



Erasmus+

**University of Zagreb School of Medicine
Department of Anatomy and Clinical
Anatomy - CURRICULUM DEVELOPMENT
based on LEANBODY project**



**Co-funded by
the European Union**

ERASMUS+ Project LEANBODY - 2021-1-HU01-KA220-HED-000027542

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**University of Zagreb School of Medicine
Department of Anatomy and Clinical Anatomy**

CURRICULUM DEVELOPMENT

Organization of Teaching During the 20th Century

The organization of teaching in the course of Human Anatomy did not undergo substantial changes from its inception until 1985. The course was conducted over three semesters.

In the first semester, the focus was on the locomotor system. Assessment was conducted through two major colloquia: the first addressing the bones of the trunk and limbs, and the second covering the joints.

In the second semester, the material was approached topographically, with two topographical regions studied weekly through dissections on cadavers. By the end of the semester, the entire body's topographical anatomy had been covered. During this period, several major oral colloquia were conducted (the format of which varied over the years). Additionally, students were required to independently dissect one or two anatomical regions. In the third semester, the material focused on the central nervous system, including the functional neuroanatomy of brain pathways, which was assessed through a comprehensive colloquium.

Students who passed the major colloquia and successfully completed their assigned dissections were eligible to take the final examination, conducted at the end of the third semester during the second year of study.

The course was delivered through lectures and practical's, which constituted approximately 80% of the overall teaching activities. Practical's were conducted exclusively on cadavers and anatomical preparations. These practical's began with a brief introduction for all groups before transitioning to practical part and assessments. Practical's took place in large dissection halls equipped with eighteen tables, each accommodating groups of 20–30 students. Typically, four to five groups conducted classes simultaneously. A team of two to three teachers (comprising an assistant, a senior professor, and a junior professor) supervised each group, with the same teachers assigned to a group throughout the semester. Student demonstrators assisted in instruction, and for a period, final-year students were employed as auxiliary assistants.

The curriculum primarily addressed macroscopic anatomy, with only occasional inclusion of topics from microscopic anatomy and embryology. Topics such as the development of the mesentery, cerebral vesicles, and liver lobules were covered within the anatomy course. However, microscopic and developmental anatomy topics were primarily addressed in a separate course, Histology and Embryology, organized by the Department of Histology and Embryology during the fourth semester, following the completion of anatomy instruction.

Teaching materials included a textbook providing textual descriptions and anatomical atlases for visual representation. The official atlas was Toldt-Hochstetter, edited internationally by Academician Jelena Krmpotić-Nemanić, with a Croatian edition available. The main textbook was Perović's *Anatomy of the Human Body*, which originated from Academician Perović's lectures, transcribed by students. Though Perović never formally authored the textbook, later revisions by the department resulted in its official publication under the title Perović's *Anatomy*, supplemented by the addition of chapters focusing on specific anatomical systems.

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In 1982, a comprehensive textbook co-authored by Academician Jelena Krmpotić-Nemanić was published, combining foundational material at the student level with updated knowledge supported by key references.

In 1977, Werner Platzer's *Color Atlas of Human Anatomy*, a three-part series, was translated into Croatian and has been continuously updated in line with its German editions. In addition to cadaveric dissections, various 3D models and anatomical illustrations, created by academic artists employed by the Department of Anatomy, were made available to students.

Written instruction for classes were predominantly defined through descriptions of structures or regions covered within each session. Students were provided with booklets containing brief descriptions of the material covered in each exercise and a portfolio to document their completion of required tasks, such as passing colloquia and completing assigned dissections. The final examination was exclusively oral, encompassing all material covered during the three semesters. However, prerequisites for taking the oral examination included the successful completion of dissection tasks and passing the major practical colloquia, which involved identification of structures on cadavers and anatomical preparations.

Separation of the Central Nervous System Topics into a Separate Course

A first change in structure of course occurred in 1985 when, under the initiative of Academician Kostović, topics related to the anatomy and functional organization of the central nervous system (CNS) were removed from the anatomy curriculum and restructured into a separate course. This new course, titled *Organization and Function of the Central Nervous System*, included material from the field of neurophysiology, which had previously been part of the Physiology course. Consequently, the course was organized as an interdepartmental, jointly delivered by teachers from the Departments of Anatomy and Physiology. Within the course framework, anatomical and physiological topics were clearly delineated. Examinations were conducted jointly, with one examiner from each department evaluating anatomical and physiological topics, respectively, and determining the final grade collaboratively.

In 1998, the Department of Neuroscience was established, and the course was renamed *Fundamentals of Neuroscience*. From that point, the course was fully integrated and its organization no longer fell under the Department of Anatomy. Only a small number of anatomy teachers continued to participate in teaching the Fundamentals of neuroscience course, while several teachers fully transitioned to the Department of Neuroscience.

As a result of this change, the Anatomy course became a two-semester subject conducted during the first year of study, with the exception of material related to the functional neuroanatomy of the central nervous system. Only topics such as the meninges, the general external morphology of the brain, and the functional organization of cranial nerve nuclei were retained.

