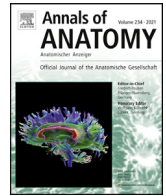




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## EDUCATION

# Teaching anatomy under COVID-19 conditions at German universities: recommendations of the teaching commission of the anatomical society



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## ABSTRACT

**Background:** In this viewpoint representatives of the Teaching Commission of the Anatomical Society summarize their teaching experiences gained during the COVID-19 pandemic in the summer term of 2020 and derive first recommendations concerning face-to-face and remote teaching of anatomy for the future.

**Methods:** Representatives of the Teaching Commission of the Anatomical Society met virtually, exchanged experiences and summarized them in writing and answered a short questionnaire.

**Results:** The required transition to remote learning during summer term of 2020 was possible, but revealed technical shortcomings and major deficits concerning practical hands-on teaching.

**Conclusion:** The Teaching Commission of the Anatomical Society recommends that universities should follow the idea of as much face-to-face teaching as possible and as much online teaching as necessary for future terms.

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## 1. Introduction

The COVID-19 pandemic has led to drastic socio-economic changes worldwide. In order to ensure everyone's health, far-reaching measures are still required, not at least within the educational system. Implementation of these actions will possibly lead to long-term effects on how German universities teach future generations of medical, dental and veterinary students as well as students and trainees in medicine related professions.

Teachers and lecturers worldwide were surprised by the rapid and unexpected events in spring 2020 related to the COVID-19 pandemic. In the past, anatomists had already developed and commonly implemented innovative computer-based teaching methods (Trelease, 2016). But the pandemic situation forced them to rapidly deliver new remote teaching concepts on an ad hoc basis and students were forced to practice remote learning and social distancing (Evans et al., 2020). Today, after completing the summer

term of 2020 and starting the winter term with yet again tightening hygiene requirements, it is imperative to look back and evaluate what worked well and what needs to be improved.

For this purpose, the representatives of the Teaching Commission of the Anatomical Society met virtually on May 20th, 2020, exchanged experiences and summarized them for members of the society in an official statement. The commission has ten members from various university locations in Germany (for detailed and personalized information reference is made to the list of colleagues mentioned under 'acknowledgements'). After the remote meeting all participants put their experiences into writing and answered a short questionnaire that included those topics that were discussed with high priority during the commission's remote meeting. Survey responses from seven members were returned, which included responses from universities organized as a subject based curriculum as well as universities providing organ-specific modules. On this basis the present viewpoint outlines first experience reports from various German universities in teaching human anatomy for medical and dental students under COVID 19 pandemic conditions. Based on their current practical experiences the authors provide some recommendations for colleague anatomists regarding the

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coming terms, and hope to induce discussions on how anatomy teaching at universities can be further developed.

## 2. Short chronology of the COVID-19 pandemic in Germany

On January 27th 2020 the SARS-CoV-2 virus was detected in Germany for the first time. The German government represented by the Ministry of Health adopted first hygiene rules (e.g. "AHA"- rules like distancing, hygiene and wearing a mouth-nose-mask) to protect the population ([Bundesgesetzblatt/Infektionsschutzgesetz](#)). In order to delay the wave of infections and to enhance COVID 19-specific capacities of health care facilities in the meantime, drastic restrictions in public life like the prohibition of large-scale events were introduced on March 16th 2020 (Release of the federal press office Nr. 96 ([Pressemitteilung 96 des Bundespresseamtes](#))). Shortly thereafter, initial plans to suspend face-to-face (F2F) teaching at universities became public. Subsequently, the Federal Ministry of Health issued an enactment that permitted changes in medical curricula from the current licensing regulations (release of the Federal Ministry of Health ([Pressemitteilung des Bundesministerium für Gesundheit, 1st April 2020](#))). University specific modifications could be established by means of federal regulations.

In the meantime, social contacts in public spaces were restricted to a distance of 1.5 meters for F2F contacts and wearing of mouth-nose-masks in public indoor areas was made compulsory. Finally, in mid-April 2020 it was decided that teaching at German universities should largely be offered only through online teaching formats. While students were denied access to their university, employees were sent into home office, maintaining only an emergency mode of service at universities. The summer term 2020 was extended by some universities by about a further month. After suspension of several restrictions it was possible to teach absolutely essential courses, such as practical examinations. They were allowed under strict hygiene regulations.

This is largely in line with the current situation at German universities. It is of great interest - ignoring how infection rates might develop in the future - how universities and teachers are going to implement teaching in the upcoming terms (winter term 2020/2021 starts in Germany Oct/Nov 2020).

