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A Glimpse into Chilean Veterinary Anatomy Educators

Un Vistazo a los Educadores de Anatomía Veterinaria Chilenos

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SUMMARY: In veterinary medicine, impressive technological advances in biochemistry, genetics and molecular biology have led to a reduction in the amount of time spent teaching anatomy and a shift toward anatomical research. As classically trained veterinary anatomists began to retire at the beginning of the 2000s, it became evident that there would be a shortage of qualified anatomists. This coincides with the increase in the hiring of recent graduates with general education experience and no specialization in the area. The aim of the study is to characterize the Chilean veterinary anatomy educator with an emphasis on their training and the academic environment they work in. Data were collected through a survey targeting a diverse population of university educators who teach content related to veterinary anatomy in Chile. The results showed that the Chilean veterinary anatomist has reached the master's level, with a wide range of continuous training experiences, from which it is perceived that he has acquired his anatomical and teaching skills. Furthermore, despite his self-perception as an educator/researcher, the evidence showed that research in veterinary anatomy is still in its infancy. However, strengths were identified related to the varied use of teaching resources, participation in the community and the dissemination of anatomical knowledge.

KEY WORDS:Veterinary medicine; Veterinary Anatomy; Educator; Chile.

INTRODUCTION

In Chile, in the early 2000s, as classically trained veterinary anatomists reached retirement age, it became evident that there would be a shortage of qualified anatomists in the future. A research question that arises is "*currently, who is filling that teaching gap?*". With the introduction of the digital era, the perception of who teaches veterinary anatomy is unknown, largely driven by a generational gap among teachers and mainly by administrative tensions between academic quality, optimization of resources, and program profitability. The aforementioned point is particularly relevant since the number of highly qualified veterinary anatomy educators that satisfy the growing demand derived from the increase in enrollment in Chilean universities over the past few decades is currently unknown (7,443 and 14,198 first-year students in 2005 and 2021, respectively; Consejo Nacional de Educación, 2022). It is worth noting that in 1990, the Organic Constitutional Teaching Law (Law 18.962) was enacted, creating the Higher Education Council (Consejo Superior de Educación, CSE) to supervise and accredit new private universities. As a result, 29 new universities were founded in the 1990s, bringing the total to 55 by 2004. Currently, there are 56 universities in Chile (18 public, 12 traditional private, and 26 private), of which 15 offer the veterinary medicine program. The enrollment of first-year veterinary medicine students in Chile has experienced a significant increase of 200 % in recent years (Consejo Nacional de Educación, 2022). The evolving landscape of veterinary medicine has prompted many veterinary schools to revise their curricula. This has had a significant impact on veterinary anatomy courses, resulting in a reduction of student hours in the classroom and dissection room. The focus has shifted towards a clinical-anatomical perspective, aimed at producing generalist professionals in animal health. However, it is unclear how many current veterinary anatomy educators have embraced these changes and how they are presenting relevant options to ensure the effective integration of their subject in the new curriculum, which should lead to a serious review of who teaches it and how.

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Unfortunately, given the boom in molecular biology, veterinary anatomy has not managed to interest new generations of educators, and few anatomists are being adequately trained. Although the cause is multifactorial, it seems clear that it stems largely from the radical technological changes that have impacted education and consequently curricular reforms worldwide in the last few decades. This has resulted in a reduction in teaching hours in macroscopic anatomy as well as in its context, which has led to a serious review of who teaches it and how (Drake *et al*., 2002). A similar scenario was described for human medicine decades ago: the elimination of practical hours and the abolition of anatomy demonstration activities. The result was that a new generation of surgeons assumed surgical responsibilities despite presenting weak anatomical knowledge (Inzunza *et al*., 2007; Santini *et al*., 2019). All of this shows that the generalized need to disseminate anatomical knowledge depends on the premise that educators must be highly qualified and equipped to impart this knowledge effectively and that there must be an adequate number of them. There are numerous reports questioning whether current anatomy educators are sufficient in number to meet educational needs, suggesting an apparent shortage (McCuskey *et al*., 2005; Wilson *et al*., 2018; Langley & Butaric, 2019; Schaefer *et al*., 2019; Wilson *et al*., 2020; Edwards *et al*., 2023). A series of factors has been suggested as contributing to this apparent shortage, including the transition from a discipline-based curriculum to an integrated one (*e.g*.: animal structure; anatomy, histology and embryology included as "*one package course*").

Regarding postgraduate training in Chile, a paradigm shift in veterinarians has led to an increase in their participation in programs aimed at training highly concentrated specialists in the areas of biomedicine, molecular biology, genetics, conservation medicine, innovation and patenting in faculties of sciences or human medicine to the detriment of the training of anatomists in the veterinary medicine faculties themselves (Wilson *et al*., 2021; Consejo Nacional de Educación, 2022). Undoubtedly, this is one of the challenges facing Chilean veterinary medicine postgraduates' schools. Currently, the need for anatomical training and the shortage of educators have increased concomitantly with the need for anatomical knowledge to extend beyond clinical and surgical specialties (Grunfeld *et al*., 2012; Orsbon *et al*., 2014). This situation is not unique to veterinary anatomy, as shortages have affected human anatomy educators both in the United States and abroad (Orer, 2011; Wilson *et al*., 2020), STEM disciplines, and specialized fields such as audiology (Florian, 2001).

Although Farfán *et al*. (2021) conducted an initial study characterizing the profile of Chilean morphologists, it is unclear whether these findings are applicable to the broader population of veterinary anatomists, as the study did not include a representative sample of this group. Specifically, information regarding number and academic training, available didactic tools, academic environment, research activities, and community engagement of Chilean veterinary anatomists is lacking. Therefore, the goal of our study is to provide a comprehensive characterization of Chilean veterinary anatomy educators, with a particular emphasis on their academic training and the environment in which they work.

METHODS

The study and survey protocols were approved by the Bioethics and Biosafety Committee of the Pontifical Catholic University of Valparaiso.

Survey and Validation

The data for this study were collected through the "*National Survey for Veterinary Anatomy Educators*" which was distributed to a wide and diverse audience of university educators who teach content related to veterinary anatomy in Chile. The objective of the survey was to assess the training and academic environment where veterinary anatomy educators work. This included questions related to history of academic training, jobs and the areas of teaching, research, and community outreach. A professional was considered a "*veterinary anatomy educator*" who works part or full time as an undergraduate educator in the veterinary anatomy course (or other denominations) in Chilean universities. The validation consisted of a qualitative phase where the content was validated according to Nikiforova *et al*. (2021). The validity of the survey, with the focus on the relevance of the items, was conducted by an expert panel composed of anatomy teachers and medical education experts. It involved approaching the target population and the opinion of experts who independently assessed content and response process validity (relevance, coherence, pertinence and clarity of the writing of the questions). The survey was piloted prior to full-scale distribution. Emails were sent with a survey link to a sample of convenience (n=5) of recognized veterinary anatomy educators belonging to Chilean and foreign universities. The survey was modified based on their answers and recommendations. Additionally, and to delve more deeply into potential survey responses, several medical education experts were invited to participate in individual semi-structured interviews. The interview questions (n=10) imitated the open items on the survey, so the participants responses were cross-referenced to verify the opinions of

the interviewees. Then, the items were ensured with respect to the overall assessment, which was based on the available literature. Individual responses were reviewed in relation to the target population data to detect patterns or inconsistencies, and a valid response rate of 50 % or higher was considered. Additionally, a non-response analysis was conducted to identify patterns or common characteristics among non-respondents, including a comparison of data between non-respondents and respondents.