The instructional approach in the first two semesters remained largely unchanged, except for the discontinuation of large oral colloquia in the second semester. Instead, students were assessed during each practical, which included two topographical regions per week. Consequently, the second semester followed the format of continuous assessment during practical's. Passing the Anatomy course became a prerequisite for advancing to the second year of study.

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Between 1980 and 1995, there was a significant decline in the availability of cadavers. During this period, in addition to lectures and practical's, seminars were introduced as a teaching method. For certain topics, a portion of the teaching was conducted through seminars, while the remaining content was covered in practical's. However, the allocation of hours for seminars and practical's was not precisely defined within the schedule.

Additionally, written and practical components were introduced to the final examination. The written exam included multiple-choice questions and matching statements, while the practical component required students to identify anatomical structures on cadavers and preparations and provide their correct Latin names. Passing both the written and practical components was required to proceed to the oral examination.

Between 1995 and 2001, a course titled *Clinical Anatomy* was introduced in the third semester, modeled after the curriculum of Harvard Medical School. This course adopted a problem-based learning (PBL) approach, where small student groups analyzed applied anatomy through clinical case studies.

During the academic years 2003/2004 and 2004/2005, anatomy teaching was temporarily reorganized into a 10–12-week modular format employing PBL. However, this approach did not gain traction, as students encountered considerable difficulty mastering the material. Student performance during these years was significantly poorer than in previous and subsequent years, when the traditional curriculum was reinstated. It became evident that first-year students struggled with the modular approach to anatomy.

It is also noteworthy that in 2002, the English-language medical program was launched.

Changes in Teaching Organization at the Turn of the 20th to 21st Century

Between 1995 and 2010, the anatomy textbook authored by Academician Jelena Krmpotić-Nemanić underwent revisions to better suit the didactic needs of students. During this period, several anatomical atlases, including Sobotta, Netter, and Rohen's Photographic Atlas of Anatomy, were translated into Croatian. In 2013, Sobotta's Atlas of Human Anatomy was published in three volumes in Croatian, and in 2020, Gilroy's Anatomy Atlas was also translated.

In 2005, Professor Dubravko Jalšovec authored the textbook Systematic and Topographical Anatomy, which underwent a significant revision in 2018 and was republished as Anatomia Humana, accompanied by a dissection manual. While the updated version featured more illustrations, it remained a supplementary textbook that required the concurrent use of an anatomical atlas. This textbook received widespread acclaim from students, particularly for its structured presentation and utility during dissection practical's.

In 2009, the Department of Anatomy translated Waldeyer's Anatomy of the Human Body, which became official course literature. This textbook included a large number of illustrations, photographs, additional explanations, and clinical annotations, marking it as a comprehensive teaching resource.

It was not until the academic year 2013/2014 that the teaching topics were thoroughly reorganized, with clearly defined themes and allocated time for lectures, seminars, and practical's. That year also marked the beginning of a systematic effort to define learning outcomes for each instructional unit. Simultaneously, a Body Donation Program was formally introduced, leading to a significant increase in donations. By the 2015/2016 academic year, dissection was reintroduced as an independent student activity. Currently, approximately 20–

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30 donor bodies are acquired annually, enabling systematic dissection during medical anatomy courses. Donor bodies prepared in one academic year are used as prosected models in the following year.

The medical program in Croatian enrolls 300 students annually, with an additional 40–50 repeating the course, while the English-language program enrolls 70 students, with 25–30 repeaters. Groups of 20–25 students are assigned to dissect one cadaver. The department has facilities capable of accommodating the dissection of up to 40 cadavers annually, which represents a high standard for this type of teaching.

Collaboration with the Heidelberg Institute of Anatomy: A Turning Point

A significant shift in the approach to the curriculum was initiated through a visit by the teachers of the Department of Anatomy to the Heidelberg Institute of Anatomy, followed by a reciprocal visit from Professor Joachim Kirsch, the director of the Heidelberg Institute of Anatomy and then-Dean of the Faculty of Medicine at Heidelberg University.