## 3. Content of the short questionnaire replied to by anatomists from seven German universities

A short questionnaire was designed for getting an overview of how anatomical teaching was realized at a selection of German Universities during the first COVID-19 summer term. In Germany, different universities follow different curricula and offer slightly different teaching formats depending on these curricula. Therefore, the survey started with a request of information what the regular anatomical teaching would have consisted of (lectures, seminars, practical sessions, in gross anatomy / microscopic anatomy / neuroanatomy) as well as the type of assessment planned (written - paper / computer-based, oral - incl. cadaveric exposure / microscopy, objective structured practical examinations - incl. cadaveric exposure / microscopy, other). For each teaching unit, more detailed information was requested on if and how it was realized under the new COVID-19 regularities. The following options were given: For lectures, (1) regular lecture hall setting, (2) postponing to the next semester/year, (3) live-stream lecture, (4) video-stream lecture - synchronous / asynchronous / both in relation to the study plan, (5) lecture slides without audio recording, and (6) other.

For seminars, (1) regular setting, (2) postponing to the next semester/year, (3) all content in online-formats - e.g. webinar, video-stream, (4) selected content in online-formats.

For practical sessions, (1) regular setting, (2) postponing to the next semester/year, (3) all content in online-formats - e.g. webinar, video-stream, Moodle, (4) selected content in online-formats, (5) reduced in time to <50% per student - including on-side microscopy sessions or cadaveric exposure session, (6) reduced in time up to >50% per student - including on-side microscopy sessions or cadaveric exposure session.

For digital resource that have been utilized the following options were named, (1) self-provided video stream, (2) commercial applications / software / video material / text books, (3) online meeting platforms, (4) chatrooms, (5) fora, (6) resources obtained from colleagues, other.

For assessment, different formats of examinations could be chosen from, e.g. (1) originally planned examinations could be performed under respect of hygiene rules, (2) originally planned examinations were canceled / postponed, (3) a modified format was chosen - web-based online examination, written home-work about selected topics, oral presentation about selected topics, (4) formative assessment e.g. via participation to examination quizzes, response to guidance questions, (5) portfolio, and (6) other.

Finally the questionnaire asked for naming the biggest challenges / difficulties / disadvantages as well as the biggest opportunities / advantages / positive effects that have arisen for anatomical teaching due to the COVID-19 pandemic.

## 4. Teaching experiences of anatomists at German universities during the first COVID-19 term

All members of the teaching commission reported that lectures were generally offered as online lectures on a regular basis. Lectures could be streamed as live-events (n = 4 out of 7 responding institutes) and/or as bespoke lectures slides (n = 5). Mostly lecture slides were uploaded to the virtual learning environment according to the student's regular time schedule and remained available to students for asynchronous use.

All universities were in need to conduct anatomy seminars for their medical or dental students. It was prohibited to organize them in a F2 F setting. Some of the seminars were postponed to the following semester (n = 2), others were offered online in an identical or a reduced time frame. Technically BigBlueButton (Big Blue Button Inc., Ottawa, Canada), Microsoft Teams (Microsoft, Redmond, Washington, USA) or Zoom (Zoom Voice Communications Inc., San Jose, USA) were used to conduct seminars or lectures.

Anatomists of all participating universities reported a regular use of cadaveric material to teach anatomy in the dissection course. On a historical basis, for a better durability of the cadavers, the gross anatomy course is being held during winter times in Germany. Thus, at some locations (n = 3), no dissection course was planned for the summer term anyway. This also applied to the practical neuroanatomy course, which is often offered in combination with the dissection course. Six out of seven institutes in module and subject based curricula offered a practical histology course during summer term and had to find digital solutions to enable participation without classroom teaching.

All anatomists reported that the respective histology courses could be carried out in a fulltime range without cutting back on teaching content. Nevertheless, all universities had to refrain from practical work using a microscope. In some cases, the use of already existing facilities of virtual microscopy was advantageous, which were previously applied only for self-study periods but now became a valuable fundament for curricular teaching. Teaching at the virtual microscope was often supported by audio recorded video demonstrations, chat rooms, forums, annotated course scripts, quizzes (Kahoot! Inc., Oslo, Norway) or interactive

learning modules offered via the learning platform (Moodle, West-Perth, Australia)

Almost all universities planned to conduct both written and oral practical examinations as an outcome control of the histology training as usual. Written examinations, however, could only be realized in compliance with the relevant hygiene rules with a great deal of organizational effort (e.g. renting public exhibition halls). Half of the institutes had implemented computer-based written examination already in advance to the pandemic situation, but unfortunately at some universities only with a limited number of PC terminals available. Therefore, computer-based examinations were run in several sequential time slots or students attended to online examinations from their home-offices by means of Zoom video control. However, cheating tendencies of the students were observed, which is supposed to have a negative influence on the examination's quality criteria like objectivity and reliability.