Acquiring contacts, sending the survey, and sampling

The educators were contacted in two phases by means of i) the distribution of an email to the directors and deans of faculties and veterinary medicine schools requesting the emails of all the veterinary anatomy educators working in their respective academic units, and ii) an email sent to each of the veterinary anatomy educators working in each of the accredited universities that offer a veterinary medicine program. Once the contacts were obtained, the educators were asked if they were willing to participate (voluntary participation). Also, the participants have no known ties to the survey distributor(s). The educators who agreed to participate received a second email containing a link to an online survey that the authors created using Survey Monkey (http://www.surveymonkey.com; SurveyMonkey, San Mateo, CA, USA) together with an informed consent. The survey also employed snowball sampling, a nonprobability method where the participants contribute by recruiting potential new participants (Heckathorn, 2011). Two reminders about the survey were sent at two-week intervals. Data were collected only once, from a single time point for a given population. The results were analyzed and interpreted as frequency analysis (%).

RESULTS

In Chile, there are 26 educators teaching veterinary anatomy, of which 24 (16 men; 8 women) responded to the survey (92.3 %) and most have been linked to the discipline for 10-15 years (Fig. 1D). All universities in Chile that are accredited to offer a veterinary medicine program were included in the survey. Most of the respondents belonged to the Santo Tomás University, which also presented the greatest number of veterinary anatomy educators (Fig. 1A). With respect to the distribution, of all the respondents, 8.33 % (2 of 24) belonged to the central macrozone, 29.16 % (7 of 24) to the southern macrozone, 25.00 % (6 of 24) to the south-central macrozone, and 37.50 % (9 of 24) to the Metropolitan Region. No responses were reported from either the northern or austral macrozone.

Academic training

All respondents were veterinarians, with 50 % (12 of 24) having graduated from a university belonging to the Corporation of Private Universities (CUP in Spanish), 33.33 % (8 of 24) from the Network of Non-State Public Universities (G9), 8 % (2 of 24) from a university belonging to the Consortium of State Universities of Chile (CUECh in Spanish), and the remaining 8 % (2 of 24) from a private university affiliated with Unique Admission System (G8). Most of the respondents had a master's degree (58.33 %; Fig. 1E) with specialization in the area of morphology (33.33 %, 8 of 24) and clinical or professional sciences (33.33 %, 8 of 24; Fig. 1B). With respect to postgraduate titles, most (58.33 %, 14 of 24) stated they had attended diploma courses in the area of university education (Fig. 1C).

Academic profile

Out of 24 respondents, 70.83 % (17) indicated having a teaching/research profile while 27.17 % (7 of 24) indicated having an exclusively teaching profile. A total of 29.17 % (7 of 24) reported having completed internships or teacher training in the field of veterinary anatomy (or a related field) abroad. With respect to the workday, they stated being full time (66.67 %, 16 of 24), half time (4.17 %, 1 of 24) and part time (29.17 %, 7 of 24). With respect to the type of teaching, 4.17 % (1 of 24) indicated teaching lectures exclusively, whereas 95.83 % (23 of 24) indicated teaching both lectures and practical sessions. With respect to the teaching hours, most stated teaching theory (lectures) and practice (labs) to groups on average of 100 (41.7 %, 10 of 24) and 30 (37.5 %, 9 of 24) students, respectively (Fig. 2). In addition, they reported that the average weekly teaching hours per educator according to lectures sessions and practical activity was 2 (58.3 %, 14 of 24) and 4 (45.8 %, 11 of 24) hours, respectively (Fig. 2B).

Research

In terms of the applications and awards for research, scholarships, postgraduate or postdoctoral studies in the area of anatomy in the last 5 years, most stated not having applied for or been awarded funding in any of those areas (Fig. 3A). With respect to Web of Science articles, nearly half (43.48 %, 10 of 24) have never published (Fig. 1F). With respect to their own strengths or those of the university where they work (opportunities), most emphasized the infrastructure and the networks of academic contacts as fundamental elements to achieve development in a research line. By contrast, the greatest weakness (or barrier) was access to funding (Fig. 3B).

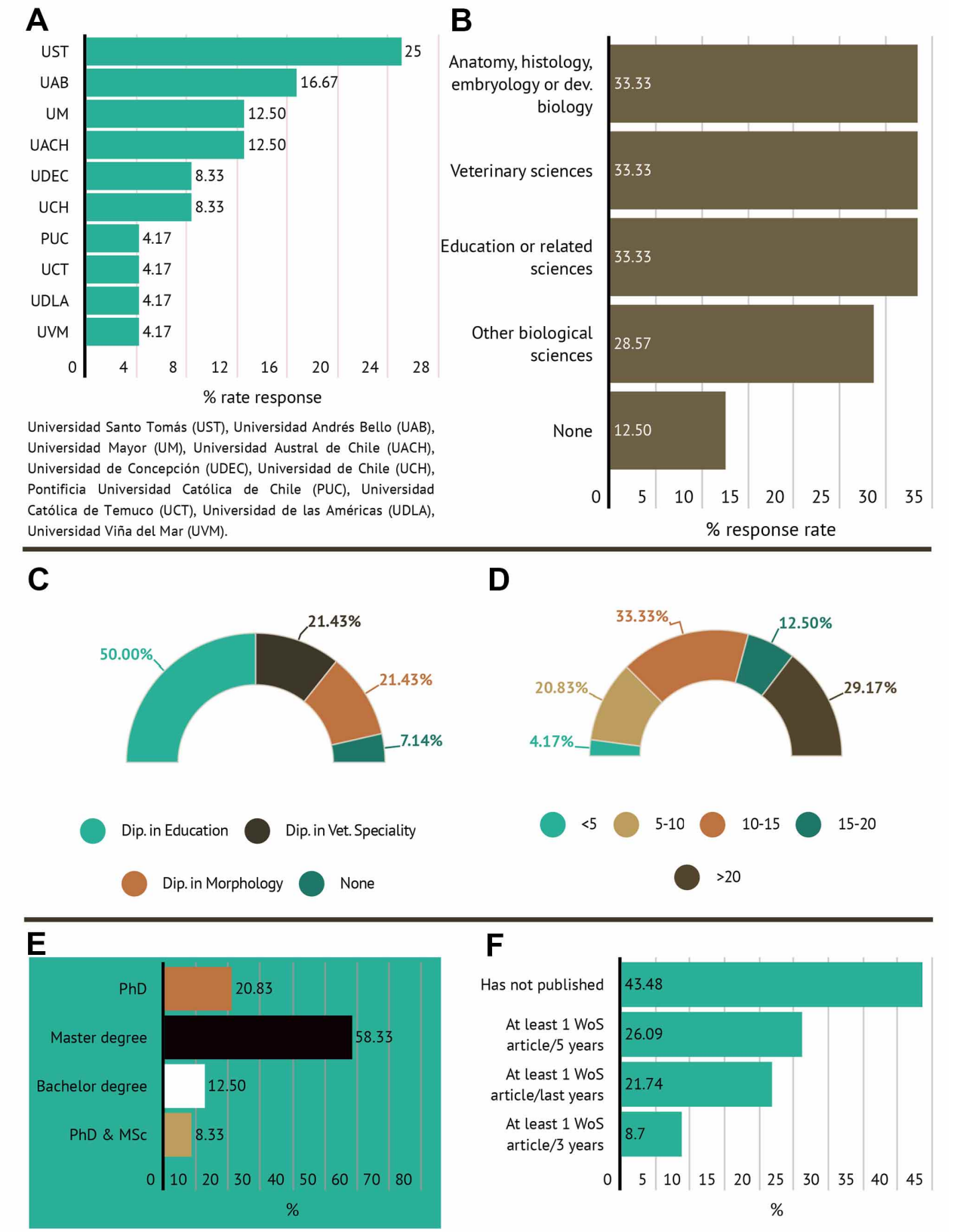

Fig. 1. (A) Academic affiliation (n=24), (B) Postgraduate area, (C) Diplomates, (D) Years of teaching experience (n=24), (E) Academic degree (n=24) and (F) Rate of WoS publications in the area (n=24)

