Experience from an Optional Dissection Course in a Clinically-Orientated Concept to Complement System-Based Anatomy in a Reformed Curriculum

Elisabeth Eppler, Steffen Serowy, Karl Link, Luis Filgueira

1Institute of Anatomy, Department of Biomedicine, University of Basel, Basel, Switzerland
2Division of Gross Anatomy, Institute of Anatomy, University of Zurich, Zurich, Switzerland
3Institute of Neuroradiology, University Hospital Magdeburg, Otto-von-Guericke University, Magdeburg, Germany
4Division of Anatomy, Department of Medicine, University of Fribourg, Fribourg, Switzerland

Profound anatomical knowledge is the basis for modern demands in medicine and surgery, but many countries worldwide including Australia and New Zealand have discontinued offering dissection courses to medical and dental students during the past decades. This educational project done in Australia aimed at enhancing basic and advanced anatomy teaching by engaging a sub-group of second-year undergraduate students of a compulsory prosection- and model-based anatomy course \((n = 54/170)\) in an optional multimodal course, which should easily articulate with a vertical curriculum. With topographical cadaver dissections as core, peer student-teams prepared and peer-assessed anatomy lectures based on clinical topics, which were rated highly by the peers and teachers. Anatomical knowledge was tested by quizzes and a multiple-choice examination. Individual dissection skills were self- and teacher-assessed. A final course grade was assigned based on these assessments. The grades in the system-based compulsory course achieved by the attendees of the paralleling dissection course were compared with their peers attending other optional courses. After beginning of the semester, the students in the dissection course performed similar, significantly \((P < 0.005)\) improved during the semester (78.5% vs. 69.9%, 70.1% vs. 64.1%), but in the integrated (including anatomy, biochemistry, physiology) final examination at the end of the year only tended to higher scores. As assessed through interviews and a voluntary questionnaire, all students of the optional dissection course liked these activities, which enhanced their learning experience. Thus, this concept elegantly integrates anatomical dissection with modern teaching demands and is feasible for implementation in modernized curricula. Anat Sci Educ 11: 32–43. © 2017 American Association of Anatomists.

Key words: Gross anatomy education; medical education; undergraduate education; supplemental instruction; team-based learning; peer-assessment; cadaver dissection

INTRODUCTION

The positive correlation between dissection and performance in anatomy as well as in practical examinations, final assessments, and professionalism has been well documented (Lachman and Pawlina, 2006; Ramsey-Stewart et al., 2010; Nwachuku et al., 2015; Rae et al., 2016; Vorstenbosch et al., 2016). Nevertheless, modern medical curricula tend to give – to varying extents - less importance to anatomy education, in particular to dissection, and some curricula in Europe and the United States have completely abandoned dissection in favor of other methods. This has led to a lively debate on how to teach anatomy (Bergman et al., 2008; Korf et al., 2008; Drake et al., 2009; Böckers et al., 2010; Sugand et al., 2010; Drake, 2014; Marom and Tarrasch, 2015; Singh et al. 2015; Pizzimenti et al., 2016). The trend of worldwide
Curriculum modernization has shifted the focus of basic medical education from a knowledge- and teacher-centered teaching to problem- and research-based early vertical integration of clinical and scientific skills (Drake, 1998; Drake et al., 2002; Schirlo et al., 2002; Drake 2007; Bergman et al., 2008; Johnson et al., 2012; Drake, 2014; McBride and Drake, 2016; Master Plan for Medical Studies 2020, 2016).

Hence, the importance of anatomy teaching and learning has declined in Australia and New Zealand over the past decades (Craig et al., 2010; Herle and Saxena, 2011), and curricula have moved away from dissection to using prosections and models, which is less expensive in anatomy teaching time, but at the expense of dissection time. For instance, when the present study was conducted at the University of Western Australia in 2011, the previously existing dissection course of approximately 100 hours had been abolished a decade ago. Instead, self-directed and team-based learning and peer teaching have been introduced (Craig et al., 2010; Burgess et al., 2012). There has also been a trend away from longer undergraduate to shorter postgraduate programs. The decline of anatomy in Australia has reached a point, where medical professionals (Craig et al., 2010; Herle and Saxena, 2011) and even medical students (Mitchell, 2007; Mitchell and Batty, 2009; Farey et al., 2014) questioned whether there was enough anatomy teaching and learning in the present medical curricula and called for a stronger emphasis on dissection, for example, at the University of Melbourne (Azer and Eizenberg, 2007). In 2006, an Australian Medical Students’ Association survey described their medical school’s anatomy emphasis as “far too little” or “too little” (Mitchell and Batty, 2009; Farey et al., 2014). These Australian data were endorsed by students at the University of Auckland, New Zealand, that only 33% of students rated their anatomical knowledge as sufficient for safe medical practice (Insull et al., 2006). Consequently, offering additional optional courses has been suggested as feasible method to counteract curricular reductions in anatomy education (Winkelmann, 2007). Recently, two optional courses of 28 hours each have been reported from Portugal, which were highly valued by the students, but to a lower degree with regard to their articulation with the pre-existing curriculum (Pais et al., 2017).

The present concept was initiated at the University of Western Australia to explore the outcome and satisfaction of an optional cadaver-based dissection course offered to a subgroup of undergraduate medical students in addition to the compulsory system-based course. Originally, this was a pilot project to be integrated into the pre-existing medical undergraduate curriculum. Thus, another aim was to investigate the feasibility and perception of a course newly introduced into the framework of a system-based vertical curriculum, even with limited faculty and reduced contact hours allocated to anatomy teaching.

Not many systematic studies have differentiated the outcome of modern medical teaching tools (Kommalage and Gunawardena, 2011; Drake, 2014; McBride and Drake, 2015), and more experience on how to score individual contributions of specific course components to a highly structured human anatomy course is needed (Shaffer, 2016; Raubenheimer et al., 2016). Therefore, an assessment system was introduced, which should monitor the self-directed team-based learning process by in-course assessments, but also reflect all skills including practical dissection and communication. A comparison with those students not attending the optional dissection course, but physiology and biochemistry sessions instead, was performed for the outcome in the integrated examinations since particularly the workload of approximately 75 course hours allocated predominantly to practical anatomy teaching and preparing peer student lectures might be at the cost of integrated learning.