The practical course in neuroanatomy is normally held as a course in F2F format with the dissection of a donor's central nervous system. The majority of the institutions offered this practical course as an online seminar without any activity on the specimen, but often supplemented by explanatory video recordings. Furthermore, in some cases, the courses overall study time according to university regulations had been shortened to less than half of the original.

Noteworthy is the immense time and effort colleagues invested to create and implement new digital learning resources to support the learning progress. These include self-produced videos/photo sequences demonstrating anatomical structures, instructor-supported discussion sessions, chat rooms, online quizzes, or the presentation of clinical cases by clinical colleagues to promote interactivity. Again, examination formats had to be adapted by switching over to web-based examinations or accepting other coursework carried out throughout the semester (e.g. written elaboration of course scripts) as part of the assessment process. Colleague anatomists also mentioned a so-called 'free shot', i.e. students took part in examinations but in case they did not pass, this did not have any negative consequences, but was rather considered to have an additional training effect.

Implementing the dissection course as the core element of anatomical training presented the greatest challenge. In the survey, four out of seven universities reported to have conducted the dissection course regularly during the COVID-19 first summer term.

One university moved the course to the winter term, and therefore switched it with the histology course, respectively. The other three institutions could - after local approval of appropriate hygiene concepts - at least organize the course with reduced group sizes (1–3 students) and a considerable reduction of time spent at the donor site (sometimes less than 50% of regular dissection time per student).

Key factors for implementing the course in a F2F setting were minimization of the number of people simultaneously present in the room, while ensuring a high-level room ventilation. Considering total cohorts of 120–370 students, it was not feasible to run the course in strict compliance with the official requirements of a minimum distance of 1.5 meters or one person per 10m<sup>2</sup> at all times. In some cases, the essential reorganization of the course resulted in only a rudimentary dissection course for the single student. At one university, these measures led to an all-day occupancy of the dissection hall on six weekdays with a corresponding substantial increase in teaching time for the available lecturers and extra high additional organizational effort.

All anatomists who were involved in the remote discussion reported that they supplemented the limited situation in the dissection hall by providing additional digital services like weekly video updates, self-created videos of dissection instructions, use of

online atlases, forums, weekly quizzes, voluntary live video seminars, e.g. to demonstrate protected specimens.

Information concerning course related examinations is limited, because at the time of the remote meeting and the survey feedback, examinations had not been performed yet. Some colleague anatomists reported that oral examination had been conducted in the regular or modified (e.g. tag test) mode using cadaveric material. Written examination had not been performed yet or were planned in an already existing web-based format.

## 5. Strengths and weaknesses of remote learning identified by selected German anatomists

In summary, anatomists of seven German universities experienced similar positive or negative aspects as reported previously by Longhurst et al. (2020) for the UK and the Republic of Ireland or by Pather et al. (2020) for Australia and New Zealand. Both students and lecturers have been able to improve their digital knowledge and skills significantly. Even formerly critical colleagues became more open to use digital media.

The use of digital media ultimately helped teachers to focus even more on the exclusively relevant learning content. Digital lectures in particular enabled a more focussed transfer of knowledge and gave students better opportunities for an improved individual pre- and post-work up. In the face of the crisis, a lot of new and innovative teaching material was created and teaching methods were adopted, which will certainly be used in the future as a complementary element in anatomy education. However, anatomists and students also painfully experienced, how important and indispensable face-to-face teaching remains.

All stakeholders frequently criticized shortcomings in the technical implementation and the considerably high effort invested in the creation of digital teaching material and its technical implementation. Similar experiences were described before by colleague anatomists from other countries (Pather et al., 2020; Srinivasan, 2020). More importantly, they missed the lack of face-to-face contact and only limited opportunities to interact with students, along with the lack of educational hands-on activities (Longhurst et al., 2020; Pather et al., 2020).

With regard to the dissection course, the anatomical colleagues described that reduced class hours and less practical activity at the donor site led to a decreased grasping perception of the human body with a poorer 3D understanding, less teamwork, less motivated students, less learning from their instructors as role models, and the inability to convey a scientific approach to the course content.

Students were often less prepared for the practical course work and the dissection process failed to reach the usual quality, which may be attributed to less effective communication of the practical course contents. The logistics of examinations were experienced as challenging concerning its content, its implementation for large cohorts under COVID-19 regulations and its jurisdiction.