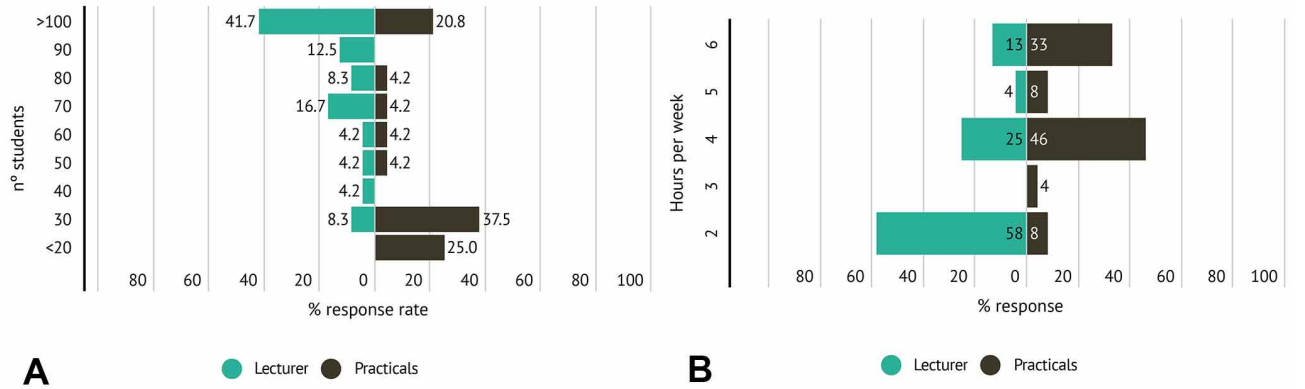

Fig. 2. (A) Students per educator to lectures and practical activity. (B) Average weekly in-person hours per educator according to theoretical and practical activity.

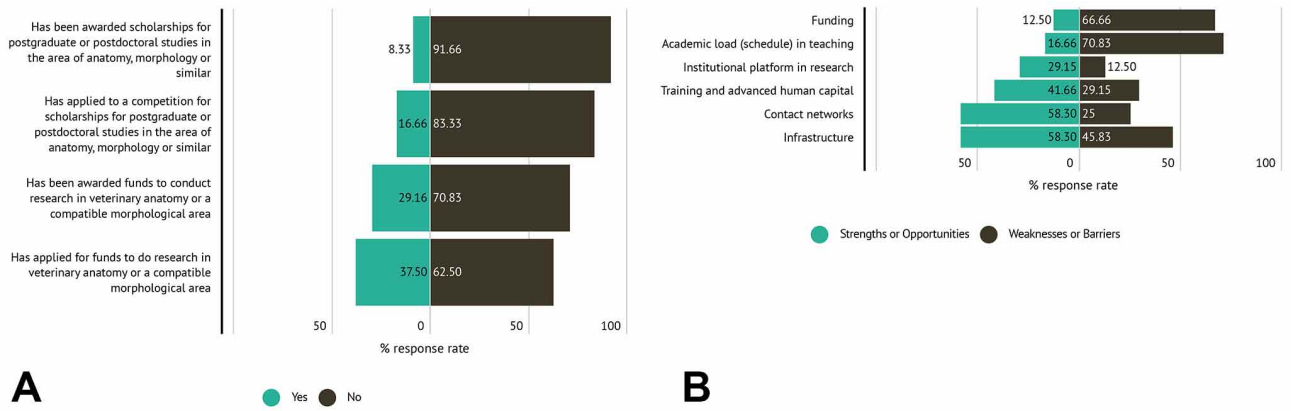

Fig. 3. (A) Scholarship applications and awards (n=24). (B) Elements available to develop a research line (n=24)

Teaching practice and teaching resources

Most of the respondents stated working in teams with other anatomists (62.50 %, 15 of 24). In addition, regarding the additional human resources that facilitate the respondents' teaching, they stated having a laboratory technician and student assistants available (62.50 %; 15 of 24), only a laboratory technician (4.17 %, 1 of 24), only student assistants (20.83 %, 5 of 24) and none (12.50 %, 3 of 24). The main activities and the approach they use in the classroom are described in Figure 4. In terms of the additional teaching resources that facilitate the teaching work, most have cadavers, skeletons and texts (100 %, 24 of 24); by contrast, plastinated specimens and 3D models are scarce

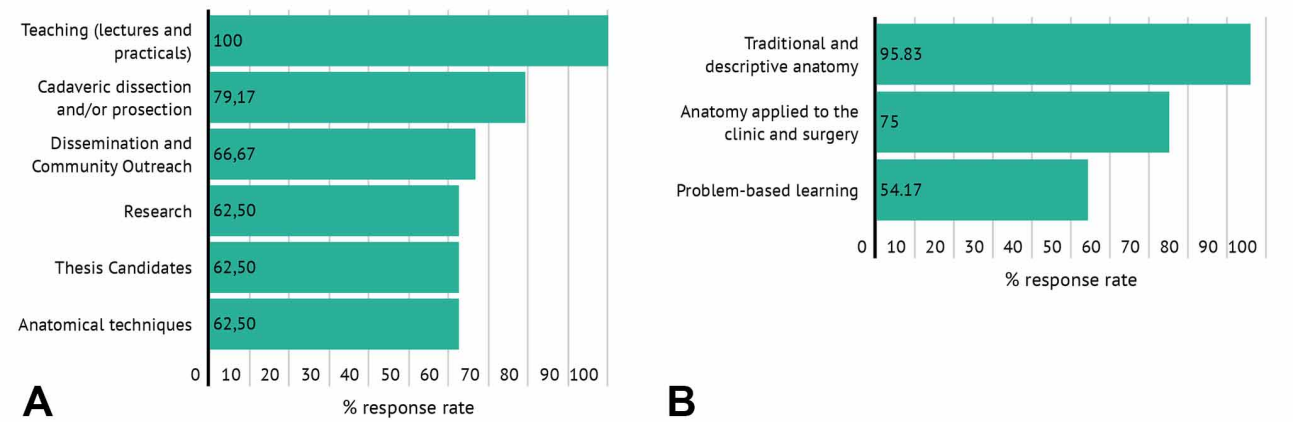

Fig. 4. (A) Main activities they perform in academic work. (B) Approach used in teaching work.

(Table I). The assessment of the teaching resources (texts, library, software, cadavers and anatomical consumables) and infrastructure (laboratories, physical spaces, accesses, ventilation, dissection rooms, refrigeration rooms, anatomical museum, bone receptacle) available for the educators was evaluated with an average of 3.78 and 3.67, respectively (scale 1-5). Out of 24 respondents, 17.4 % (4) indicated having all the necessary teaching resources at their disposal while 33.8 % (8 of 24) reported having the required infrastructure to teach effectively.

Table I. Available teaching resources*.

Resources	% (n)
Fixed cadaveric material (anatomical prosection)	100 (24)
Skeletons and disarticulated bones	100 (24)
Textbooks	100 (24)
Protocols - Guidelines – Own/Institutional textbooks	91.67 (22)
Medical images (x-rays, ultrasounds, etc.)	83.33 (20)
Software	79.17 (19)
Fresh cadaveric material (anatomical dissection)	66.67 (16)
Images and/or samples of pathology	50.00 (12)
3D Models	41.67 (10)
Platinated specimens	41.67 (10)

*Respondents could answer more than one answer alternative.

