Restrictions of student access to practical sessions and animal teaching hospitals were common issues.
- The need for cost-effective digitalization methods of teaching practices is recognized.
- Most VEEs indicated that a hybrid form of teaching will likely to continue to develop and operate regardless of future pandemic status.

During the course of the pandemic in 2020, the closure of animal teaching hospitals with partial or full restriction of the availability of services to clients was common in all participating VEEs as a response of universities’ administrations to governmental orders. In the United States, veterinary colleges stopped in-person instruction as of late March 2020, but most veterinary teaching hospitals and clinics remained open for urgent or emergency appointments (Kaitlyn, 2020). Similarly, an epidemiological “lockdown” response was implemented in Mediterranean VEEs. However, different countries followed different epidemiological policies, restriction of access of students to teaching hospitals, extramural facilities, and laboratories. These restrictive measures were implemented during the entire time of the pandemic of 2020 and 2021 in most of the participating VEEs in the survey. At the same time, all VEEs continued to provide a full program of theoretical lecturing using different “online” platforms.

Discussions among veterinary educators and studies on benefits and advantages of the use of information and computer technologies in teaching and learning started few decades ago, together with development and appearance of those technologies in other aspects of our life (De Bie & Lipman, 2012; Farrell, 2020; Fejzic et al., 2019; Short, 2002). Mostly, authors confirmed that the veterinary education sector and veterinary profession will not be isolated or resistant to the rapid development of new technologies dealing with collection and processing of data, storage and communication of information, and creation of artificial intelligence tools. Only two decades ago, it was alarmed that there is a real danger of the increasing reliance on computers to deliver veterinary education (Short, 2002). More

Table 1.
Survey on Educational Practices During COVID 19 Pandemic in Mediterranean Region

Establishment	DL Before COVID19 Closure of the University				DL During COVID19 Closure of University				Education from Autumn 2020
	In place	Required	Year of Study Program	Platform/ App Used	Onset Date	Time to Adjust Since Closure	Types of Classes T/P	Support Provided	
1	Yes	Yes	All in approximately equal proportion	Microsoft Teams	March 2, 2020	1 week	All	Internally Y Externally Y	<ul style="list-style-type: none"> - Useful experience - Practical can be conducted through LDL - Need to expand ICT resources and competencies - Experiences and materials should be shared
2	Yes	Yes	First year in some of the nonprofessional theoretical courses	Adobe Connect	March 23, 2020	1.5 weeks	All theoretical and some practical	Internally Y Externally Y	<ul style="list-style-type: none"> - Limited interface with students - LDL practical limited in developing hands-on skill - Need to expand extramural teaching options - Students can watch and listen the practical examinations but cannot do it. - Therefore, the hand abilities do not develop.
3	Yes	Yes	Some of the theoretical course.	e-Kampüs	March 23, 2020	1.5 weeks	All theoretical and some practical	Internally Y Externally Y	<ul style="list-style-type: none"> - Students can get the theoretical and practical on-line. - Some of the internship education is face to face in faculty with small groups (five students). - The animal hospital and laboratories are open to service and scientific projects.

Table 1. Survey on Educational Practices During COVID 19 Pandemic in Mediterranean Region (Continued)

Establishment	DL Before COVID19 Closure of the University				DL During COVID19 Closure of University				Education from Autumn 2020	
	In place	Required	Year of Study Program	Platform/App Used	Onset Date	Time to Adjust Since Closure	Types of Classes T/P	Support Provided		Self-Evaluation Remarks
4	Yes	Yes	First year in some of the nonprofessional theoretical courses	Zoom, Google meet	March 23, 2020	1,5 w	All theoretical and some practical	Internally Y Externally Y	<ul style="list-style-type: none"> - Students can get the theoretical knowledge. - Students can watch and listen the practical examinations but cannot do it. - Therefore, the hand abilities do not develop. 	<ul style="list-style-type: none"> - All of the lectures (theoretical and practical) on-line except clinical practices and internship. - Clinical practices and some of the internship education is face to face in faculty with small groups. - The animal hospital and laboratories are open to service and scientific projects.
5	Yes	Yes, for some courses	All	Google classroom Meet/Zoom	April 6, 2020	1 week	All theoretical and some practical	Internally Y Externally -	<ul style="list-style-type: none"> - LDL can be used in full for theoretical but not for practical classes - Useful experience (expanded teaching approaches, more flexibility for students) - With LDL more classroom time can be dedicated to practical 	
6	Yes	Yes, for some courses	All, more or less in similar percentage	Webex	Mid March, 2020	2 weeks	All theoretical and some practical	Internally Y Externally Y	<ul style="list-style-type: none"> - Demanding but experience - Some practicals can be also conducted through LDL, but there are conflicting opinions - Need to improve ICT resources and teachers competencies (a radical change of attitude is needed)- Experiences gained and teaching materials should be made publicly available and/or shared (although problem of language) 	<ul style="list-style-type: none"> - Theoretical lectures are being issued online (Webex platform + Moodle), while practical lectures/hands-on activities are done (in small groups) in the labs/vet hospital/farms/abattoirs/etc.