The Heidelberg Institute of Anatomy follows a long-standing tradition of classical anatomical schools, renowned for human body dissections as well as the development of the plastination technique. In the first two years of study, only preclinical subjects are taught, followed by three years of clinical subjects, with the final year dedicated solely to practical teaching. Ten years before our visit, the curriculum underwent a comprehensive reorganization. This reorganization aimed to adapt the content and modernize education in line with advances in medicine and new educational models, while also considering the profile of the teachers available at the faculty. The primary criteria for selecting staff at the Institute are scientific qualifications, and most of the researchers have not completed a medical degree. Consequently, a curriculum was developed that integrates teaching through the interpretation of each organ system, starting from biochemistry and molecular biology, extending through cellular biology and microscopic anatomy, to physiology. However, unlike in Vienna and Graz, Heidelberg did not establish a fully integrated curriculum in basic medical science. They were guided by the attitude that future doctors need to first familiarize themselves in detail with the macroscopic structure of the human body. Therefore, the program begins with anatomy, which is the only subject during the first semester (4 months). The organization of this course at first glance does not differ from the traditional approach to anatomy instruction, which dominated until the mid-20th century, when the "golden age of anatomy" ended. The course consists of fewer hours of lectures, with all remaining time dedicated to practical's on cadavers. At each session, students undergo oral examinations, and the teaching is divided into three thematic units, identical to those in our curriculum. However, it is clear that the preparation and delivery of teaching in Heidelberg has been significantly "enhanced" compared to the classical approach. The goals for each teaching unit ("learning outcomes") are clearly and specifically defined and presented to the students. In addition, the results students achieve in the final anatomy exam, as well as in the anatomical part of the final exam in the basic sciences, which is conducted at the national level, are closely monitored. The faculty administration intervenes promptly if the results are deemed unsatisfactory and requires improvements to be made in the teaching process. Another important element is the textbook, which is predominantly oriented towards functional anatomy. In addition to macroscopic anatomy, the textbook covers substantial content in microscopic anatomy, embryology, and even physiology. At the time of the visit, the textbook

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was in its third German edition and was the best-selling anatomy textbook in Germany. The Department of Anatomy in Zagreb decided to translate this textbook, which, in addition to excellent didactic organization and numerous high-quality images, is also rich in clinical examples and connections. What is particularly impressive is that these clinical examples are fully integrated into the anatomical content and do not constitute additional material that burdens students but rather provide better conceptual and applied knowledge of anatomy. Despite its focus on functional anatomy, which may omit some anatomical details, the material is still oriented toward detail. Importantly, all innovations in teaching must not reduce the time students need for independent work and preparation of an entire cadaver in small groups.

Body Donation Program

The Heidelberg Institute has had a Body Donation Program in place since 1990, through which various promotional and educational activities emphasize the importance of human body dissection for mastering anatomical content. Voluntary donors have a shared burial site, and once a year, they are honored in a commemorative ceremony. The visit to Heidelberg coincided with the ceremony, which began with a ritual in the church, near the burial site for body donors. The ceremony was attended by all professors from the Anatomy Institute, first-year students, and family members of the donors. The ceremony was led jointly by an Evangelical and a Catholic priest. The emotional speech delivered by the student representative and the singing of the student choir were particularly impressive. After the ceremony, all attendees dignifiedly proceeded to the cemetery, where a symbolic burial took place with the interment of an urn.

Attending this ceremony was a particularly inspiring experience, one that led us to rethink our approach to anatomical dissection. We realized that, in addition to the crucial role that anatomical dissection plays in generating knowledge and understanding of the human body, there is another equally important dimension. This dimension is the development of humility, empathy, and professionalism in the behavior of future physicians. The development of ethical conduct, as well as the objectification of the process, is critical for a doctor to perform their work professionally and distance themselves from the patient while maintaining a sense of approaching the person with all their hopes and fears. Therefore, anatomical dissection and the farewell ceremony for body donors are the best ways for future doctors to develop these skills.

The School of Medicine at the University of Zagreb completed the construction of a memorial tomb for body donors in 2017, during the 100th anniversary of the faculty, and the first ceremonial farewell was held at that time.

Changes in the Organization of Teaching in the Last 10 Years

Since the 2014/2015 academic year, significant changes have been introduced in the organization of anatomy teaching:

- Although the teaching concept remained focused on detailed macroscopic anatomy, the emphasis shifted towards ensuring that the outcome was an understanding of functional anatomy and the main anatomical concepts.

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- Continuous efforts were made to refine and improve the learning outcomes for each teaching topic, and teachers consistently participated in professional development regarding the formulation of learning outcomes.
- The teaching topics were aligned with the new textbook.
- Clear objectives that students must achieve were defined, and a repository of anatomical preparation images from the Department, with labeled structures that students must recognize, was created.
- The most important focus was placed on practical student work and body dissection in small groups, encouraging independent student work, as it was observed that students were increasingly unprepared for classes and exhibited a passive approach.
- Students were provided with additional access to the Department's materials and given extra time for interaction with student demonstrators.
- Continuous knowledge assessments were introduced through partial practical and written exams, stimulating ongoing student engagement.
- The question bank for the written exam was expanded, with new types of questions introduced. There was continuous work on expanding and improving the question bank, ensuring alignment with learning outcomes and course objectives.
- A monitoring system was introduced to track student progress, allowing early detection of students facing difficulties in mastering the material and offering suggestions for more effective learning strategies.
- Special emphasis was placed on the importance of respect for body donors, the development of professionalism, and the focus on fostering empathy and objectification skills.
- At the end of each academic year, a ceremonial farewell for body donors was organized, with the participation of all first-year students and the student choir, where students expressed their gratitude and placed urns in the memorial tomb.
- The platform for e-learning (LMS) at the University of Zagreb School of Medicine began to be used more intensively in the teaching process.
- At the end of each academic year, a detailed report on the teaching process and student performance was compiled, which was shared with the administration and discussed at the Department.
- Based on an analysis of student performance and the organization of the course, decisions regarding changes to the teaching plan for the upcoming academic year are made, with the goal of improving student success and teaching efficiency.