The original course was not perpetuated at the University of Western Australia due to further reform processes and structural changes. After four years of experience with core elements of this concept, which have been implemented into diverse course settings, this concept is perceived as a feasible and easy to implement optional dissection course to fit with a modernized curriculum, clinical context orientation and competence-based active learning as recommended (Kerby et al., 2011; Drake, 2014).

MATERIALS AND METHODS

Course Concept and Participants

The optional course concept was a highly structured multimodality course, which should be adaptable to a 6-year medical curriculum (UWA, 2011) undergoing a modernization process. A second year level second semester cohort of 170 undergraduate medical students was included who were enrolled in the regular course/unit (IMED2202), which covered musculoskeletal and nervous systems, and head and neck anatomy based on faculty lectures, laboratory sessions and clinical tutorials (Supporting Information Material 1, 3). A subgroup (~1/3 of the total cohort) of 54 students had the option on a “first come, first served” basis without specific entrance tests to choose the new course/unit (IMED2283) as one of the curricular option units of the second year. Thus far, this unit of 75 total course hours had used prosections, models, radiography images, and regional dissection with the dissection result presented as a poster. The other 2/3 of the cohort had the option to choose between physiology and biochemistry laboratory courses during the second year (Supporting Information Material 1). The new course concept of IMED2283 encompassed core instruments such as topography-based cadaver dissection, clinically orientated group presentations and a competence-orientated multimodal assessment. The local ethics committee of the University of Western Australia approved the study. Written informed consent to participate in the study was obtained from all students enrolled in the course IMED2283.

Cadaver Dissection Course

The laboratory sessions were performed in the dissection laboratory twice a week during the morning for 2 hours over 13 weeks (50 teaching hours in total; Supporting Information Material 2). During the first week, introductions to the course in general and to dissection in the laboratory were given via a lecture, using the course web sites “Clinical and Topographic Anatomy” and “Musculoskeletal System” from the Institute of Anatomy, University of Zurich (Groscurth and Filgueira, 2010), as well as by viewing the documentary film “Donated to Science,” directed by Paul Trotman and Helen Nicholson from Medical School of the University of Otago, Dunedin, New Zealand (Trotman, 2009). A written dissection manual with figures of the most prominent structures was provided by the unit coordinators, which was complemented by learning recommendations at the beginning (“Prepare by identifying and labeling structures on following...
page, which shows result at end of week 2”), and questions at the end of each chapter, for example when dissecting the abdomen and inguinal region (“1. Which intercostal nerves/segments provide innervation to the anterior abdominal wall? 2. What structures cross dorsal to the inguinal ligament? 3. Why is it possible to palpate the femoral pulse in the inguinal region?”).

Web-based teaching material was accessible via the University’s intranet as well as anatomy books and atlas recommendations for all students such as A.D.A.M. Student Atlas of Anatomy (Olson and Pawlina, 2008), Applied Radiological Anatomy for Medical Students (Butler et al., 2007), Atlas of Human Anatomy (Netter, 2010), Clinically Oriented Anatomy (Moore et al., 2010), Cunningham’s Manual of Practical Anatomy (Romanes, 1986a,b,c), and Melloni’s Illustrated Review of Human Anatomy (Melloni et al., 2008).

The dissection course was performed on six formalin-embalmed cadavers from the local body donation program, which predominantly sustained surgery training and the prosecution-based courses. In contrast to prostheses, where the students are not actively involved in the dissection process (Winkelman, 2007), and to the limited regional dissection offered in the compulsory course, in the present course, head and neck, thorax and back, abdomen and gluteal region, upper, and lower limbs were dissected by topography (Supporting Information Material 2). Supervision by the unit coordinators was supported by an experienced surgeon (see Acknowledgments) who contributed from a clinical anatomy perspective to the classical dissections and occasionally demonstrated surgical exposures such as arthroscopic access to the knee joint and surgical landmarks for abdominal surgery.

### Group Lectures of Anatomy by Clinical Syndromes or Diseases

Teams of three students gave PowerPoint-based presentations of approximately 35–40 minutes each. Clinical syndromes or diseases were selected by the unit coordinators with respect to their topographical relation to the dissection regions (Supporting Information Material 2), for instance head and neck (meningioma, hydrocephalus, Parkinson’s disease, trigeminal neuralgia, Horner’s syndrome, retina ablation, middle ear infection, Hashimoto thyroiditis), thorax and back (esophageal varices, asthma, viral myocarditis, spina bifida), abdomen and gluteal region (diabetes mellitus, Reynold’s syndrome, inguinal hernia), and upper and lower limb (frozen shoulder syndrome, carpal tunnel syndrome, Raynaud’s phenomenon, Ewing’s sarcoma).

The teaching aims were to enhance basic and advanced knowledge in topographical anatomy, and application of anatomical knowledge for the theoretical understanding and reasoning of clinical issues including (differential) diagnosis, pathology, clinical investigation, radiological imaging, therapy modalities (such as drug-based and surgery), and prognosis. Additional teaching aims followed the demands of a modernized student-orientated education, such as teamwork, scientific, and communication skills (Table 1). During the first weeks, introductions to the unit in general and to scientific skills and group presentation were offered in the tutorial sessions. Further guidelines were available via the University’s intranet. Group plenary lectures started 2 weeks after the beginning of the semester to give the first presenters sufficient time for preparation. The lectures were presented by all group members together in front of the attendees of the optional course in the plenary theatre similar to a faculty lecture.