Community outreach and scientific dissemination.

Fewer than half of the respondents stated that they undertook community outreach activities (Table II). However, they declared a large number of dissemination activities of anatomical knowledge, such as presentations in schools (50 %, 12 of 24), conferences in the area (58.33, 14 of 24) and web or social media (50 %, 12 of 24). A total of 16.67 % (4 of 24) reported not engaging in the dissemination of anatomical knowledge.

DISCUSSION

This study characterizes the Chilean veterinary anatomy teacher within a complex and highly competitive academic environment, cohabiting with other disciplines and subjected to high demands of academic training, scientific production, and teaching. A survey was used to analyze their academic activities, the value of human resources and infrastructure available, their own area of research, community outreach and scientific dissemination, and indirectly their self-perception within academia. At the same time, it provides valuable information to argue for the creation of new training programs for highly qualified anatomists in universities. A positive aspect is that it represents 92.3 % (24 of 26) of veterinary anatomy educators in Chile and 87 % (13 of 15) of the universities that offer the veterinary medicine program. An important factor to consider is that the group of veterinary anatomy educators in Chile is small; therefore, the survey effectively reflects the attributes of the population. The responses were analyzed considering as an educational model that which is performed exclusively in the veterinary anatomy area, this means that the performance or the activities of the respondent in other areas, such as cellular and molecular biology, biomedical sciences, research in education, learning, Information and communications technology, etc., were not included in the analysis. The reader must consider that this study reports the responses obtained by the educators; therefore, generalizations cannot be made about their impact on the students and results linked to knowledge of these, which could be addressed in future studies. In addition, no variables related to the impact of the COVID19 pandemic were included, since the survey was applied during the final quarantine period.

Academic training

According to the evidence, 66 % (17 of 24) of the veterinary anatomists surveyed have not done postgraduate studies in anatomy, histology, embryology or developmental biology. This agrees with the report in a descriptive and general study of professionals in the area of human and veterinary medicine in Chile, where they emphasize that morphology as a discipline has not

Table II. Community outreach activities*.

Community outreach activities	% (n)
Membership in Scientific Societies	37.50 (9)
Reviewer of Scientific Articles	33.33 (8)
None	29.17 (7)
Other (summer schools, presentations in schools, presentations in clinics, book editor, dissemination activities)	25.00 (6)
Editor of Scientific Journals	8.33 (2)
Membership on Scientific Committees	4.17 (1)
Membership on Panel of Professional Experts	0.00 (0)
Membership on Advisory Council in a disciplinary area	0.0 (0)

*Respondents could answer more than one answer alternative.

shown any increase in the rate of postgraduate degrees among its academics. Nevertheless, they describe the number of morphologists (with and without specialization) has quintupled in recent years due to the increase in the university academic offerings, of which veterinary medicine has been a part. The lack of postgraduate training among Chilean morphologists is due to the scant offering of postgraduate disciplinary programs nationally (Farfán *et al*., 2021). In addition, the survey presented here revealed that almost 85 % of the respondents lack studies in continuing education in anatomy; however, most have had continuing education in education sciences or clinical veterinary specialties. Such practices have allowed educators to not only improve their knowledge in the area of anatomy, but also to acquire the additional skills needed to teach them and become involved in research, such as the evaluation of anatomical knowledge (Gutiérrez *et al*., 2017), the exploration of the use of team-based learning (Diamond *et al*., 2020), improvements in editing and updating of veterinary anatomy textbooks (Concha *et al*., 2012; Morales *et al*., 2021) and in traditional anatomy techniques and plastination (Gómez & Aburto, 2006; Bernal *et al*., 2022). It is known that being a competent educator in modern veterinary anatomy requires something more than experience in the content of the discipline (Supovitz & Turner, 2000; Mattheis & Jensen, 2014; Wilson *et al*., 2018).

According to the results, it is possible to infer that, given the comprehensive vision of the discipline, educators have been forced to acquire knowledge beyond the four traditional morphological disciplines (anatomy, histology, embryology, developmental biology) with the aim of to find their place within these evolving curricular models (Muller *et al*., 2008). This would partly explain the wide range of knowledge declared by the respondents. The question that arises is what routes were available for veterinary anatomy educators to acquire this body of knowledge? Were the postgraduate or postgraduate courses enough by themselves? It has been said that university educators require systematic development programs that incorporate reflective practice, formative assessments, regular feedback, and access to a wide range of development activities; that is, knowledge in evaluation of and for learning applied in teaching (Hendry, 2009; Steinert *et al*., 2016). The value that students of anatomical sciences place on such teaching experiences (or knowledge) has been widely reported, including improving teaching and communication skills to achieve deeper learning and greater anatomical knowledge (Evans & Cuffe, 2009; Yu *et al*., 2011; Erie *et al*., 2013).

For this, professional continuing education programs in education methodologies, education sciences, cellular or molecular biology have apparently been identified by veterinary anatomists as viable resources for professional improvement and recognized as indicators of quality in their own faculties. Accordingly, it may be suggested that continuing education is an efficient way to obtain competencies as a veterinary anatomy educator, since the courses can be done through remote learning or for short periods of intensive training without interrupting work duties. In addition, the data analysis infers that a considerable number of the respondents likely received part of their training in veterinary anatomy through their own experience as undergraduate students or other pre-professional activities (*i.e*., assistantships, short-term workstays, undergraduate thesis or internships), which is consistent with the reports in the literature (Rhodes *et al*., 2018). These experiences seem to represent important and significant means by which current educators have become "*qualified educators*" of veterinary anatomy.

This apparent deficit in postgraduate training and disciplinary deficiency occurs at a time in Chile where new veterinary medicine school and postgraduate programs are multiplying (UFRO, PUC, UCM, UOH, UDELALBA), further increasing the demand for highly qualified educators in the discipline. The evidence obtained in this survey agrees with the long-reported trend in human anatomy, which points to a tendency towards a reduction in highly qualified teaching personnel with postgraduate anatomy training (Pryde & Black, 2005; Farfán *et al*., 2021). A series of factors has been hypothesized as the cause of the apparent shortage of highly qualified academics in the area, based on the paradigm shift in postgraduate training which has led to a move from producing generalist educators in anatomy to specialists highly concentrated in one area of research (Rizzolo & Drake, 2008; Brokaw & O'Loughlin, 2015).

Research

This survey reveals information worth noting in the research area. Most of the respondents did not complete doctoral or postdoctoral training; however, they managed to secure full-time academic positions in their respective faculties. It is possible that the respondents who graduated in the last 15 years - most of whom have completed a master's degree - sought more traditional academic positions focused on teaching or education sciences, with no expectation of doctoral or postdoctoral training in morphology. This could represent a paradigm shift in medico-veterinary academia in Chile which, at least in morphology, is showing a gradual distancing from postdoctoral training. Although there has been a considerable increase in doctoral students in recent years, Chile is still in last place in the Organization for Economic Cooperation and Development for the number of doctors per million inhabitants. Despite the low ranking, the