Key Changes in Teaching Before the Pandemic (2014-2020):

1. In the 2015/2016 academic year, independent dissection by students in small groups was reintroduced.
2. In the 2016/2017 academic year, a memorial tomb for body donors was opened, and the first ceremonial farewell for body donors was organized.
3. In the 2018/2019 academic year, the new Duale Reihe Anatomy textbook (a translation of a textbook written by the Anatomy Institute teachers) was introduced into the curriculum, and the teaching plan was fully aligned with it.
4. In the 2019/2020 academic year, the following innovations were introduced in teaching the A1 block (Locomotor System and Extremities):

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- Clearly defined exam content based on official literature (the Duale Reihe textbook and teaching materials available through LMS).
- Clearly defined learning outcomes for all teaching units.
- Clear knowledge assessment criteria during lessons, with continuous knowledge evaluation.
- Significantly improved use of e-learning:
 - weekly self-assessment quizzes (known as LMS tests) were introduced to improve and facilitate student preparation for the upcoming week's material,
 - all necessary supplementary teaching materials were made available on the LMS, including additional texts, notes, presentations, video materials, lists of structures for practical work, list of the exam structures, exam pictures, and corrections to the core textbook.
- A higher number of non-compulsory demonstration practical's were introduced, enabling students to better master the practical aspects of the material.
- The teaching plan was fully reorganized to follow the new official textbook (Duale Reihe).
- Two weeks before the start of Course, students were given the opportunity to work with demonstrators in the Anatomy Department's classroom to prepare for the first practical colloquium.
- Regular objective evaluations of student knowledge were conducted every three weeks, either through well-structured practical colloquia or partial written and practical exams.
- After each objective evaluation, a detailed analysis was conducted.
- A list of exam structures for the practical exam was defined, including structures of particular importance (the so-called "red structures"), along with a clearly defined structure for the practical exam, significantly increasing its objectivity and reducing discrepancies between instructors who prepare the exam.
- The scope of teaching in the form of problem-based learning (PBL) and team-based learning (TBL) was expanded – Problem-Solving Tasks practical's.
- Increased translation of anatomical knowledge to clinical knowledge through the introduction of Problem-Solving Tasks practical's.
- 12 clinical case-based problem-solving tasks were created, all original (the concept and text were developed by members of the A1 working group, drawing inspiration from clinical examples found in the most significant clinical anatomy textbooks).
- The teaching of anatomical dissection was completely reorganized, taking place immediately after the systematic anatomy teaching. Students attend a brief introductory lecture on the anatomy of specific topographical regions on Mondays, followed by anatomical dissection, with the main goal of exposing these topographical regions. Students then have additional practical's later in the week in very small groups (5-6 students per cadaver, with one teacher/associate and demonstrator at two cadavers, i.e., one teacher/associate for 10-12 students). During these practical's, with the assistance of teachers/associates and demonstrators, students perform detailed anatomical dissections, following the list of structures for practical work and are questioned about the topographical relationships of these structures.

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Changes in the Organization of Teaching During the Pandemic and the Impact of the Earthquake

From the onset of the pandemic until the current academic year, teaching has been carried out under significantly more challenging conditions, as the building sustained substantial damage in the earthquake of March 22, 2020. In the academic year 2019/2020, teaching was interrupted when only one-third of the practical's had been completed. Despite this, considerable efforts were made to ensure that students could return to classes in a modified format, which was achieved in June. In the academic year 2020/2021, due to the building's renovation and the pandemic, the first semester was conducted online, while in the second semester, contact teaching resumed. Thus, in these two academic years, it was necessary to adapt the organization of teaching, which required innovative solutions and enabled the analysis of these approaches. The results of these analyses were published in two scientific papers. It is also important to note that due to the comprehensive renovation of the building, the department was completely vacated by the end of the 2022/2023 academic year. In the 2023/2024 academic year, the dissection was conducted in a demonstration form using only two bodies. However, students were provided with practical's on prepared cadavers and organ specimens.

The changes introduced in the first semester (before the pandemic) of the 2019/2020 academic year significantly increased the use of the LMS e-learning platform by students. In the first semester alone, an average of 100,000 student activities were recorded monthly, which represented a fivefold increase compared to the previous period. This was key in allowing the Department to react promptly when it was decided that teaching would be conducted remotely ("online"). Regardless of the transition to online teaching and the damage caused to the Department by the earthquake, the curriculum was fully implemented, and the material was covered according to the planned timeline. Practical work on cadavers was also made-up during June. All content covered in the curriculum after the suspension of contact teaching was addressed through online materials.