### Table 1.

<table>
<thead>
<tr>
<th>Competence Levels</th>
<th>Evaluation Tools</th>
<th>Maximum Achievable Points</th>
<th>Calculation of the Grade</th>
<th>Contribution (%) to Summative Final Gradea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic anatomical knowledge of the dissection regions (level 1)</td>
<td>Five Monday introductory quizzes (10 points each)</td>
<td>5 × maximum</td>
<td>Divided by 2 for maximum of 25 points</td>
<td>25 points = 25%</td>
</tr>
<tr>
<td>Applied anatomical knowledge (level 1, 2)</td>
<td>In course MCQ exam covering all course issues</td>
<td>20 points</td>
<td>Maximum 20 points</td>
<td>20 points = 20%</td>
</tr>
<tr>
<td>Understanding and presentation of advanced anatomy in light of clinical problems (level 1–3), using scientific skills, literature search, referencing, team work</td>
<td>Group presentation assessed by 10 items (maximum 2 points/item, see Supporting Information Material 4)</td>
<td>20 points (average from peers)</td>
<td>Average calculated from peers and teachers (maximum 20 points)</td>
<td>20 points = 20%</td>
</tr>
<tr>
<td>Dissection skills, applying anatomical knowledge to practical dissection, advanced understanding of topography (level 1–4), self-reflection</td>
<td>Dissection result, presentation and discussion, self-assessment and agreement on a final grade</td>
<td>10 points</td>
<td>Multiplied with 3.5 to maximum of 35 points*</td>
<td>35 points = 35%</td>
</tr>
</tbody>
</table>

The competence levels are based on the level of competence pyramid by Miller (1990): Competence level 1: “knows” (gathering factual knowledge as basis), level 2: “knows how” (knowledge to apply that knowledge), level 3: “shows how” (ability to show a certain knowledge) and level 4: “does” (ability to apply the knowledge in a practice setting), adapted to an undergraduate level of education as described in the Material and Methods section. In order to attribute a high relevance to dissection competence and presentation of the specimens, the result was multiplied by 3.5 to contribute to the final grade by 35%; maximum 100 points = 100%.
Students' In-Course Assessment Tools

Student evaluations (Table 1, Supporting Information Material 1) combined readiness assurance quizzes, self and teacher assessments of the dissection results, peer and teacher assessments of the group presentations, and a final multiple choice examination covering the course contents with special emphasis on anatomy and physiology. The competence levels (Table 1) were based on the pyramid of clinical competence by Miller, which originally aimed at clinical skills and competences, but could be adapted to all stages of medical education (Miller, 1990; Norcini, 2003; Davis and Harden, 2003). In detail, during five Monday dissection course sessions, introductory quizzes were held to test anatomical knowledge of the week’s dissection regions (3–4 open questions covering basic structures), which contributed in total to 25% of the final grade (Table 1). All questions were designed by the unit coordinators, thereby establishing content validity.

To assess identification of anatomical structures and performance in the dissection laboratory, the final laboratory session was scheduled for completion of dissection and demonstration of specimens for quality evaluation (Table 1, Supporting Information Material 2). For self-assessment, the students were interviewed: “When assessing the quality of your dissection in comparison with your peers, and using a scale of 1 to 10 (10 being excellent, 1 being extremely poor), what grade would you give your work?” The unit coordinators evaluated whether the dissection result was completed according to the manual, if all relevant structures were easy to identify, tidy and intact similar to published criteria (Hofer et al., 2011; Nwachukwu et al., 2015). Thus, another aim was engaging students in a practice of active dissection and critical reflection on their results including comparison with their peers. Discrepancies between students’ and teachers’ assessments were discussed before agreement on a final grade (Table 1).

The group presentations were assessed immediately after the presentation with a questionnaire (Supporting Information Material 4) adapted from published didactic recommendations by Goering (2003) from Perlman Center for Learning and Teaching at Carlton College, Northfield, MN. This peer-assessment approach had been previously applied and evaluated in other courses and shown to be adequate and valid for such teaching and learning sessions (unpublished own experience). Assessed issues were coverage of the content, appropriate pace, structure and logical flow, clarity of the slides and speech, clarity of the presentation and explanation of the figures, as well as appropriate referencing. All students had to rate all presentations including their own to foster scientific and presentation skills and critical (self-) reflection. The first and senior authors also assessed the presentations, and the average group grade was calculated from the average points achieved from both, the peers and the teachers, and assigned as collective group grade to each individual presenter (Table 1). Finally, at the end of the semester, knowledge in anatomy and physiology covering all issues taught during the course unit were tested by an in-course multiple-choice (MCQ) examination (Table 1).

Comparison of Student Grades with and without Optional Dissection Course

During the semester, all attendees of the optional course also underwent two continuous assessments and a final practical anatomy examination (CA1, CA2, CA3) in the regular course/unit (IMED2202), and at the end of the semester, in the frame of a unit (IMED2232) passed an integrated (anatomy, histology, physiology, biochemistry) final theory examination (NS200), which covered all topics from the first two years of their medical studies (Supporting Information Material 1). The respective grades were compared between the self-selected sub-group attending the optional dissection course and the group in the compulsory course doing other option units.

Evaluation of the Optional Course by the Students

After discussion of the dissection results, the students were individually asked about their overall perception of the course as a concept, in particular their attitude toward dissection. The unit coordinators recorded the students’ individual perceptions of this optional course with special emphasis on potential positive or negative experiences. In addition, more substantial information was collected by an anonymous online questionnaire (Supporting Information Material 5), which was adapted for the present study from the “University Student Satisfaction Survey Template” (SurveyMonkey®, Sydney, Australia), and could be voluntarily submitted after the final examination (NS200) only after cessation of the course.

Evaluation of the Optional Course by the Teachers

The senior author as a faculty member and the first author as visiting academic at the University of Western Australia evaluated and discussed the concept after the course primarily with respect to outcome and students’ perception. Since a special focus was directed to the adaptability to different teaching environments, they re-evaluated the concept 4 years later after implementation of core elements such as dissection, clinically-orientated student lectures, and tutorials for sub-groups at their new institutions in Switzerland, particularly in light of their experience in teaching anatomy in different traditional and reformed curricula in Australia, Germany, and Switzerland, respectively.