number is greater than the one Chile presented in 2014, increasing from 0.10 % to 0.17 % (Organisation for Economic Co-operation and Development, 2020). Another interesting aspect is that 70.83 % (17 of 24) and 62.5 % (15 of 24) of respondents perceive themselves as an "educator/researcher" and they also affirm research as their "main academic activity", respectively. However, most lack doctoral training, have never published a WoS scientific article and have not applied for or been awarded a research project in the area. With respect to the development of research lines, most of the respondents identified as positive or facilitating having an adequate infrastructure and networks of contacts; however, it seems that these attributes were not sufficient to consolidate such research lines since, in addition, they emphasized that the main barriers or limitations as being the high time demand dedicated to teaching and the lack of funding. This last result is paradoxical, given that most stated not having applied for funding to do research in veterinary anatomy, being that universities from their own vice-rectors' offices provide competitions for the awarding of funds and incentives for scientific publication. It is known that the allocation of competitive funds for research promotes the development of research lines, enables ascent through the academic hierarchy, generates recognition by peers, and provides work stability (Bloch *et al*., 2014; Jessani *et al*., 2020). In addition, it is noted that most of the respondents have not done workstays or training abroad, have not applied to scholarship competitions, nor have they been awarded funding to do postgraduate studies in the area. The survey "Trajectory of Professionals with a Doctorate in Chile" (Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, 2019), indicates that the State is the main source of funding for doctoral scholarships, followed by subsidies from foreign institutions, represented by 65 % and 15 %, respectively. Some reports have pointed out that training in the acquisition of new research skills for educators strengthens the development of new research lines; however, it takes time and resources, which suggests that the lack of these can limit the implementation of more extensive future training programs and support, like master's degrees or doctorates, becoming a vicious circle. Initially, age was not included as a study variable (Hunt *et al*., 2008; Shiozawa *et al*., 2017). Yet we can infer that if there is little diversity in age, the actions to influence better training, improve institutional incentives or increase interest in being truly dedicated to aspects of research in the area would be very similar and the challenge becomes more accessible; however, if there is a great diversity, this aspect becomes more complex to address in terms of actions to take in the short, medium and long terms.

Teaching practice and resources

Chilean veterinary anatomists come from and work in various environments where they instruct a heterogenous number of students. The collected data indicate that there are 100 and 30 students per educator on average in the lectures and practical activities, respectively. This is a positive aspect, since students benefit from learning anatomy by working in small groups and interacting with their peers during the practical activities (Johnson *et al*., 2013; Drake *et al*., 2014; Prabodha *et al*., 2016). Most respondents stated that their students attended two academic hours of lectures sessions and four hours of demonstrative activities and dissection weekly. This reduction in the lectures and practical sessions, associated with the increase in the number of registered students, suggests students have poor access to education resources and particularly to cadaveric material. In the 1990s, morphological sciences were seriously affected by a curriculum reform process of multi-center origin and global reach, giving way to other disciplines, which was verified in the American, European and Asian faculties (Parker, 2002; McKeown *et al*., 2003; Plaisant *et al*., 2004; Muller *et al*., 2008; Drake *et al*., 2009; Craig *et al*., 2010; Drake *et al*., 2014). The net effect of this process was the tangible reduction in the number of credits and teaching hours in anatomy, neuroanatomy, histology and embryology courses (Drake *et al*., 2002; Inzunza *et al*., 2007). To compensate for the effects of the reduction in hours, anatomy educators have resorted to the use of mobile devices, live drawing, software (Drake *et al*., 2009; Cowan *et al*., 2010; Borrelli *et al*., 2018) and even the independent reinforcement of anatomy in later courses on the curriculum. Moreover, most indicated having additional human resources in their teaching work, such as other anatomists (part of a team of anatomists), laboratory technicians and student assistants (tutors). These student assistants are a significant contribution not only to teaching, but they also serve as a direct reference for the students, giving them confidence during the teaching and learning process (Manyama *et al*., 2016; Burgess & McGregor, 2018).

With respect to the approach to anatomy contents, most respondents declared an approach to descriptive and topographic anatomy with an emphasis on prosection and dissection, with the latter being a positive aspect as it provides students with direct contact (visual and tactile) with real anatomical samples. This enables them to improve their visual-spatial perceptions (Luursema *et al*., 2017). This information is consistent with the approach that has historically been used in the subject, mainly based on descriptive and topographic anatomy (traditional and static). However, over the past few years clinical anatomy has gained ground, emphasizing the dynamic function and interrelations of anatomical structures to prepare students for clinical practice through the use of, for example, problem-based learning (PBL), clinical cases (Thistlethwaite *et al*., 2012)

and integration with other disciplines (*e.g*., imaging). This is explained by integration being the right way for a veterinarian to think during contact with a patient. In this context, the literature indicates that both PBL and project-based learning (PjBL) have enabled the horizontal and vertical integration of different disciplines with veterinary anatomy, fostering the integration of students' knowledge (Allenspach *et al*., 2008; Grauer *et al*., 2008; Baillie *et al*., 2010; Trace *et al*., 2012). In Chile, there is evidence of the implementation of PjBL in veterinary anatomy (Borroni *et al*., 2021), which has made it possible for students to be protagonists in their learning process, since it enables them to develop skills for self-learning, teamwork, problem solving, planning, time and resource management, *i.e*., development of self-regulation competencies in learning (Carr *et al*., 2022). This suggests that educators are applying evidence-based changes from the fields of psychology and education, *i.e*., knowledge is retained when students actively participate in their learning, and curriculum integration seems to be an essential component of this process (Diamond *et al*., 2020). In this light, it may be stated that veterinary anatomy in Chile has been presented by educators mainly from a traditional view and to a lesser extent dynamically, integrating other disciplines in the veterinary medicine curriculum. Although this survey was applied when the COVID restrictions were eased, it is worth noting that as a result of this a change occurred in anatomy teaching, which forced anatomists to change or modify their conventional methods of anatomy teaching to produce learning resources online (Bassett *et al*., 2020; Byrnes *et al*., 2021; Félix *et al*., 2022).

The respondents highlight the most used teaching resources as being fixed cadavers, skeletons and disarticulated bones, textbooks and medical images (x-rays, ultrasounds, etc.). This is consistent with studies that state that cadaveric dissection is and will continue to be, along with textbooks, the most effective resource for anatomy education (Prabodha *et al*., 2016; Bharadwaja & Aman, 2017; Ghosh *et al*., 2017; Küçükaslan *et al*., 2019; Varner *et al*., 2021). The predominant use of dissection and prosection laboratories declared in the survey is consistent with the evidence (Torres *et al*., 2014; Ghosh *et al*., 2017). Other aspects they highlight are: (1) most educators use a wide variety of resources, (2) the use of software is not prolific. This is noteworthy because there is information that anatomy is more pleasant with the use of multimedia applications (Ozkadif & Eken, 2012), (3) the use of scale models and 3D models is not widespread either, which could be explained by the ease in obtaining cadaveric material, and (4) although its use is limited, plastination and the use of plastinated specimens seem to have a place in teaching, albeit in the early stages (Bernal *et al*., 2022).

Community outreach and scientific dissemination

This study demonstrated that veterinary anatomy educators undertake few community outreach activities, with membership in scientific societies being the main activity. This information is not consistent with the current roles declared by Chilean universities, because they have added - in addition to human capital formation and research - community outreach as the essential axis of their view and institutional mission (Irarrázaval, 2020). Nevertheless, the evidence demonstrates that there is great interest through the dissemination of the anatomy of domestic animals in activities as varied as presentations in schools, attendance at conferences on morphology and contents on websites or social networks. In that sense, the social networks operated by the same educators are considered promising teaching tools through which reliable content is provided, and at the same time students can interact, consult, and discuss with experts (Barry *et al*., 2016; Hennessy *et al*., 2020; Mahdy & Sayed, 2022).