Following the shift to complete online teaching, the number of student activities increased further to around 300,000 per month. Interestingly, the same level of activity was maintained during June when contact teaching resumed. This indicates that, during the four months of online teaching in the second semester, students completed over 1 million activities on the LMS in the Anatomy course, with each student averaging more than 200 activities per week during the second semester of the 2019/2020 academic year. Approximately 50% of all student activities on the LMS (when considering all academic years) were completed in the Anatomy course, and this high percentage was maintained throughout the 2020/2021 academic year.

The Department of Anatomy viewed this situation of pandemics and earthquake primarily as a challenge that could lead to significant improvements in the teaching process. In the academic year following the start of the pandemic and the earthquake, students had access to nearly 250 video lectures (most lasting 20-30 minutes), 21 review sessions with several thousand images, 33 clinical cases, 24 practical colloquia, and over 1,500 other teaching resources, additional texts, presentations, and animation links. This enabled students to master most of the theoretical material without contact classes, although, of course, the organization of practical's and seminars was essential for the development of practical skills.

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Current Organization of Teaching in the Anatomy Course

Experience from these two academic years clearly shows that the combination of online and contact teaching can significantly improve the teaching process and motivate students to engage in learning.

The Anatomy course currently consists of 220 teaching hours (50 hours of lectures, 50 hours of seminars, 120 hours of practical's, and 24 ECTS credits). The Department also coordinates several elective courses related to specific topics in functional, clinical, or comparative anatomy.

The Anatomy course is conducted over the first and second semesters, spanning 29 weeks. In the first semester, teaching takes place over 12 weeks, alongside the courses Physics and Biophysics, Medical and Molecular Biology, Medical English I, and Fundamentals of Medical Skills I. In the second semester, teaching takes place over 17 weeks, in parallel with Medical Chemistry and Biochemistry I and First Aid, with 75% of contact hours evenly distributed throughout. This results in almost double the weekly workload in the second semester compared to the first semester, which is why the A1 thematic block is taught in the first semester, and the remaining two blocks in the second semester.

The Anatomy course is divided into three teaching blocks: A1 – General anatomy, anatomy of the back and limbs; A2 – Anatomy of the trunk; A3 – Anatomy of the head and neck. The course objectives are to develop a professional attitude towards learning anatomy, to develop anatomical dissection skills, to develop learning strategies using contextualization and visualization, to encourage the recognition of general structural principles in special anatomy, to develop the ability to visualize the three-dimensionality of human body structure, to cultivate positive attitudes towards evidence-based medicine, and to integrate knowledge of systemic, developmental, functional, and topographical anatomy through clinical problems. This knowledge is essential for understanding physiological processes and clinical entities.

The approach to teaching and learning in the Anatomy course aligns with student-centered learning principles. This means that the focus is on active student engagement. The role of the teacher is to guide students' learning and provide expertise, enabling them to synthesize and conceptually understand the material and apply their knowledge in practice.

The course follows the flipped classroom model, where students prepare for each instructional unit before attending contact sessions. Each teaching unit includes materials available on the e-learning platform. Teaching activities are carried out through lectures, seminars, and practical's in contact form, as well as non-contact activities such as self-assessment tests, repetitoria, guided preparation for classes aligned with the principles of constructive alignment, interactive problem-solving tasks, worksheets, pre-recorded video lectures, and video demonstrations of anatomical dissections.

Students are regularly offered (optional) opportunities to use the Anatomy Department's resources and spaces outside formal teaching activities (which are not included in the regular course hours). This includes guided independent work and small group work with demonstrators. During these demonstration practical's, students achieve separate learning outcomes with the help of demonstrators.

Student performance is monitored through continuous assessments, including activities related to class preparation, participation in contact teaching, additional tasks after contact classes, practical colloquia, and formative and summative tests conducted either in contact

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form or via the e-learning platform. Descriptive and diagnostic learning analytics are regularly conducted for all activities on the platform. An electronic record of each student's activities throughout the academic year is maintained, allowing for detailed monitoring and feedback on their achievement of the course's learning outcomes.

After each teaching block (A1, A2, A3), practical thematic colloquia are organized to assess students' knowledge, including identification and naming of anatomical structures. These practical thematic colloquia can be held either in person on anatomical preparations or through the LMS as monitored tests, either remotely or in person. Successfully passing the thematic practical colloquia is a prerequisite for applying for the final exam. Students who fail to pass all three thematic colloquia must take a comprehensive (large) practical colloquium. During the summer exam periods, two exam sessions are organized, while during the fall exam periods, one session is held for the comprehensive practical colloquium.

At the end of each teaching block, partial written exams are organized (A1, A2, A3). Students who achieve a positive grade on these partial written exams are exempt from taking the final written exam. A positive grade from the partial exams is valid for all exam periods within the current academic year. Written exams are conducted via the LMS, in-person at the faculty as supervised written exams, or as remote supervised written exams (via video surveillance).