Statistical Analysis

For statistical calculations of the in-course grades for the cohort doing the optional dissection course (n = 54), data were analyzed using an Excel® 2013 software, version 15.0 (Microsoft Corp. Redmond, WA). Qualitative variables were expressed as percentage or points, respectively. The SPSS statistical package, version 23.0 (IBM Corp. Armonk, NY) was used for descriptive and inferential statistical analysis. Data were examined by Shapiro–Wilk test to check for normal distribution and calculating Pearson’s correlation coefficient (r). A correlation r ≤ 0.39 was considered as weak, 0.4 ≤ r < 0.6 as moderate, and ≥ 0.6 as strong. For comparison of the performance in the assessments of the compulsory course including the final examination, grades of the student cohort attending the optional dissection course and of the student cohort attending other curricular optional courses were analyzed using a GraphPad Prism® software, version 5.0 (GraphPad Software Inc., La Jolla, CA). Data were statistically
analyzed by a non-parametric two-tailed Mann–Whitney U test with the same variance. A two tailed P-value <0.05 was considered to be statistically significant.

RESULTS
Characterization of the Student Cohorts
Among the 54 students in the optional course, 77.8% were local or came from Australia and New Zealand (ANZ), respectively, and 22.2% were international students, with a moderate trend toward more local or ANZ students compared with the entire semester cohort (data not shown). While in the non-dissecting group, gender distribution was exactly 50% (38 females, 38 males), the self-selected participants in the optional dissection unit constituted 40% (n = 22) females and 60% (n = 32) males. The students choosing dissection performed significantly better (P = 0.001) in both, the preceding integrated (anatomy, biochemistry, physiology) first year (IMED1101) and second year (IMED2201) normal systems courses (Fig. 1). In detail, the students choosing the dissection course had in the first year course a mean of 70.4% (±8.7, median 70.5, range 50.0–84.0) as compared with the group without dissection (average 65.2% ± 9.7, median 66.0, range 36.0–84.0). Similarly, students in the dissection course had in the second year course a mean of 72.9% points (±9.1, median 75.0, range 50.0–86.0) as compared with the group without dissection (mean 68.3% ± 9.5, median 67.0, range 50.0–92.0).

Results Achieved in the Dissection Course
During the five introductory quizzes, an average summative grade of 37.5 points ±6.3 out of maximum 50 points (range 15.5–46.5) was achieved, which contributed 25% to the final grade (Tables 1 and 2). Self-assessment of the students achieved a grade of 8.0 or 9.0, respectively. Self-assessment and evaluation of dissection quality by the teachers revealed an average of 8.1 (median 8.0, range 8.0–9.0 points). On average, out of a maximum of 35 points, 28.5 (±1.9, median 28.0, range 28.0–31.5 points) were achieved (Table 2).

Results for the Group Presentations
The lectures were preferentially structured by the group members as follows: introductory description of the problem/disease and its clinical relevance (one student), followed by a detailed description of the anatomy and physiology (one student), and diagnostic and therapeutic methods and prognosis (one student). Aside the provided house manual and recommended learning resources, the students procured relevant up-to-date clinical and epidemiological data from the Internet. The presentations were finalized by a discussion round of approximately 10 minutes, often initiated by short quiz questions on the final slide. Subsequently, teachers and peers assessed the presentations, with a very good average result of 17.1 points (±1.0, median 17.4, range 15.4–18.7 points) from a maximum of 20 points (Table 2). Assessments did not significantly differ, ranging generally between 2 points (yes) and 1 point (mostly) per item (Supporting Information Material 4), with a moderate trend to the higher grade by the teachers. In detail, excellent rankings were achieved with regard to lecture content (item 5), which appropriately covered all relevant anatomical structures of the region (item 10) as well as physiological, pathological and clinical aspects (item 8). The presentations were clearly structured (item 6) with an appropriate and logical pace (items 2 and 3). In addition, the achievement of a minimum of 15.4 points reflects the high quality of the presentations. There were some minor point deductions with regard to clarity of the PowerPoint slides (item 4), explanation of figures (item 7) and referencing (item 9), predominantly by the teachers, and clear and concise language (item 1), logical pace (item 2), and clarity and readability of the PowerPoint slides (item 4), predominantly by the peers.

Results for the Unit-Internal Examination and the Final Course Grade
The unit-internal MCQ examination at the end of the semester (Table 2) revealed an average of 16.4 ± 1.5 points from a maximum of 20 points (median 16.5, range 12.5–18.5 points). A summative final grade with a mean of 81.0% (±3.8, median 81.0, range 69.0–89.0 points) was achieved.
In detail, scores from the weekly introductory quizzes were significantly lower ($P < 0.001$) than the final grade, and strongly correlated ($r = 0.74$) with it. The agreed good or very good (8 or 9 points from 10) scores for the dissection result were not significantly different ($P = 0.58$) from the final grade and weakly ($r = 0.30$) correlated with it. Assessments of the group presentations were significantly better than the final grade ($P < 0.001$) with a weak correlation ($r = 0.32$). Grades from the unit-internal MCQ test at the end of the semester were not significantly different ($P = 0.34$) from the summative grade, and strongly correlated with it ($r = 0.6$).