Table 1.
Survey on Educational Practices During COVID 19 Pandemic in Mediterranean Region (Continued)

Establishment	DL Before COVID19 Closure of the University				DL During COVID19 Closure of University				Education from Autumn 2020		
	In place	Required	Year of Study Program	Platform/ App Used	Onset Date	Time to Adjust Since Closure	Types of Classes T/P	Support Provided		Self-Evaluation Remarks	
7	Yes	Yes, for some courses	All in approximately equal proportion	Moodle Zoom	March 11, 2020	1-2 weeks	All theoretical and some practical	Y	N	Theoretical lectures continued; however, practical lessons stopped during lockdown	Theoretical lectures on-line, practical in class/lab/clinics/extramural
8	Yes	Yes	All	Zoom Google meet Google Classroom Plataforma Edimondo Plataforma Formavet	April 6, 2020	2 weeks	All theoretical and some practical	Y	N	Useful for some theoretical but not practical activities	All theoretical lectures are done on-line via different platform. The animal hospital for large and small animals and laboratories are open to service and scientific projects but not for the students until now. Beginning November 9 will start receiving 50% of students given the priority to the practical activities.
9	No	Yes for some courses	Less than 5 %	Adobe content YouTube Google meet Zoom MS teams E Learning Moodle	March 16, 2020	1 week	All theoretical and some practical	Y	Y	Useful experience and will help university to move to 30% online teaching as planned before the closure. Need to find better way to teach practical courses.	Theoretical lectures are being delivered online (Moodle, MS teams, Zoom and recorded lectures). Practical lectures/hands-on activities are done (in small groups) in the labs/vet hospital/farms/abattoirs/etc.. However, with the surge in Corona cases, most of the labs are changed to the online platform by November 2020

Table 1.
Survey on Educational Practices During COVID 19 Pandemic in Mediterranean Region (Continued)

Establishment	DL Before COVID19 Closure of the University				DL During COVID19 Closure of University				Education from Autumn 2020	
	In place	Required	Year of Study Program	Platform/ App Used	Onset Date	Time to Adjust Since Closure	Types of Classes T/P	Support Provided		Self-Evaluation Remarks
10	Yes	Yes for some courses	All, more or less in similar percentage	Moodle	March 16, 2020	1 week	All theoretical and some practical	Internally Y Externally N	Theoretical lectures and seminars continued, Practical lessons stopped from mid March to mid May	From September to end of October, all courses were given as usual. Since beginning of November, theoretical lectures and seminars are on-line.
11	Yes	Yes for some courses.	All, more or less in similar percentage	MS Teams	March 16, 2020	24 hours	All theoretical and practical	Internally Y Externally N	Most of the teaching was provided numerically. A very discrete loss of teaching sessions. Almost everything was maintained	From September to end of October, all courses were given as usual. Since beginning of November, clinical practice maintained in the clinics (second and fifth year in the clinics). All teaching sessions provided numerically for the second, fifth and other years, without any loss
12	Yes	Yes for some courses	All	Moodle, Teams	March 16, 2020	1 week	All theoretical and some practical	Internally Y Externally Y	Lack of training and support to new numeric tools for the teachers; examination sessions were not satisfactory	Lectures are online – Practical are mostly onsite for the first and third year students. Laboratories and clinics are open for the fourth and fifth year students; the number of third year students onsite is adapted depending on the rotations; examination sessions are mostly online.

Note: DL = distance learning.

dramatically, in that time, it was warned that traditional academic lecturing could eventually be replaced by computers, and there is a risk that smaller academic centers will not be able to compete with the larger academic institutions and private providers. We witness today how digital education is new reality and becoming routine in our work.

E-learning has potential to drive down the costs of veterinary studies, considered to be one of the most expensive among other professions. However, the cost of software, hardware, and the cost of developing appropriate course material have been supported so far (De Bie & Lipman, 2012; Nicola et al., 2020). Technical and financial demands of implementing new approaches and practices based on digital technologies may even compromise existing fragile viability of higher education institutions ultimately affecting the quality of education provision (Short, 2002). Another important issue is the training of the teachers themselves, and the access/availability and maintenance of technologies, infrastructure, and capacity building that in addition may contribute to “digital divide” among countries. The effect of the digital divide or the issue of affordable access to digital infrastructure and technologies, not just between the countries/universities but also within individuals due to variations in income and affordability of gaining access to technological commodities has been realized more than ever as a direct result of this pandemic (Mahdy, 2020; Nicola et al., 2020). In some countries, internet access and band issues are still an obstacle of some form affecting mainly the transmission of virtual content to end users (students) (i.e., content rich with audio/video and other high memory load items).