Limitations

The concept of what a "veterinary anatomy educator" should be like is not clearly defined or classified in the literature; therefore, it was considered a limitation. Given the lack of previous studies in Chile and Latin America characterizing veterinary anatomy educators, it was not possible to conduct an adequate longitudinal comparison of data related to their academic training, work environment, or research activities. Furthermore, the study only reports the responses obtained from educators within their own scope of work, making it impossible to make inferences about the impact that each evaluated dimension has on students, thesis candidates, assistants, or collaborators. Although this study is not based on the opinion of students, it is still considered relevant, as the degree of anatomical learning can be evaluated during its application in professional practice. This could be addressed in future studies.

Challenges (or futures directions)

We set out to characterize the veterinary anatomy educator to list their virtues and shortcomings to improve and strengthen the discipline, however, this is really only the beginning. For there to be significant advances in the area, university policy must put attention to teacher training and activities. In this sense, based on our findings, we believe that veterinary anatomy in Chile presents the following challenges: (1) the paucity of information in Chile and the evidence contributed make it possible to state that veterinary anatomy, which occupied a prominent place on the veterinary medicine curriculum, has not made significant advances in

terms of the postgraduate training of its educators. This is relevant because the discipline responds to the need to build a solid foundation that contributes to veterinary medicine as a whole. Veterinary medicine schools and their administrations should regularly debate to find solutions to the situation raised in this study, considering both the impact on teaching and the clinical and surgical knowledge of their graduates; (2) given that in Chile there is a variety of veterinary anatomy educators in terms of academic training, it is possible that there are heterogenous learning outcomes among universities. We still do not know how deep and wide those differences are. Unfortunately, the data on the contents of each subject, the methods of delivery of the anatomy content and assessment were generally not shared by the respondents for analysis in this study. This suggests a great opportunity for interdisciplinary groups seeking to assess deeper aspects in veterinary anatomy education; (3) research in veterinary anatomy is only beginning to appear. The challenge for its development is to establish guidelines, clear goals and incentives in academic regulations with respect to the responsibilities that commit the educator to research, *i.e.*, a stimulus in academic categorization. Additionally, offering opportunities to hone research skills and future offers of continuing education may be a feasible strategy to drive the discipline and fill the gaps in the portfolios of veterinary anatomy educators, (4) in Chile, postgraduate programs in the area are currently scarce; therefore, estimating interest in the specialization must be included in a broader and more cross-sectional study. The data provided in this survey could support an exploration of new postgraduate training opportunities or offerings for future veterinary anatomists and finally, (5) veterinary anatomy educators must reflect on their motivational role in their immediate environment, including students, research assistants, thesis candidates, technicians, and collaborators. They have the opportunity to actively involve these individuals in their academic work and serve as a "role model" which could generate a deeper interest in the discipline in the long-term.

In conclusion, the data contributed by this study make it possible to hypothesize that although there is an increase in the number of veterinary medicine schools, enrolments and the demand for specialists, this increase has not been accompanied by the specialization of veterinary anatomy educators. Also, Chilean veterinary anatomy educators have reached the master's level in their education, with 10-15 years of teaching experience, and a wide range of continuing education certifications, from which it is inferred that they have acquired their teaching skills. Generally, their approach their teaching from a traditional viewpoint (descriptive and static) including aspects of clinical anatomy and problem-based learning. Although they self-perceive as an instructor/researcher and declare research to be one of their main activities, the evidence shows that this area is still in the early stages. They do, however, demonstrate strengths in activities related to the various uses of teaching resources, community outreach and the dissemination of anatomical knowledge. Studying the profile of the veterinary anatomy educator and their work environment cannot be considered static work; on the contrary, it merits constant feedback with all the educators who participate in the curriculum of later courses, to ascertain needs, weaknesses and strengths in order to propose diagnoses and better validate the subject, and therefore this becomes a need for a more comprehensive view of the patient by the future veterinarian.

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SALINAS, P. & BELMAR, L. Un vistazo a los educadores de anatomía veterinaria chilenos *Int. J. Morphol., 41(4)*:1228-1239, 2023.

RESUMEN: En medicina veterinaria, los impresionantes avances tecnológicos en bioquímica, genética y biología molecular han llevado a una reducción en la cantidad de tiempo dedicado a la enseñanza de la anatomía y un cambio hacia la investigación anatómica. Cuando los anatomistas veterinarios de formación clásica comenzaron a jubilarse a principios de la década de 2000, se hizo evidente que habría escasez de anatomistas cualificados. Esto coincide con el incremento en la contratación de recién egresados con experiencia en educación general y sin especialización en el área (licenciados, tesistas, etc.). El objetivo del estudio es caracterizar al educador de anatomía veterinaria chileno con énfasis en su formación y el ambiente académico en el que se desempeña. Los datos fueron recolectados a través de una encuesta dirigida a una población diversa de docentes universitarios que imparten contenidos relacionados con la anatomía veterinaria en Chile. Los resultados muestran que el anatomista veterinario chileno ha alcanzado el nivel de maestría, con una amplia gama de experiencias de formación continua, a partir de las cuales se infiere que ha adquirido sus competencias anatómicas y docentes. A pesar de su autopercepción como educador/investigador, la evidencia demostró que la investigación en anatomía veterinaria aún se encuentra en ciernes. No obstante, se identificaron fortalezas en actividades relacionadas con el uso variado de recursos didácticos, la participación en la comunidad y la difusión del conocimiento.

PALABRAS CLAVE: Medicina Veterinaria;Anatomía Veterinaria; Educador; Chile.

REFERENCES

Allenspach, K.; Bell, J. & Whittlestone, K. D. Interactive clinical cases in veterinary education used to promote independent study. *J. Vet. Med. Educ., 35(4)*:589-94, 2008.

Baillie, S.; Pierce, S.E. & May, S. A. Fostering integrated learning and clinical professionalism using contextualized simulation in a small-group role-play. *J. Vet. Med. Educ, 37(3)*:248-53, 2010.

Barry, D. S.; Marzouk, F.; Chulak-Oglu, K.; Bennett, D.; Tierney, P. & O'Keeffe, G. W. Anatomy education for the YouTube generation. *Anat. Sci. Educ., 9(1)*:90-6, 2016.

Bassett, D. L.; Gruber, W. A.; O'Neill, H.; Ogren, R. & Segal, L. *Bassett Collection of Stereoscopic Images of Human Anatomy. Stanford (CA), Stanford School of Medicine*, 2020. Available from: http://lane.stanford.edu/biomed-resources/bassett/index.html

Bernal, V.; Aburto, P.; Pérez, B.; Gómez, M. & Gutiérrez, J. C. A technical note of improvement of the Elnady technique for tissue preservation in veterinary anatomy. *Animals (Basel), 12(9)*:1111, 2022.

Bharadwaja, A. & Aman, M. Cadaveric dissection - Its importance and students response: a questionnaire study. *Int. J. Sci. Study, 5(2)*:252-5, 2017.

Bloch, C.; Graversen, E. K. & Pedersen, H. S. Competitive research grants and their impact on career performance. *Minerva, 52*:77-96, 2014.

Borrelli, M.; Leung, B.; Morgan, M.; Saxena, S. & Hunter, A. Should drawing be incorporated into the teaching of anatomy? *J. Contemp. Med. Educ., 6(2)*:34-48, 2018.

Borroni, C.; Pimentel-Ávila, A.; Stoore, C.; Hidalgo, C.; Diamond, K.; Vásquez-Carrillo, C.; Landerer, E. & Paredes, R. A unique approach to Project-Based Learning (PjBL) in a veterinary anatomy course. *Med. Sci. Educ., 31(2)*:511-7, 2021.

Brokaw, J. J & O'Loughlin, V. D. Implementation of an education-focused PhD program in anatomy and cell biology at Indiana University: Lessons learned and future challenges. *Anat. Sci. Educ., 8(3)*:258-65, 2015.