The final exam consists of a collective written part, followed by individual assessments of practical (practical exam) and theoretical knowledge (oral exam) across three stations corresponding to the thematic blocks (A1, A2, A3). Each section (station A1, station A2, and station A3) is graded separately, and the final grade is the weighted average of the individual sections of the final exam.

Practical and oral final exams are conducted by the assigned teacher, who is randomly assigned a student for assessment. Practical and oral exams are held at three stations corresponding to the thematic blocks. At each station, the teacher first checks the student's practical knowledge (practical part of the exam) and then assesses their theoretical knowledge (oral part of the exam).

To ensure objectivity in grading, it is preferred that each station be examined by a different teacher. The student must pass the practical exam to proceed to the oral exam. Questions for the oral exam are on exam cards, randomly selected by the student for each station. Exam dates and partial written exam dates are aligned with those of other courses.

In conducting practical's, student demonstrators assist the teacher. The practical part of the course is carried out demonstratively on available anatomical dissection bodies, prosected specimens, and anatomical models. Students are encouraged to engage in continuous work through oral questioning during practical's and seminars, as well as ongoing knowledge checks, including practical colloquia, activity tracking, partial written exams, and thematic practical colloquia. After fulfilling all course requirements, students are eligible for the final exam, which consists of a written section, a practical exam on bodies and models, and an oral exam. In recent academic years, approximately 80% of enrolled students have successfully completed the Anatomy course.

The content and schedule of teaching topics are precisely defined, including the name and definition of each teaching unit, the type of teaching, and duration. Teachers are familiar with the course objectives and learning outcomes have been developed for each teaching unit, as well as general objectives and outcomes at the course level. Additionally, the algorithms for

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written exams, continuous knowledge assessments, and practical exams are meticulously outlined.

Regarding learning outcomes, the goal is not only to master anatomical topics but also to focus on developing skills for learning complex and extensive material, as students will encounter similarly demanding courses throughout their medical studies.

The Department of Anatomy has viewed the situation in which teaching occurred under pandemic conditions and limited space as a challenge that could lead to significant improvements in the teaching process. This allowed students to master most theoretical material without contact classes, but, of course, the organization of practical's and seminars was crucial for understanding and developing practical skills. The provision of extensive online content enables better and more effective contact teaching, as, for example, students were able to complete the presentation part of seminars or check their preparedness for practical's online, thus leaving more time for discussion, clarification, and practical work during practical's.

Given that online content allows for the mastery of theoretical knowledge and guides students through learning, it is possible to establish a hybrid teaching model where practical's are held entirely in person, and seminar and lecture topics are covered online, followed by contact seminars to address potential ambiguities and emphasize key concepts. This also enables a different structure of teaching, for instance, holding contact classes in one larger or several smaller blocks after students have mastered most of the theoretical knowledge through online learning, thereby opening the possibility for the commercialization of this teaching format.

At the English-language medical program, Anatomy and Clinical Anatomy are taught with a total of 250 hours (50 hours more of seminars and 20 hours fewer of practical's than in the Croatian-language program). The teaching method and student assessment structure are organized in the same way as in the Croatian-language program, and classes are almost entirely conducted in parallel.

The teaching plan for the current year, along with the list of topics, is available in a separate document.

Summary of Course Description, Organization, Objectives and Learning Outcomes, ECTS Load Calculation, and Best Practices

Course description

The Anatomy course is organized into three teaching blocks:

A1 – General anatomy, systemic and topographical anatomy of the back and limbs,

A2 – Systemic and topographical anatomy of the trunk,

A3 – Systemic and topographical anatomy of the head and neck.

The approach to teaching and learning in the Anatomy course follows the principles of student-centered learning. This implies a focus on active student engagement, with the teacher's role being to guide and direct students' learning. The teacher also serves as an expert, facilitating students' synthesis of knowledge, conceptual understanding, and practical application.

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The course is delivered using the flipped classroom model, where students are required to prepare for each lesson before attending contact classes. Materials for each unit are provided on the e-learning platform, making it an integral part of the learning process.

Objectives and Purpose of the Course

Objectives:

1. Develop a professional attitude toward learning anatomy.
2. Develop anatomical dissection skills.
3. Develop learning strategies using contextualization and visualization.
4. Encourage the recognition of general principles of anatomical structure in special anatomy.
5. Develop skills in visualizing the three-dimensionality of human body structures.
6. Foster positive attitudes toward evidence-based medicine.
7. Integrate knowledge of systemic, developmental, functional, and topographical anatomy through clinical problems.

Purpose:

To provide the anatomical foundation necessary for understanding clinical practice.

Forms of teaching

Teaching activities are carried out in the following forms:

Contact teaching (in the form of):

1. Lectures,
2. Seminars,
3. Practical's.

Non-contact teaching (via the e-learning platform, in the form of):

1. Self-assessment tests,
2. Repetitoria,
3. Guided preparation for classes aligned with the principles of constructive alignment,
4. Problem-solving tasks as interactive lessons,
5. Worksheets,
6. Pre-recorded video lectures,
7. Video demonstrations of anatomical dissection.