Grades in the Compulsory Course Assessments and External Final Examination by Students with and without Optional Dissection Course

In the continuous assessments (Fig. 2) of the regular unit (IMED2202, Supporting Information Material 1), students taking the optional dissection course did not perform significantly different ($P = 0.07$) in CA1 after 4 weeks of the semester with a mean of 66.4 points ($\pm 13.5$, median 68.5, range 34.0–90.0) as compared with the group without dissection (mean 62.4 points $\pm 14.0$, median 64.0, range 0.0–89.0), but the students not doing dissection revealed a broader range in CA1, which narrowed throughout the course but was still broader in the final examination (Fig. 2b). Students in the optional dissection course achieved significantly better results in assessment CA2 ($P = 0.0011$) in the middle of the semester (average points 78.5 $\pm 11.4$, median 80.8, range 46.0–94.5) versus average points 69.9 ($\pm 16.6$, median 73.5, range 12.5–94.0) and in assessment CA3 ($P = 0.0025$) at the end of the semester (average 70.1 points $\pm 10.4$, median 73.0, range 41.3–85.8) versus average 64.1 points ($\pm 12.7$, median 64.5, range 28.0–89.8). Nevertheless, in the integrated final examination (NS200/IMED2232) with a minimum pass limit of 60%, a not significant ($P = 0.08$) trend toward higher scores (Fig. 2) was observed for the group in the dissection course (mean 68.7 points $\pm 6.3$, median 69.3, range 50.8–80.0) as compared with the group without dissection (mean 66.4 points $\pm 8.7$, median 67.0, range 45.8–83.0).

Online-Evaluation of Teamwork and Peer-Assessments of Group Presentations

The voluntary anonymous online questionnaire (Supporting Information Material 5) was returned by 21 of the 54 students (39% response rate). The responders (76.2% local or from ANZ, 23.8% international) were representative with respect to nationality and sex ratio for the entire cohort in the dissection course. In brief, 14/21 responders had not given lecture-like presentations before the course, but none of them perceived the setting as stressful. Almost all (19/21) responders considered preparation for the group presentations as very interesting and satisfactory. For almost all (20/21) raters, workload for the presentations was just right, whereby the majority (18/21) used 3–10 hours for preparing and divided workload equally amongst the members of their group. One student reported severe team problems, which were difficult to solve. Generally, teamwork for preparing the group presentation was evaluated positively and the majority of the responders (12) were satisfied with their own group’s presentation and would have given themselves a grade between 80 and 95% (18/21 students), whilst six students wrote that they could have done better with their presentations (Supporting Information Material 5). The majority (17/21) thought that peer assessment improved their own presentation skills and learning. Criteria for peer-assessing were considered as adequate by all 21 responders, however eight thought that the weighting was questionable, but no one thought there was inadequate or biased assessing. More than half of the responders were concerned that peer and teacher assessment would be harsher, and four students that peer assessment would be harsher.

Perception of Dissection and the Option Unit IMED2283 Concept by the Students

The course unit was highly valued by all students. During the dissection course and lecture sessions, the students expressed their satisfaction with the entire concept, particularly the dissection course. Individual discussions with the unit coordinators during the laboratory sessions and interviews at the final specimen evaluation revealed that all students perceived dissection as

Table 2.

Grades (%) Achieved During the In-Course Assessments of the Optional Dissection Course

<table>
<thead>
<tr>
<th>Assessment Tool</th>
<th>Quiz 1</th>
<th>Quiz 2</th>
<th>Quiz 3</th>
<th>Quiz 4</th>
<th>Quiz 5</th>
<th>Total Quizzes</th>
<th>Dissection Result</th>
<th>Group Lecture</th>
<th>MCQ Examination</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (± SD)</td>
<td>7.7 (±2.0)</td>
<td>6.3 (±1.6)</td>
<td>8.0 (±1.5)</td>
<td>8.5 (±1.4)</td>
<td>7.4 (±1.9)</td>
<td>37.5 (±6.3)</td>
<td>28.5 (±1.9)</td>
<td>17.1 (±1.0)</td>
<td>16.4 (±1.5)</td>
<td>81 (±3.8)</td>
</tr>
<tr>
<td>Median</td>
<td>8.0</td>
<td>6.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.0</td>
<td>38.5</td>
<td>28</td>
<td>17.4</td>
<td>16.5</td>
<td>81</td>
</tr>
<tr>
<td>Minimum/Maximum</td>
<td>4.0</td>
<td>2.0</td>
<td>4.0</td>
<td>6.0</td>
<td>1.5</td>
<td>15.5</td>
<td>28</td>
<td>15.4</td>
<td>12.5</td>
<td>69</td>
</tr>
<tr>
<td>Maximum to achieve</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>50</td>
<td>35</td>
<td>20</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>% of final grade</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>25</td>
<td>35</td>
<td>20</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

For detailed description of the contribution to the final grade, see Table 1; Quiz 1–5, Monday short quizzes; MCQ, multiple choice questions.
the students were ready for dissection with a sufficient background of anatomical knowledge. The teacher- and self-assessment of the dissection results additionally motivated the active dissection process. Also the peer teaching presentations reached a high level and the grades achieved in the in-course assessments as well as those from the compulsory course were satisfying. This optional course can thus be easily implemented into a modernized reformed curriculum to complement anatomy teaching by topographical aspects.

Preliminary data from this project were presented at meetings of Anatomical Societies (Eppler and Filgueira, 2012; Filgueira and Eppler, 2012), however, to verify the adaptability of this multimodal concept, core elements were implemented first in consecutive courses such as in the bachelor course for third year human biologists at the University of Western Australia, which is still being offered using student lectures (ANHB3313). In addition, at the University of Fribourg, Switzerland, student presentations were implemented as core elements in the bachelor and master courses for human biologists and neurobiologists. In 2016, a bachelor course on the locomotion tract for second year medical students (MH.4901) was newly introduced, which included student presentations on the locomotion tract, clinical examination, ultrasound, and dissection of joints and muscles together with orthopedic surgeons and a rheumatologist (Filgueira and Eppler, 2016). Also in a reformed dental medicine curriculum at the University of Basel, team-based and self-directed learning were integrated into a course concept (No. 18929) for second year bachelor students of dental medicine, which included faculty lectures by anatomists, dentists and dental-facial surgeons. Further, head and neck topography is taught by anatomists together with dentists and dental-facial surgeons. When the present study was conducted in Australia in 2011, health professionals and medical students in Australia and New Zealand requested more anatomy teaching (Mitchell, 2007; Azer and Eizenberg, 2007; Mitchell and Batty, 2009; Herle and Saxena, 2011; Campbell and Fox, 2012). Optional courses have been recommended to compensate reductions in anatomy teaching (Winkelmann, 2007), however, the course must match the overall curriculum and philosophy of education with a multimodality approach and early incorporation of clinical issues (Kerby et al., 2011; Drake, 2014). Considering this background, the aim of the project was to introduce a course concept as a multimodal entity, which integrates student- and competence-orientated teaching and assessment methods with topographical dissection to fit into modernized curricula. Required are a body donor program and a time frame allowing good articulation with the preexisting curriculum, which may be difficult for optional courses (Pais et al., 2017).