Burgess, A. & McGregor, D. Peer teacher training for health professional students: a systematic review of formal programs. *BMC Med. Educ., 18(1)*:263, 2018.

Burns, G. A.; Ruby, K. L.; De Bowes, R. M.; Seaman, S. J. & Brannan, J. K. Teaching non-technical (professional) competence in a veterinary school curriculum. *J. Vet. Med. Educ., 33(2)*:301-8, 2006.

Byrnes, K. G.; Kiely, P. A.; Dunne, C. P.; McDermott, K. W. & Coffey, J. C. Communication, collaboration and contagion: "Virtualisation" of anatomy during COVID-19. *Clin. Anat., 34(1)*:82-9, 2021.

Carr, A. M. N.; Kirkwood, R. N. & Petrovski, K. R. Facilitating development of problem-solving skills in veterinary learners with clinical examples. *Vet. Sci., 9(10)*:510, 2022.

Concha, I. *Anatomía del Perro.* Santiago de Chile, Ediciones Universidad Santo Tomás, 2012.

Consejo Nacional de Educación (2022, November 30). *INDICES Informe de Tendencias de Matrícula de Pregrado, 2022*. Available from: https://www.cned.cl/sites/default/files/informepregrado2022.pdf

Cowan, M.; Arain, N. N.; Assale, T. S.; Assi, A. H.; Albar, R. A. & Ganguly, P. K. Student-centered integrated anatomy resource sessions at Alfaisal University. *Anat. Sci. Educ., 3(5)*:272-5, 2010.

Craig, S.; Tait, N.; Boers, D. & McAndrew, D. Review of anatomy education in Australian and New Zealand medical schools. *ANZ J. Surg., 80(4)*:212-6, 2010.

Diamond, K. K.; Vásquez, C.; Borroni, C. & Paredes, R. Exploring veterinary medicine students' experiences with team-based learning at the Universidad Andrés Bello. *J. Vet. Med. Educ., 47(4)*:421-9, 2020.

Drake, R. L.; Lowrie Jr, D. J. & Prewitt, C. M. Survey of gross anatomy, microscopic anatomy, neuroscience, and embryology courses in medical school curricula in the United States. *Anat. Rec., 269(2)*:118-22, 2002.

Drake, R. L.; McBride, J. M. & Pawlina, W. An update on the status of anatomical sciences education in United States medical schools. *Anat. Sci. Educ., 7(4)*:321-5, 2014.

Drake, R. L.; McBride, J. M.; Lachman, N. & Pawlina, W. Medical education in the anatomical sciences: the winds of change continue to blow. *Anat. Sci. Educ., 2(6)*:253-9, 2009.

Edwards, D. N.; Meyer, E. R.; Brooks, S. & Wilson, A. B. Faculty retirements will likely exacerbate the anatomy educator shortage. *Anat. Sci. Educ., 16(4)*:618-28, 2023.

Erie, A. J.; Starkman S. J.; Pawlina W. & Lachman, N. Developing medical students as teachers: An anatomy-based student-as-teacher program with emphasis on core teaching competencies. *Anat. Sci. Educ., 6(6)*:385-92, 2013.

Evans, D. J. & Cuffe, T. Near-peer teaching in anatomy: An approach for deeper learning. *Anat. Sci. Educ., 2(5)*:227-33, 2009.

Farfán, E.; Cárdenas, J.; Espinoza-Navarro, O.; Lizana, P. A.; Pacheco, J.; Salinas, P.; Riveros, A. & Villarroel, M. Profile of morphology teachers in chilean universities. *Int. J. Morphol., 9(6)*:1615-24, 2021.

Félix, M.; Carvalho, H. J. C.; Ribeiro, R. R.; Silva, I. G. R.; Baptista, C.; Lebre Júnior, E.; Sasahara, T.; Hataka, A.; Valbão, M.C.; Porto, C.; *et al*. Development of an interactive multidisciplinary platform for the bovine neuroanatomy study. *Int. J. Morphol., 40(6)*:1546-51, 2022.

Florian, J. As fewer earn PhDs, where will audiology find tomorrow's teachers, researchers? *Hear. J., 54*:21-2, 2001.

Ghosh, S. K. Cadaveric dissection as an educational tool for anatomical sciences in the 21st century. *Anat. Sci. Educ., 10(3)*:286-99, 2017.

Gómez, J. M. & Aburto, V. P. Modificaciones del método de preparaciones anatómicas de pulmones insuflados. *Int. J. Morphol., 24(2)*:143-6, 2006.

Grauer, G. F.; Forrester, S. D.; Shuman, C. & Sanderson, M. W. Comparison of student performance after lecture-based and case-based/problem-based teaching in a large group. *J. Vet. Med. Educ., 35(2)*:310-7, 2008.

Grunfeld, R.; Banks, S.; Fox, E.; Levy, B. A.; Craig, C. & Black, K. An assessment of musculoskeletal knowledge in graduating medical and physician assistant students and implications for musculoskeletal care providers. *J. Bone Joint Surg. Am., 94(4)*:343-8, 2012.

Gutiérrez, J. C.; Gómez, M.; Sudel, G. & Prater, M. R. Anatomical knowledge in veterinary medical students in Chile. *Investig. Educ. Med., 6(22)*:70-4, 2017.

Heckathorn, D. D. Snowball versus respondent-driven sampling. *Sociol. Methodol., 41(1)*:355-66, 2011.

Hendry, G. D. Problem-based learning tutors' conceptions of their development as tutors. *Med. Teach., 31(2)*:145-50, 2009.

Hennessy, C. M.; Royer, D. F.; Meyer, A. J. & Smith, C. F. Social media guidelines for anatomists. *Anat. Sci. Educ., 13(4)*:527-39, 2020.

Hunt, J.; Stubbe, D. E.; Hanson, M.; Al-Mateen, C. S.; Cuccio, A.; Dingle, A. D.; Glowinski, A.; Guthrie, E.; Kelley, K.; Malloy, E. M.; *et al*. A 2-year progress report of the AACAP-Harvard Macy Teaching Scholars Program. *Acad. Psychiatry, 32(5)*:414-9, 2008.

Inzunza, O.; Vargas, A. & Bravo, H. Anatomy and neuroanatomy the most impair in the curricular reform. *Int. J. Morphol., 25(4)*:825-30, 2007.

Irarrázaval, I. La vinculación universitaria con el medio y los mecanismos de reconocimiento académico. *Rev. Calid. Educ., 52*:296-323, 2020.

Jessani, N. S.; Valmeekanathan, A.; Babcock, C. M. & Ling, B. Academic incentives for enhancing faculty engagement with decision-makers—considerations and recommendations from one School of Public Health. *Humanit. Soc. Sci. Commun, 7*:148, 2020.

Johnson, D. W.; Johnson, R. & Holubec, E. *Cooperation in the Classroom*. 9th ed. Edina, (MN), Interaction Book Company, 2013.

Küçükaslan, Ö.; Erdog˘an, S. & Bulut, I. Turkish undergraduate veterinary students' attitudes to use of animals and other teaching alternatives for learning anatomy. *J. Vet. Med. Educ., 46(1)*:116-27, 2019.

Langley, N. R. & Butaric, L. N. Anatomical sciences education among biological anthropology graduates: a solution to the dearth of anatomy educators? *Med. Sci. Educ., 30(1)*:129-37, 2019.

Luursema, J. M.; Vorstenbosch, M. & Kooloos, J. Stereopsis, visuospatial ability, and virtual reality in anatomy learning. *Anat. Res. Int., 2017*:1493135, 2017.