Other (Demonstration Practical's):

Students are regularly offered the optional use of the Anatomy Department's facilities and resources outside formal teaching hours (not included in the regular course schedule). These sessions involve guided independent study and small group work, enabling students to achieve specific learning outcomes with the help of demonstrators.

Expected Learning Outcomes

The learning outcomes are defined according to the latest revision of Bloom's Taxonomy.

Cognitive Domain

Recall

1. Name anatomical structures in the human body
2. Identify anatomical structures on the human body and anatomical preparations

Understanding

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1. Describe the structure, vascularization, lymphatic drainage, and innervation of anatomical structures in the human body
2. Explain the topographical relationships between anatomical structures in the human body
3. Explain the interrelations and continuity of topographical areas of the human body

Application

1. Use relevant data sources for understanding the structure of the human body
2. Apply official anatomical terminology in the classification and description of anatomical structures

Analysis

1. Classify anatomical structures based on shared morphological and functional features
2. Compare the principles of anatomical organization in different parts of the human body
3. Differentiate between the structure and function of organs and organ systems in the human body

Evaluation

1. Critically assess the accuracy and relevance of data on the structure, organization, and function of anatomical structures in the human body
2. Investigate morphological and functional evolutionary adaptations of the human body
3. Explore the anatomical basis of selected clinical entities
4. Evaluate one's own knowledge of human anatomy against expected learning outcomes

Synthesis

1. Connect morphological organization with functional anatomy of the human body
2. Predict the consequences of the loss of function of specific anatomical structures

Affective Domain

Values

1. Recognize the importance of appropriate academic behavior within the context of fundamental medical sciences and identify the specific requirements of the Anatomy course

Motivation

1. Align student expectations regarding the scope, level, goal, and purpose of the Anatomy course with the demands of the curriculum

Attitudes

1. Assess the role of the human body in the learning process of anatomy
2. Understand the significance of the Body Donation Program and the respectful handling of bodies
3. Develop an ethical relationship with donated bodies and anatomical dissection

Psychomotor Domain

1. Apply anatomical dissection skills in displaying and studying anatomical structures in the human body
2. Sketch the principles of anatomical structure and the three-dimensionality of topographical relationships in the human body

Student Obligations

Students are required to actively participate in all forms of teaching. Teaching obligations include activities on the e-learning platform. Since contact teaching follows the flipped

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classroom model, students are expected to prepare the teaching materials, including those on the e-learning platform, before attending contact classes.

Monitoring of Student Performance

Student performance is monitored through continuous assessment. Continuous assessment involves activities such as preparation for classes, participation during contact classes, additional tasks after contact classes, practical colloquia, and formative and summative tests conducted either in person or via the e-learning platform. Descriptive and diagnostic learning analytics are regularly conducted for all activities on the platform. Each student has an electronic record of their activities throughout the academic year.

Exam Structure

The final exam consists of a written section followed by individual assessments of practical (practical exam) and theoretical knowledge (oral exam) across three stations corresponding to the thematic blocks (A1, A2, A3). Each part of the exam (written section, station A1, station A2, and station A3) is graded separately. The final grade is the weighted average of the individual parts of the final exam and continuous assessment grades, calculated using the following formula:

$$\text{Final Grade} = 0.22 \times \text{Written Exam} + 0.22 \times \text{Station A1} + 0.22 \times \text{Station A2} + 0.22 \times \text{Station A3} + 0.12 \times \text{Continuous Assessment.}$$

A passing grade on the final exam requires positive results in all sections of the exam.

ECTS Credits Calculation

Activity	Hours	Note	ECTS
Contact Teaching	220		6,30
Lectures	50		1,45
Seminars	50		1,45
Practical's	120		3,40
Non-contact Teaching	620		17,70
<i>Preparation for Contact Teaching</i>	<i>120</i>		<i>3,40</i>
Preparation for lectures	10		0,25
Preparation for seminars	50		1,45
Preparation for practical's	60		1,70
<i>Literature</i>	<i>215</i>		<i>6,10</i>
Simple text	65	325 pages (5 pages/h)	1,80
Complex text	150	450 pages (3 pages/h)	4,30
<i>Self-study Tasks</i>	<i>100</i>		<i>2,90</i>
<i>Exam Preparation</i>	<i>50</i>		<i>1,45</i>
<i>Independent Learning Using Anatomy Department Spaces</i>	<i>40</i>		<i>1,15</i>
<i>E-learning</i>	<i>95</i>		<i>2,70</i>
Total	840		24,00

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1 ECTS = 35 h

Best practices

1. **Constructive Alignment**

Learning outcomes for each teaching unit are clearly defined. Each unit is structured to allow for the achievement of these outcomes. Each unit has preparation (before class), interaction (during class), and activity (after class). Knowledge assessment is structured to test the achievement of learning outcomes in alignment with how they are addressed during teaching. This increases student motivation and reduces stress, as their tasks and assessment are clearly defined.