Perception by the Instructors and Sustainability of the Course Concept

The course was considered as feasible concept. Stringent monitoring of the learning process by the introductory quizzes made supervision of the dissection process very comfortable since the students were ready for dissection with a sufficient background of anatomical knowledge. The teachers and self-assessment of the dissection results additionally motivated the active dissection process. Also the peer teaching presentations reached a high level and the grades achieved in the in-course assessments as well as those from the compulsory course were satisfying. This optional course can thus be easily implemented into a modernized reformed curriculum to complement anatomy teaching by topographical aspects.

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DISCUSSION

Background

When the present study was conducted in Australia in 2011, health professionals and medical students in Australia and New Zealand requested more anatomy teaching (Mitchell, 2007; Azer and Eizenberg, 2007; Mitchell and Batty, 2009; Herle and Saxena, 2011; Campbell and Fox, 2012). Optional courses have been recommended to compensate reductions in anatomy teaching (Winkelmann, 2007), however, the course must match the overall curriculum and philosophy of education with a multimodality approach and early incorporation of clinical issues (Kerby et al., 2011; Drake, 2014). Considering this background, the aim of the project was to introduce a course concept as a multimodal entity, which integrates student- and competence-orientated teaching and assessment methods with topographical dissection to fit into modernized curricula. Required are a body donor program and a time frame allowing good articulation with the preexisting curriculum, which may be difficult for optional courses (Pais et al., 2017).
Self-Selected Student Cohorts

After the start of the semester, the students in the optional dissection course performed similar to the combined cohorts, but tended to have better grades only. Nevertheless, since they had better grades in the preceding courses than the combined cohorts of students in the compulsory unit, statistical comparison between the students cohorts should be looked at with caution. Probably a preference for anatomy can be anticipated, as well as differences amongst groups when evaluating self-selected anatomy courses (Winkelmann, 2007; Pais et al., 2017).

Comparatively more male students (60%) chose the dissection course. Since students interested in surgery may tend to prefer a tactile learning experience (Preece and Cope, 2016) such as a dissection course, this is in line with reports that more male students are interested in surgery, for example, in New Zealand (Insull et al., 2006). In Norway, only 10–20% of general surgeons are women while they were in the majority (>60%) at medical school (Quinlan, 2007; Søreide et al., 2008; Troppmann et al., 2009). In a more recent study from Puerto Rico, 60% of undergraduate and 50% of medical students are women, but they make up only 36% of surgical residents (Cruz et al., 2016). Recently, specific programs were suggested, which should aim at increasing personal interest in the field to attract male and female trainees to surgery in the future (Rohde et al., 2016).

Experience from the Dissection Course

Concerned about inefficient anatomy knowledge and afraid of decreased safety of surgical practice and surgery as a career path, surgeons in Australia and New Zealand introduced anatomy education in postgraduate programs (Herle and Saxena, 2011; Campbell and Fox, 2012; Burgess and Ramsey-Stewart, 2014; Burgess et al., 2016). Dissection is proposed to foster surgery as a career path, in particular when conducted in cooperation with surgeons (Kozar et al., 2003; Hammer et al., 2015). Moreover, Orsbon et al. (2014) suggested that advanced anatomy training should prepare students for the practical needs of their specialty residency programs rather than follow a generalized format for all clinical-year students.

Another approach is integrating surgical exposures into anatomy courses with collaborative teaching of anatomists and clinical teachers (Böckers et al., 2014; Burgess and Ramsey-Stewart, 2014, 2015; Hammer et al., 2015). In the present study, anatomical dissection was only occasionally combined with surgical exposures, but systematically adding surgical or endoscopic approaches by clinical specialists to the overview of anatomical topography enriches anatomy teaching and contributes to students’ motivation (Filgueira and Eppler, 2016).

Integration of surgical teachers into a traditional dissection course could also facilitate dissection even with limited faculty. In the present study, a single faculty member with the support of an experienced anatomist and a surgeon educated 54 students. However, when planning such an integrative dissection course at the undergraduate level, one should be aware that this can be logistically challenging and may be at the expense of dissection time (Drake et al., 2009). A trend increasing in popularity is to teach surgery, radiology and anatomy together, which has a high acceptance rate amongst medical students (Dettmer et al., 2010; Filgueira and Eppler, 2016), particularly when using high quality CT and MRI scans from the cadavers, which the students dissect (Schramek et al., 2013). Furthermore, radiological images may bring more awareness to the students about the medical record of their body donors (Scheurer et al., 2016). Although clinical or radiological (e.g., DICOM) data from the body donors was not integrated into the presented course concept, this approach in future conceptions will stimulate students’ perception of the dissection course and integration with clinical issues. Nevertheless, allotting 50% of dissection time to radiology as has been suggested (Benninger et al., 2014), may affect the efficacy of dissection and learning outcome.

In a nationwide survey in Israel, specialists in all fields of medicine believed more strongly than medical students that anatomy and medical imaging should be taught separately in order to allow anatomical principles to be appreciated, which in turn will better serve the students when studying radiology (Marom and Tarrasch, 2015).