Solutions Towards New Approaches and Practices for Addressing the Long-Term Consequences of COVID-19 on Veterinary Profession and Veterinary Education

New learning technologies are constantly developing. While time to evolve of traditional teaching tools such as textbooks and blackboard was measured over hundreds of years (Short, 2002), most of the new technologies used today in education are not older than a decade. With the same pace, arises the need to adapt and create learning content and develop appropriate teaching practices to accommodate fast updates in technologies. In addition to sharing digitally written materials, teachers have various options to ensure or even improve interaction with students and their engagement through blended learning. Developers of e-learning environments today understand better how people learn in order to design methods that interact with students and encourage a deeper approach to learning (Gormley et al., 2009).

The findings and elaborations presented in this study are an incentive to support the networking of VEEs, partly due to the rising request for international accreditation of institutions and programs. Even more accentuated with COVID-19 experiences, fostering global and regional cooperation is pivotal in driving forward improvements and advances of veterinary education and research in the future in spite of resources deficit (Eyre, 2018; Farrell, 2020; Fernandes, 2004). In fact, the need for adjusting legal and accreditation requirements to novel practices was recognized well before the pandemic (Eyre, 2018; Fernandes, 2004).

A study conducted by Mahdy (2020) showed that the COVID-19 pandemic lockdown affected the academic performance of the majority of students with varying degrees. Immediate support measures

in response to COVID-19, almost universally, were not directed to the education sector. However, dire circumstances can sometimes force changes that might not be considered during better times. It is a common knowledge that the education sector has difficulty in setting priorities and measuring the outcomes, while uncouthly confirmed by COVID-19 challenges that this process needs to be managed, evaluated, and most importantly appropriately awarded. In today's fast-moving, ever-changing environment, if progress is a goal, new “tricks” need to be learned and become sufficiently adaptable including nimble enough to embrace the unforeseen (Eyre, 2011). A fixed physical location is no longer the *sine qua non* for education, especially regarding digital technologies widely available and in use enabling that learning can take place wherever, whenever, and however. Facing the heightened challenges could be an opportunity to bridge existing inconsistencies among multiple roles that veterinary medicine has today, veterinary curricula, and better career options for new veterinarians. Distance learning use in veterinary education was challenged for being driven more by novelty, than pedagogical evidence (Gormley et al., 2009), but regardless of that, now there is a necessity we should not take for granted that DL is “lesser way” or “temporary/necessary evil” but strive to take advantage of new opportunities it provides. For example, it could be a benefit for a network such as REEV-Med, opening access to common virtual courses and exchange of digital modules, in spite of some language's difficulties.

Distance Learning and Different Types of Classes

The implication of long-distance (online) learning is providing the learner with more choices. Digital resources make data, content, and material indefinitely more accessible and versatile, notwithstanding the role of an educator who becomes less in role of provider of knowledge but, in turn, act as a facilitator in the learning process. Indeed, theoretical lessons conducted by different veterinary establishments through DL during the COVID-19 lockdown had been positively perceived by students, as better than practical lessons (Mahdy, 2020).

Practical lessons which generally represent a substantial part of the veterinary program are purposed to develop both hands-on skills and competencies of critical thinking and decision-making. The extent to which they are initially provided through DL during COVID-19 lockdown, in general, was purely observational with veterinary schools adapting schedules and capacities to accommodate compensation of face-to-face clinical and laboratory teaching (Eyre, 2018). However, some experiences and avenues (i.e., virtual clinics based on real cases and webinar-based workshops) had emerged and need to be further exploited for accommodating the teaching of practical lessons through DL. Several studies had previously addressed the use of (digital) games and simulators in several disciplines of the veterinary curriculum (De Bie & Lipman, 2012). So-called “game-based learning” closely relates to “problem-based learning,” concept which is considered pivotal in adapting and modernizing veterinary curriculum in past decades. The perspective that gaming as predominantly a leisure activity is not suitable for “serious” nature of learning/teaching for highly technical and sophisticated professions had changed since in the twenty-first century training of pilots, astronauts and sailors, or even business management professionals cannot be imagined without the use of digital and virtual reality (VR) simulators. In human health sector, several VR applications