2. **Objective Structured Practical Examination (OSPI)**

Skills in anatomical dissection and sketching, along with professionalism (ethical and hygienic standards, professional behavior towards cadavers), are assessed through OSPI in practical colloquia. This verifies the achievement of learning outcomes in the affective and psychomotor domains.

3. **Problem-Solving Tasks**

Clinical entities are connected to relevant anatomical foundations through structured clinical scenarios (problem-solving tasks). Each task is an interactive online lesson, including introductory questions to provide the necessary anatomical context, learning outcomes, clinical cases, discussion questions to expand the clinical context, key messages, and final questions that check the integration of clinical and anatomical knowledge. Feedback is provided based on the student's responses.

4. **Record of Student Activities**

All student activities and assessment results are electronically recorded in a unified database. This allows students to track their own progress and plan their learning, while teachers can monitor individual students' fulfillment of requirements and achievement of learning outcomes.

5. **Detailed Feedback to Students**

Detailed feedback on all student activities and assessments is provided, including performance in achieving expected learning outcomes.

6. **Teamwork and Small Group Work**

Students are encouraged to engage in small group work after individually achieving the expected learning outcomes in the preparation of teaching units. In these small groups, they perform dissection and collaboratively solve clinical-anatomical problems through teamwork.

7. **Objective Structuring of the Final Grade**

The final grade is the weighted average of the grades for the individual parts of the final exam and continuous knowledge assessments. This ensures that all aspects of knowledge and skills assessment are included in the formation of the final grade, which promotes continuous engagement and work throughout the academic year. Additionally, this approach achieves objectivity in the assessment of overall knowledge and skills, positively influencing the affective domain.

8. **Body Donor Farewell**

Since human bodies and organ preparations are used in teaching, it is especially important that students, demonstrators, and teachers express their gratitude to the body donors and

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their families. To this end, regular ceremonial farewells are organized, in which students, demonstrators, and faculty members participate.

9. **Demonstrator Training**

Demonstrators assisting in practical teaching undergo two types of training: pedagogical skills training within the framework of constructive alignment (considering the specific nature of the Anatomy subject) and advanced anatomical dissection skills training. This ensures the quality of demonstrator work and consistent collaboration with students.

10. **Demonstration Practical**

Students are offered the optional opportunity to use the facilities and resources of the Anatomy Department outside formal teaching activities. These exercises do not count as part of the regular course hours, but students, through guided independent work and small group sessions, achieve specific learning outcomes with the assistance of demonstrators.

11. **Student Evaluation of Teaching**

At the end of the academic year, a detailed and structured student evaluation of the Anatomy course is conducted. The uniqueness of this evaluation lies in its focus on assessing the usefulness of teaching content, methods, and activities in achieving learning outcomes, rather than student satisfaction with the conducted lessons. The evaluation is thoroughly analyzed and used as the basis for developing new teaching materials and making targeted adjustments to parts of the curriculum. Additionally, the detailed analysis of the evaluation is utilized in publishing scientific papers in the field of medical education.

FINAL REMARKS

The teaching of anatomy at the University of Zagreb School of Medicine has always relied on time-tested, effective curricula from leading institutions, complemented by cutting-edge technologies and innovative pedagogical methods. A critical factor in the success of this approach has been the dedication and excellence of both teachers and students.

Academics Perović and Krmpotić-Nemanić played pivotal roles in shaping the Department of Anatomy and Clinical Anatomy, combining a cautious approach to change with a visionary openness to new methods. Their legacy persisted even after their tenure, notably through the efforts of Academician Kostović, who spearheaded the integration of central nervous system anatomy and physiology into a dedicated course—making our School one of the first globally to adopt such an initiative. This progress was rooted in respecting traditional values and aiming to enhance students' knowledge and skills. In contrast, abrupt curricular changes that disregarded proven elements of traditional teaching, such as a shift to modular, problem-oriented learning, often led to poor outcomes for students. The challenges posed by the pandemic and post-earthquake reconstruction at our Institute highlighted the irreplaceable value of traditional, detail-oriented anatomy involving cadaver dissection. This approach not only allows for a comprehensive understanding of the structure of the human body but also fosters the development of practical skills while instilling ethical values and professionalism in future medical practitioners. However, it is equally vital to embrace the opportunities offered by advancements in technology and the educational sciences to develop and successfully implement innovative teaching methods.

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Supplement:

ZagrebzCurirDev2CourseProgram – Course Program

ZagrebzCurrDev3Perovic – Drago Perović -in memoriam (German)

ZagrebzCurrDev4Krpmotic – contribution of Jelena Krmpotić Nemanić - manuscript

ZagrebzCurrDev5ManuscriptCMJ2021 – COVID and teaching anatomy - manuscript

ZagrebzCurrDev6AnnalsAnatomy2023 – impact of course delivery - manuscript

ZagrebzCurrDev7DonorCeremon2019 – donor ceremony 2019 (Croatian)

ZagrebzCurrDev8DonorCeremon2023 – donor ceremony 2023 (Croatian)