## 6. Conclusion

The Teaching Commission of the Anatomical Society concluded that the required (due to the external circumstances) transition to remote learning during summer term 2020 worked well. Overall, most of the teaching sessions could be provided within the time-frame of the summer term, or within minimal extension times. Therefore, a prolongation of the students' overall study time could be prevented. This is in alignment with international reports and demonstrates the overall prompt agility of anatomy education (Evans et al., 2020; Pacheco et al., 2020).

As also concluded by Evans et al. (2020) considering strengths and weaknesses of remote learning, the selected anatomists in

Germany, as represented by the authors, are convinced that teaching concepts as they were performed in the first COVID-19 semester have to constitute an exception, because sound pedagogical principles for remote teaching have not yet been established. Evidence-based data on how students interact with remote learning facilities are still sparse. Therefore, the COVID-19 pandemic offers the chance to get more information about students' learning habits and on potential effects of online anatomy learning on the students' performance, attitudes, social behavior or health, that have been studied before only in limited settings (Mathiowetz et al., 2016; Attardi et al., 2018; Langfield et al., 2018). Only, if all aspects are taken together, reasonable conclusions can be drawn for the future.

Which implications should arise for teaching anatomy in the near future?

- 1 In first priority, peoples' health has to be preserved at all times. Therefore, it is crucial that students and faculty closely communicate with each other and stay at home in case of any potential COVID symptoms. However, this may only be possible if generous arrangements for times absent are offered. The pandemic shows a dynamic development, therefore it is difficult to make any predictions. But the longer we manage to live with the crisis, the better prepared we will be to react on acute educational challenges (e.g. development of teaching materials) and also similar external situations that may arise in the future.
- 2 It must be ascertained that a predominantly or even entirely digital teaching format remains an exception in medical or medicine-related education. In this context, it is important to scientifically document for which teaching formats (e.g. lectures) online education is well suited and for which educational settings F2F teaching is indispensable (e.g. dissection course, professional social interaction, role modelling). **In summary and using the COVID-19 pandemic situation as a kind of blue-print for any similar future situation, the commission's members propose that German universities should follow the slogan: As much face-to-face teaching as possible and as much online teaching as necessary!** Especially the gross anatomy course with its hands-on teaching must not degenerate into some teaching module, which, in its essence, no longer meets the requirements of a practical training. Especially taking into account that online teaching formats are often not able to teach practical skills or additional competences that students ultimately need to develop in their professional career (Smith et al., 2014). The overall aim of a high-quality training for future medical, dental and veterinary doctors and other medicine-related professionals has to be preserved. Additionally, in order to implement high quality online teaching in medical education, financial resources for personal and technical support have to be (further) allocated to German universities, similar to those that have been released in 2019 for schools within the government's digital pact (DigitalPakt Schule).
- 3 The possibility to return to F2F teaching enables and significantly facilitates direct interaction between lecturers and students. But also, and above all, between students themselves, who, like many others, have been deprived of their social interaction for a considerable time in the first COVID 19 term (Franchi, 2020). Preserving present health regulations, universities should find opportunities for particularly sensitive groups of students - inevitably freshmen are among them - that make social interaction and the experience of university life on the campus possible.

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## Submission declaration and verification

The authors confirm that this manuscript is not under consideration for publication elsewhere. The manuscript has been read and approved by all named authors. All authors agreed on the final order of their authors.

## Ethical statement

All authors made a significant contribution to the conception, design, execution, or interpretation of the reported study. The manuscript is an original work and other workings groups have been cited or quoted appropriately.

Human or animal subjects, patient images or case details have not been studied in this report.

## Author contributions

*Prof. (apl) Dr. med. Anja Böckers* is a physician and faculty member of the Institute for Anatomy and Cell Biology at Ulm University. She is a member of the Teaching Committee and conceptualized the survey and wrote the original draft of this manuscript.

*Prof. Dr. med. Dr. rer. nat. Horst Claassen*, is a retired professor for anatomy and anthropology at Friedrich-Alexander-University Erlangen-Nürnberg and contributed to the manuscript by proof reading.

*Prof. Dr. med. vet. Kirsten Haastert-Talini* is an associate professor at the Institute of Neuroanatomy and Cell Biology at Hannover Medical School. Her main research field is the development of new therapeutic strategies to enhance peripheral nerve regeneration. She gathered survey data and reviewed and (Srinivasan, 2020) edited the manuscript.

*Prof. Dr. med. Jürgen Westermann* is director of the institute of anatomy in Lübeck and chairman of the Teaching Commission of the Anatomical Society. He coordinated the meeting of the commission and reviewed the draft of the manuscript.

## Conflicts of interest

None.

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