had been already developed and used particularly for practical training in clinical and laboratory skills with many based on real patient cases and realistic scenarios (De Bie & Lipman, 2012; Farrell, 2020). Nevertheless, this methodology of learning is not yet standardized in current education, but newly arisen circumstances and needs will surely promote further development of these technologies as well as their wider use. Despite the relative lack of research on their usability or the outcomes achieved, the use of VR simulators has been brought to the forefront by the current COVID-19 pandemic as viable option to deliver contextualized, hands-on training normally provided in laboratory or clinics (Farrell, 2020; Mahdy, 2020). Collaborations are needed to be established and supported with clear goals and expectations on what and how learning outcomes may be achieved through VR and simulator technologies. Recognized benefits of VR simulators include high impact on cognitive processes, immediate impact and measurable process, increased student motivation and engagement, and repetitiveness while avoiding ethical and patient-safety issues and lacking educational cases in university training polygons (De Bie & Lipman, 2012; Gormley et al., 2009). Implementing the practical part of veterinary curriculum through DL and VR thus has two issues: firstly, adaptability and availability of digital technologies that in theory and according to scares studies on the subject should meet of requirements in reaching desired competencies and skills. The second issue is whether both teachers and students are willing to place their faith in gaining appropriate knowledge in settings that almost exclusively rely on digital imitation of the hands-on work they are expected to do independently after graduation.

Distance Learning and Examination

Learning however is not just lessons and practices. For effective learning to take place, learners need the opportunity to discuss and reflect on what have they learned (i.e., final evaluation/exam). More appropriate for DL is "open book" – the concept for examinations resonates with an adopted paradigm of moving away from evaluating student knowledge and trivia towards developing clinical reasoning and problem-solving, whereas the aim of the evaluation is to assess achieved learning outcomes. Very common issue for DL veterinary students during COVID-19 lockdown was time management (deadlines, due dates, and time available to complete various tasks/test) either due to poor estimates by the teacher in forming time restraints or due to inability of students to focus in home settings or even due to technical issues that intervened (too many users at same time accessing same digital content) (Mahdy, 2020).

Conclusions

Even well before COVID-19, information and computer technologies in different forms of distance (remote) learning, web platforms (webinars), digital libraries, and virtual simulation models were in use by veterinary educators (Bowen, 2020). Partial or fulllock down, commonly adapted as response to mitigate pandemics, fostered VEEs to activate existing resources and optimize infrastructure use and continue teaching fully in a virtual mode. Simultaneously, the pandemic seriously impacted practical education and waked up existing initiatives for development of solutions to bridge gaps in practical lecturing traditionally carried out in teaching hospitals and laboratories. Challenges and impact of lockdown on the veterinary profession, in providing clinical care to patients, was even more dramatic. American Veterinary Medical Association (AVMA) (2021) published guidelines for the use of telehealth in veterinary practices. It is

evident that the pandemic made breaking impact on our profession. New approaches appeared in providing veterinary services to clients and patients (connected care, telehealth, teleadvice, telemedicine, teleconsulting, telemonitoring, mHealth, tele triage, tele supervision) and, as never seen before, strong and urgent request was presented to VEEs to provide education and training of veterinary professionals to be able to meet client's expectations and demands. Indeed, appropriate policies need to be developed and adopted to regulate those new approaches; however, issues remain how to integrate those requests in already overloaded 4, 5, or 6 years of veterinary curricula? Something should "go out" if we want to satisfy new needs and requirements. Of course, overloading of veterinary curricula and omni-competency of first day graduates is already recognized as things of past well before the pandemic (Fernandes, 2004). In order to continue our mission and stay committed in developing capacity for scientifically based decisions and critical thinking of our students, we need to keep science, including teaching of scientific theories in current curricula. However, pressure is intensifying in seeking for cost effective and specialists' skills demanded by clients and employers. Good balance of scientific basis and practical, and more commercial in short term, skills need to be better explored and recognized by standards developing bodies and evaluation and accreditation agencies. The tracking in final study year and availability of significant amount of elective modules and courses has already recognized and implemented as solution. Nevertheless, those solutions are still hardly and slowly adopted by most of VEEs in developing countries (lack of both human and other resources and employment perspectives) and even in countries with one or two veterinary faculties.

Assessment of the potential impact of the use of digital technology (DT) and artificial intelligence (AI) on veterinary education has been done by expert group of European Coordinating Committee on Veterinary training in September 2020 (EAEVE, 2020). The expert group concluded that it is fundamental that undergraduate and postgraduate students are ensured sufficient hands-on training on animals to acquire all day one competences. The use of DT and AI should therefore complement and enhance the theoretical and practical training, instead of replacing it. We can agree with this; however, several questions remain to be addressed: how to measure sufficiency and who and how will evaluate that: clients, employers, media, social networks, or evaluation and accreditation agencies? The students are actor of their education as well, they are very familiar with use of new technologies, and educators cannot ignore that.