In the present study, the regular readiness assessments were a suitable tool to monitor the learning performance of the students. Grades achieved in the quizzes were significantly lower than the final grade, but strongly correlated with it, which supports the advantageous impact of strictly guided learning in gross anatomy courses and regular in-course assessments on summative grades (Kooloo et al., 2012; Pratten et al., 2014). The quizzes also motivated the students to be well prepared for dissection, which also facilitated supervision and efficiency of dissection. Evaluation of the dissection quality was a stimulus as previously reported (Arroyo-Jimenez Mdel et al., 2005; Daly, 2010; Kumar et al., 2010; Hofer et al., 2011; Nwachukwu et al., 2015).

There exist reports (for review see: Rotenstein et al., 2016), also from Australia (e.g., Beyond Blue, 2013; Bore et al., 2016) about anxiety and burnout during medical studies. Some studies predominantly focused on early semesters including the dissection course (Bernhardt et al., 2012; Limbrecht et al., 2013; Burger et al., 2014; Wild et al., 2014; Mata et al., 2016; Moua et al., 2016; Scholz et al., 2016). Nevertheless, in the present study, many students expressed that they had “fun,” and found the course “enjoyable.” Even in light of the voluntary selection of the dissection course, also integration of anatomy with clinical topics in the group presentations may have enhanced the interest and supported the learning experience as widely accepted (Bergman et al., 2008; Johnson et al., 2012; Drake, 2014; Böckers et al., 2014; Burgess et al., 2012; Kageyama et al., 2016), in addition to the positive effects of hands-on experiences for understanding three-dimensional structures in the traditional dissection laboratory (McKeown et al., 2003; Lachman and Pawlina, 2006; Sugand et al., 2010; Drake, 2014). As can be concluded from responses to the online questionnaire, also teamwork, feedback, and face-to-face interaction with supervisors, which is known to improve learning and professional behavior (Nieder et al., 2005; Youdas et al., 2013; Attardi et al., 2016; Han et al., 2015), may have contributed to the overall positive perception of the dissection course, which is well in agreement with previous reports (Lee et al., 2011; Quince et al., 2011).

Experience with Group Lectures and Team Work

In the present study, student teams prepared plenary lectures instead of the faculty to complement the core anatomy
contents, which was a demanding task. When undertaking such an educational approach, one has to weigh out the advantages of plenary lectures, by which according to Peterson and Tucker (2005) students may learn more than from dissection and facts can be communicated to a broad audience. Team-based learning requires more tutors, and so far mainly focused on shared learning experiences and peer teaching for in-course preparations and tests (Nieder et al., 2005; Vasan et al., 2008, 2009). While beneficial effects have been reported, so far particularly for academically at-risk students and heterogeneous classes (Nieder et al. 2005; Vu and Dall’Alba, 2007; Spandorfer et al., 2014; Pizzimenti et al., 2016), team-based learning and peer-assessment have been demonstrated to effectively improve students’ overall performance in medical curricula such as scientific and clinical skills (Schönrock-Adema et al., 2007; Vasan et al., 2008; Perera et al., 2010; Burgess et al., 2012).

The high scores achieved from peer and teacher assessments in the present study may be due to the attribution of a collective mark to all presenting group members. It is under debate that by this assessment procedure the individual contribution is not fully considered (Plymouth University, 2013), so that it is recommended not to allocate more than 40% of the grade to teamwork (Gibbs, 1995). However, medical students are anyway considered as high performing students (Winkelmann, 2007), such that high quality lectures would be expected, the grade accounted for 20% to the final grade only, and workload was equally divided. The majority of students was satisfied with the own group’s presentation and would have given themselves a grade between 80% and 95%, but students rated team-based activities high even irrespective of their grades (Vasan et al., 2009). Thus, the high scores achieved may also result from the collaborative efforts and a range of skills required for the complex task (Gibbs, 1995; Plymouth University, 2013).

**Experience of Peer Assessment**

For the majority of the responders, peer assessment improved their own presentation skills and learning. Only a few successful peer-assessment systems have been implemented in medical curricula and there are still concerns regarding acceptance by the students (Arnold et al., 2005; Spandorfer et al., 2014). In a study among first-year medical students (Spandorfer et al., 2014), peer-assessment was limited to the dissection course and focused predominantly on low-scoring students, which might explain the students’ concerns. In the present study, approximately half of the rating students had not experienced self-assessment or peer-assessment. In a previous study, highly encouraging comments were achieved from medical students whereby the majority (67%) had never been exposed to formal self- and peer-assessment during pre-university studies (Perera et al., 2010). Also, in the present study, there existed some concerns, whereby the students predominantly feared that teacher evaluations would be harsher than those by their peers. For instance, students’ lectures on physiology were rated lower by faculty members than by students (Kommalage and Gunawardena, 2011), which contrasts with the present study and previous reports (Albanese et al., 1991; Lurie et al., 2006) when students with low levels of interpersonal attributes were proposed to be more negative in their judgment of classmates (Lurie et al., 2006) while advantageous personal performance scores were achieved by those students who assessed others (Schönrock-Adema et al., 2007). Aside the above described didactic effects of self-assessment, the concept of the present study that all students of the unit rated all presentations including their own, also avoided such as raters’ selection bias.

**Outcome and Perception of the Assessment System**

In the present course, students were satisfied with their assessments and improved their anatomy marks significantly in the continuous assessments as compared with the students not doing dissection similar to previous studies integrating team-based learning and self-assessment into the dissection course (Han et al., 2015) or assessing the dissection quality (Nwachukwu et al., 2015). The teachers perceived the in-course assessment system as valid to score anatomical knowledge since strong correlations of the introductory quizzes and MCQ test with the individual final grade were achieved. The teachers were also satisfied with the evaluation methods for applied anatomy knowledge and other competences, based on the at least weak correlations of the dissection result and assessments of the group lectures with the individual final grade.