Mahdy, M. A. A. & Sayed, R. K. A. Evaluation of the online learning of veterinary anatomy education during the Covid-19 pandemic lockdown in Egypt: Students' perceptions. *Anat. Sci. Educ., 15(1)*:67-82, 2022.

Manyama, M.; Stafford, R.; Mazyala, E.; Lukanima, A.; Magele, N.; Kidenya, B. R.; Kimwaga, E.; Msuya S. & Kauki J. Improving gross anatomy learning using reciprocal peer teaching. *BMC Med. Educ., 16*:95, 2016.

Mattheis, A. & Jensen, M. Fostering improved anatomy and physiology instructor pedagogy. *Adv. Physiol. Educ., 38(4)*:321-9, 2014.

McCuskey, R. S.; Carmichael, S. W. & Kirch, D. G. The importance of anatomy in health professions education and the shortage of qualified educators. *Acad. Med., 80(4)*:349-51, 2005.

McKeown, P. P.; Heylings, D.; Stevenson, M.; McKelvey, K. & Nixon, J. R. The impact of curricular change on medical student's knowledge of anatomy. *Med. Educ., 37(11)*:954-61, 2003.

Ministerio de Ciencia, Tecnología, Conocimiento e Innovación. *Informe final del estudio de Encuesta Trayectoria de Profesionales con Grado de Doctor*. Santiago de Chile, Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, 2019. Available from: https://api.observa.minciencia.gob.cl/api/datosabiertos/download/?handle=123456789/593&filename=2019-CDH-informe-final-del-estudio.pdf

Morales, P. *Anatomía Comparada y Aplicada de Bovinos y Equinos*. Santiago de Chile, Ediciones Universidad Santo Tomás, 2021.

Muller, J. H.; Jain, S.; Loeser, H. & Irby, D. M. Lessons learned about integrating a medical school curriculum: Perceptions of students, faculty and curriculum leaders. *Med. Educ., 42(8)*:778-85, 2008.

Nikiforova, T.; Carter, A.; Yecies, E. & Spagnoletti, C. L. Best Practices for Survey Use in Medical Education: How to Design, Refine, and Administer High-Quality Surveys. *South Med. J., 114(9)*:567-71, 2021.

Orer, H. S. An overview of the doctoral education in health sciences in Turkey. *Turk. J. Biochem., 36*:35-41, 2011.

Organisation for Economic Co-operation and Development (OECD). *Health at a Glance 2019: OECD Indicators.* París, OECD Publishing, 2020. Available from: http://doi.org/10.1787/4dd50c09-en

Orsbon, C. P.; Kaiser, R. S. & Ross, C. F. Physician opinions about an anatomy core curriculum: A case for medical imaging and vertical integration. *Anat. Sci. Educ., 7(4)*:251-61, 2014.

Ozkadif, S. & Eken, E. Modernization process in veterinary anatomy education. *Energ. Edu. Sci. Tec., 4(2)*:957-62, 2012.

Parker, L. M. What's wrong with the dead body? Use of the human cadaver in medical education. *Med. J. Aust., 176(2)*:74-6, 2002.

Plaisant, O.; Cabanis, E. A. & Delmas, V. Going back to dissection in a medical curriculum: the paradigm of Necker-Enfants Malades. *Surg. Radiol. Anat., 26(6)*:504-11, 2004.

Prabodha, L. B. L.; Nanayakkara, B. G.; Ilayperuma, I.; Samarawickrama, M. B. & Johnson P. Is the cadaver dead? Learning anatomy beyond the horizon. *Int. J. Adv. Eng. Technol., 4(1)*:57-61, 2016.

Pryde, F. R. & Black, S. M. Anatomy in Scotland: 20 years of change. *Scott. Med. J., 50(3)*:96-8, 2005.

Rhodes, D.; Fogg, Q. A. & Lazarus, M. D. Dissecting the role of sessional anatomy teachers: A systematic literature review. *Anat. Sci. Educ., 11(4)*:410-26, 2018.

Rizzolo, L. J. & Drake, R. L. Anatomists debate the value of a teaching credential. *Anat. Sci. Educ., 1(2)*:60-7, 2008.

Santini, A. G.; Korndorffer, M. L.; Barraza, M. J.; Johnson, H. R.; Kaplan, J. L.; DuCoin, C. G.; Satchell, E. K. & Korndorffer Jr., J. R. A surgeon led clinically focused anatomy course increases student selection of general surgery as a career. *J. Surg. Educ., 76(3)*:694-9, 2019.

Schaefer, A. F.; Wilson, A. B.; Barger, J. B.; Azim, H. M.; Brokaw, J. J. & Brooks, W. S. What does a modern anatomist look like? current trends in the training of anatomy educators. *Anat. Sci. Educ., 12(3)*:225-35, 2019.

Shiozawa, T.; Butz, B.; Herlan, S.; Kramer, A. & Hirt, B. Interactive anatomical and surgical live stream lectures improve students' academic performance in applied clinical anatomy. *Anat. Sci. Educ., 10(1)*:46-52, 2017.

Steinert, Y.; Mann, K.; Anderson, B.; Barnett, B. M.; Centeno, A.; Naismith, L.; Prideaux, D.; Spencer, J.; Tullo, E.; Viggiano, T.; *et al*. A systematic review of faculty development initiatives designed to enhance teaching effectiveness: A 10-year update: BEME Guide No. 40. *Med. Teach., 38(8)*:769-86, 2016.

Supovitz, J. A. & Turner, H. M. The effects of professional development on science teaching practices and classroom culture. *J. Res. Sci. Teach., 37(9)*:963-80, 2000.

Thistlethwaite, J. E.; Davies, D.; Ekeocha, S.; Kidd, J. M.; MacDougall, C.; Matthews, P.; Purkis, J. & Clay, D. The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. *Med. Teach., 34(6)*:e421-44, 2012.

Torres, K.; Torres, A.; Pietrzyk, L.; Lisiecka, J.; B?on´ski, M.; Ba¸cik-Donica, M.; Stas´kiewicz, G. & Maciejewski, R. Simulation techniques in the anatomy curriculum: review of literature. *Folia Morphol. (Warsz.), 73(1)*:1-6, 2014.

Trace, C.; Baillie, S. & Short, N. Development and preliminary evaluation of student-authored electronic cases. *J. Vet. Med. Educ., 39(4)*:368-74, 2012.

Varner, C.; Dixon, L. & Simons, M. C. The past, present, and future: a discussion of cadaver use in medical and veterinary education. *Front. Vet. Sci., 8*:720740, 2021.

Wilson, A. B.; Barger, J. B.; Perez, P. & Brooks, W. S. Is the supply of continuing education in the anatomical sciences keeping up with the demand? Results of a national survey. *Anat. Sci. Educ., 11(3)*:225-35, 2018.

Wilson, A. B.; Notebaert, A. J.; Schaefer, A. F.; Moxham, B. J.; Stephens, S.; Mueller, C.; Lazarus, M. D.; Katrikh, A. Z. & Brooks, W. S. A Look at the Anatomy Educator Job Market: Anatomists Remain in Short Supply. *Anat. Sci. Educ., 13(1)*:91-101, 2020.

Wilson, A.B.; Kaza, N.; Singpurwalla, D.J. & Brooks, W.S. Are anatomy PhDs nearing extinction or adapting to change? United States graduate education trends in the anatomical sciences. *Anat. Sci. Educ., 14(4)*:432-9, 2021.

Yu, T. C.; Wilson, N. C.; Singh, P. P.; Lemanu, D. P.; Hawken, S. J. & Hill, A. G. Medical students-as- teachers: A systematic review of peer-assisted teaching during medical school. *Adv. Med. Educ. Pract., 2*:157-72, 2011.

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