Strengthening of existing networks of VEEs, such as REEV-Med, is seen as opportunity for improvement of quality of teaching process and even much more in this digital era (i.e., exchange of practical videos, digital case studies, guest lectures via virtual, pool of elective courses available for students). In most of countries, VEEs operate under university administration and need to satisfy national accreditation criteria set by ministries. Lack of political will and support in providing financial resources to achieve existing international accreditation standards, that is EAEVE, has seen as obstacle in continuity for developing countries.

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References

- AVMA. (2021). *Guidelines for the use of telehealth in veterinary practice*. Retrieved from <https://www.avma.org/sites/default/files/2021-01/AVMA-Veterinary-Telehealth-Guidelines.pdf>
- Bowen, M. (2020). COVID-19 has changed how we teach students. *Veterinary Record*, 186(14), 461–461. [CrossRef]
- De Bie, M. H., & Lipman, L. J. A. (2012). The use of digital games and simulators in veterinary education: An overview with examples. *Journal of Veterinary Medical Education*, 39(1), 13–20. [CrossRef]
- EAEVE. (2020). *Report on the ECCVT Expert Working Group on the impact of Digital Technologies & Artificial Intelligence in Veterinary Education and Practice*. Retrieved from https://www.eaeve.org/fileadmin/downloads/eccvt/DTAI_WG_final_report_ECCVT_adopted.pdf
- Eyre, P. (2002). Engineering veterinary education. *Journal of Veterinary Medical Education*, 29(4), 195–200. [CrossRef]
- Eyre, P. (2011). All-purpose veterinary education: A personal perspective. *Journal of Veterinary Medical Education*, 38(4), 328–337. [CrossRef]
- Eyre, P. (2018). On teaching biomedical science to undergraduates. *Journal of Veterinary Medical Education*, 45(2), 147. [CrossRef]
- Farrell, R. (2020). Beyond the classroom: Insights into the use of virtual simulation in veterinary education. *Veterinary Record*, 186(17), 559–561. [CrossRef]
- Fejzic, N., Seric-Haracic, S., & Mehmedbasic, Z. (2019). From white coat and gumboots to virtual reality and digitalization: Where is veterinary medicine now? In *IOP Conference 392 Series: Earth and Environmental Science* (Vol. 333, No. 1, p. 012009). Kopaonik, Serbia: IOP Publishing.
- Fernandes, T. H. (2004). General panorama of European veterinary education. *Journal of Veterinary Medical Education*, 31(3), 204–206. [CrossRef]
- Fernandes, T. H. (2005). European veterinary education: A bridge to quality. *Veterinary Journal*, 169(2), 210–215. [CrossRef]
- Gormley, G. J., Collins, K., Boohan, M., Bickle, I. C., & Stevenson, M. (2009). Is there a place for e-learning in clinical skills? A survey of undergraduate medical students' experiences and attitudes. *Medical Teacher*, 31(1), e6–e12. [CrossRef]
- Kaitlyn, M. (2020). Veterinary colleges go on line only amid COVID-19 concerns. *Journal of the American Veterinary Medical Association*. JAVMA News. <https://www.avma.org/javma-news/2020-05-01/veterinary-colleges-go-online-only-amid-covid-19-concerns>
- Mahdy, M. A. A. (2020). The impact of COVID-19 pandemic on the academic performance of veterinary medical students. *Frontiers in Veterinary Science*, 7, 594261. [CrossRef]
- Matthew, S. M., Bok, H. G. J., Chaney, K. P., Read, E. K., Hodgson, J. L., Rush, B. R., May, S. A., Salisbury, S. K., Ilkiw, J. E., Frost, J. S., & Molgaard, L. K. (2020). Collaborative development of a shared framework for competency-based veterinary education. *Journal of Veterinary Medical Education*, 47(5), 578–593. [CrossRef]
- Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, Maliha, & Agha, R. (2020). The socio-economic implications of the coronavirus and COVID-19 pandemic: A review. *International Journal of Surgery*, 78, 185–193. [CrossRef]
- OIE (World Organisation for Animal Health). (2012). Retrieved from <https://www.oie.int/app/uploads/2021/03/dayone-b-ang-vc.pdf>
- Short, N. (2002). The use of information and communication technology in veterinary education. *Research in Veterinary Science*, 72(1), 1–6. [CrossRef]