Almost all responders of the online questionnaire rated the choice of topics of the group lectures as very or even extremely helpful for the unit internal tests and for the assessments of the regular course and the external examination. However, the sub-group in the optional dissection course performed similar, with only a trend to higher scores, to the other students in the integrated final examination. In a study comparing plastic models, organ and virtual dissections, students learning on plastic models scored higher on physiology questions than students doing organ dissections. Thus, different didactic goals can be achieved using different teaching and learning approaches (Lombardi et al., 2014). In the present study, main emphasis was laid on advanced and applied anatomical knowledge and practical, clinical, scientific and presentation skills, which may not have predominantly improved results in examinations testing mainly knowledge and understanding in integrating different disciplines such as physiology and biochemistry. These findings are in accordance with another study, when instructional approach for anatomy not or only weakly correlated with the final results at the United States Medical Licensing Examination® (USMLE®). However, Cuddy et al. (2013) emphasized that longer exposure to anatomy instruction may better prepare students for clinical practice; dissection only laboratories may lessen medical errors and increase patient satisfaction in everyday practice.

**Limitations of the Study**

First, direct comparison between the students choosing the dissection course as option unit and those choosing other option units has to be considered with caution. Regarding the tests in the compulsory course, students doing the optional dissection may constitute a cohort with overall above average performance. Therefore, also the results shortly after beginning of the course were analyzed, which showed no difference. Nevertheless, there may be some preferences not reflected by marks, which has been reported for other studies comparing optional courses (Winkelmann, 2007). Further studies are needed to compare such a multi-modality concept under completely equal conditions such as
random assignment of students to classes of the same student number, and all groups undergoing equal assessments, with special focus on the different teaching and assessment contributions.

Furthermore, all students of the option unit IMED2283 were asked for their perception of the optional course. Nevertheless, recording the experiences of the entire second level cohort in the compulsory anatomy unit who attended other optional courses was beyond the scope of the study. While all students choosing the optional dissection course expressed their overall satisfaction with the concept during individual interviews, only 21 of the 54 students voluntarily returned the more detailed online questionnaire, which could be submitted at the earliest after the final examination, which took place several months after cessation of the course. This procedure might have impaired the return rate, but according to Pabst and co-workers (Pabst and Rothkött er, 1997; Pabst et al., 2001), questionnaires evaluating the curriculum or after modifying a course should be done not only during and immediately after a course, but also at later time points since the clinical relevance of lectures and courses can only be graded adequately after some years of clinical experience. In these studies, gross anatomy was graded top at all time points evaluated and reached higher levels of “clinical relevance” than other subjects. Thus, future studies should aim for long-term evaluations of courses. Nevertheless, some information could be drawn from the questionnaire with regard to future courses, since the responders were representative for the entire group.

Finally, despite the overall very positive outcome of the course with regard to academic success and acceptance by the students, the course design was nevertheless not implement ed into the medical curriculum at the University of Western Australia due to further structural changes. However, since also Switzerland has undergone a move to a problem- and system-based integrated modernized medical curriculum (Schirlo et al., 2002), which has led, to a varying extent, to reductions in time allocated to anatomy, including dissection, substantial parts of the presented didactic concept could be implemented into new courses in Switzerland.

CONCLUSION

The present study integrates anatomical dissection with student team-directed and clinically orientated learning in a multimodal concept. Also, a score system was introduced to assess anatomy competences at different levels of undergraduate preclinical education. The presented concept is feasible for sub-groups as described and can be adapted to larger classes, which can be realized when these are viewed as multiple small groups (Drake, 2007). The authors feel that their concept could stimulate and encourage other anatomists to tailor this concept into their local modernized curricula as a means to reinforce the importance of practical cadaveric dissection integrating modern teaching demands as previously recommended by Winkelmann (2007), Sugand et al. (2010), Kerby et al. (2011), Drake (2014), and Pawlina and Drake (2016).

ACKNOWLEDGMENTS

The study was performed at the School of Anatomy, Physiology and Human Biology at the University of Western Australia, in Perth, where the senior author was employed. The study was possible by a research fellowship provided to the first author by the University of Western Australia in Perth, Australia. The authors are very grateful to Dr. Avinash Bharadwaj, and Professor Linz Schmitt, School of Anatomy, Physiology and Human Biology, The University of Western Australia, for helpful support. Special thank is due to our co-supervisor Michael Thomas, MD, surgeon, and the students of unit IMED2283.

NOTES ON CONTRIBUTORS

ELISABETH EPPLER, M.D., is a lecturer in the Institute of Anatomy at the University of Basel, in Basel, Switzerland, and adjunct lecturer in the Institute of Neuroradiology, University Hospital of Magdeburg, in Magdeburg, Germany, and the Institute of Anatomy, University of Zurich, in Zurich, Switzerland. Previously, she was anatomy instructor in the University of Zurich involved in the reform of the medical curriculum. During research semesters at the University of Western Australia in Perth, Australia, and at the Institute of Anatomy II, University of Erlangen-Nurnberg, in Erlangen, Germany, she broadened her view on medical teaching methods, curriculum development, and clinical anatomy. She teaches anatomy to undergraduate medical and dental students, and to bachelor and master students of biomedicine, and contributes to postgraduate education of health professionals.

STEFFEN SEROWY, Ph.D., is a senior physicist at the Institute of Neuroradiology, University Hospital of Magdeburg, in Magdeburg, Germany. He participates in the teaching activities of the Institute of Neuroradiology in undergraduate, clinical, and postgraduate medical and biomedical curricula. His research focuses on integration and optimization of medical engineering systems for neuroradiology.

KARL LINK, Ph.D., D.V.M., is anatomy instructor for undergraduate medical and dental students in the University of Zurich, Switzerland and in the University of Fribourg, Switzerland. His research interests are in clinical anatomy and in comparative endocrinology and diabetes.

LUIS FILgueira, M.D., is professor and chair of anatomy in the Department of Medicine at the University of Fribourg, in Fribourg, Switzerland. Previously, he was professor at the School of Anatomy, Physiology and Human Biology at the University of Western Australia, in Perth, Australia. He teaches in the medical, biomedical science, neuroscience and immunology programs and contributes to curriculum development in the medical program. He has designed and established various new courses for medical and science students over the past 10 years. His research interests are in medical and science education, cell biology and clinical anatomy.

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