

Medical students' perspective on training in anatomy

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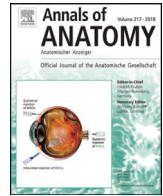
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Medical students' perspective on training in anatomy[☆]

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ABSTRACT

Gaining sufficient knowledge of anatomy is an important part of medical education. Factors that influence how well students learn anatomical structures include available sources, learning time and study assistance. This study explores the attitude of medical students with regard to studying anatomy and evaluates possibilities for improvement of training in anatomy. Twenty medical students participated in a focus group meeting. Based on this focus group, an online survey consisting of 27 questions was developed and distributed amongst medical students of Maastricht University, the Netherlands. A total of 495 medical students (both Bachelor and Master level) participated in this survey. Master students found studying anatomy less attractive than Bachelor students (36.8% of the Master students vs. 47.9% of the Bachelor students ($p = .024$)). Although most students responded that they thought it is important to study anatomy, 48% of all students studied anatomy less than 10 h per study block of 8 weeks. Only 47.9% of the students rated their knowledge of anatomy as adequate. Students suggested that three-dimensional techniques would help improve their knowledge of anatomy. Therefore investing in three-dimensional tools could prove beneficial in the future.

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1. Introduction

Knowledge of anatomy is essential to ensure safe clinical practice for many clinicians, especially in the fields of surgery and imaging. In addition to physiology, pathology and clinical reasoning, anatomy is one of the basic subjects taught in medical curricula (Frank and Danoff, 2007; Netterstrøm and Kayser, 2008). Anatomical knowledge facilitates the learning pathophysiology, supports the examination of a patient, and facilitates reaching a diagnosis and communicating these findings to the patient and other medical professionals (Turney, 2007).

Evidence suggests that students at all stages of their medical training consider anatomy important (Older, 2004; Moxham and Plaisant, 2007; Nabil et al., 2014). Medical students nevertheless admit that they have, on average, insufficient anatomical knowl-

edge (Bergman et al., 2011). To determine why there is a lack of anatomical knowledge, most studies evaluate the efficacy of the medical degree curriculum (Dolmans et al., 2005; Turney 2007; Fitzgerald et al., 2008; Bergman et al., 2011; Smith and Mathias, 2011), while other studies focus on medical students' perception of the anatomy curriculum (Chapman et al., 2013). Some studies compare traditional versus problem-based-learning curricula, but conclude that there is no difference between the two regarding the students' knowledge of anatomy (Colliver, 2000; Newman, 2003). However, it is known that the learning approaches of teachers also affect students' learning methods and thereby their medical functioning in a clinical setting (Gibbs and Coffey, 2004).

Possible explanations for the lack of sufficient anatomical knowledge include absence of or too few core courses in anatomy, decline of dissection as a teaching tool and failure to vertically integrate the teaching of anatomy (Bergman et al., 2011; Bergman et al., 2014).

Controversy exists regarding how students can best study anatomy (Pandey and Zimitat, 2007; Estai and Bunt, 2016), but also regarding how anatomy can best be taught (Craig et al., 2010; Kerby et al., 2011; Estai and Bunt, 2016). Some favour dissection

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of human cadavers in combination with studying with textbooks, whereas others support the use of newer technologies to study anatomy (e.g. computer-assisted learning and the use of three-dimensional images) (Davis et al., 2014). A combination of using anatomical books and dissection plus newer technology is probably the best learning system (Estai and Bunt, 2016). Accordingly, anatomical learning methods are now supplemented or combined with e-learning (Azer and Azer, 2016; Lochner et al., 2016).

Medical students' perception of anatomy education and their opinion on the best methods to teach or study anatomy may help to shape future courses in anatomy and optimize student performance. The aim of our study was, therefore, to explore medical students' attitude toward and appreciation of studying anatomy at different phases of their studies and to evaluate possibilities to improve anatomy education.

2. Methods

2.1. Study setting

The setting of this cross-sectional study was Maastricht University (MU), Maastricht, the Netherlands. MU divides its medical curriculum into three years of Bachelor and three years of Master education. The Bachelor program concentrates on basic sciences, while the Master program aims to apply the basic sciences to requirements of clinical practice. MU uses Problem-Based Learning (PBL) as its educational model. The anatomical curriculum is a 'block-centred curriculum', based on a specific organ, which covers both anatomical knowledge and physiological knowledge. Training in anatomy consists of macroscopy, histology, and (human) developmental biology with lectures, (predissected) cadavers, and virtual microscopy as teaching tools. Furthermore, in accordance with PBL, anatomical topics are discussed in small groups of approximately 13 students, who are supervised and assisted by a tutor. During the PBL lesson, students determine for themselves how extensively all anatomical structures, in combination with physiological knowledge, will be discussed. The tutor checks if all topics of the study block are discussed. Therefore, the total anatomical education hours depend on the difficulty and final objectives of a study block. For this reason, it is difficult to indicate exactly how many hours are spent on anatomy. Approximately 10% of the final test after an 8-week study block consists of questions on the anatomy relevant for that block. In the Master phase, clinical knowledge is individually assessed during clinical practice. The medical curriculum at MU does not have separate anatomical tests. Ethical approval was not applicable to this study.

2.2. Development of the survey

In order to develop a survey for medical students, a focus group discussion was conducted. Twenty medical students varying in gender, age, current study year, previous education and preference for future specialization participated. Prior to the focus group, a script with relevant topics and questions about anatomy education and its appreciation was developed based on the experience and literature research of two researchers (CPRT and KJBN). This script was used to check if all topics were discussed. The group discussion was recorded and transcribed verbatim and then clustered into five principal themes. Based on this qualitative content analysis, we developed twenty-seven questions for the survey (Appendix A). The survey was conducted in Dutch and contained closed questions that could be scored on binary scales (e.g. yes/no), 4- 5- and 6-point Likert scales (ranging from totally disagree to totally agree) and 10-point Likert scales. In addition to the closed questions, it

contained open-ended questions such as "Which other sources do you use for studying anatomy?" The survey was checked regarding quality and structure by an education expert (HEP). We performed a pilot test survey among 15 medical students (Bachelor and Master students). Informed consent for participation was provided by each medical student upon submission of the completed online survey.

2.3. Distribution of the survey

The survey was distributed to Bachelor and Master medical students using SurveyMonkey (SurveyMonkey Inc, San Mateo, California, USA). This is a secured online website on which surveys can be developed and hosted. For privacy reasons, MU did not allow mass emailing to all medical students. Therefore, medical students were personally invited – face-to-face on campus, before the start of a lecture or classes, and during preparations for medical clerkships at the Maastricht University Medical Centre – to visit the website and complete the online survey. Medical students were asked to invite their classmates to do so as well.

2.4. Statistical analysis

Characteristics of the participating medical students were described using means and standard deviations for continuous variables, and absolute values and percentages for categorical variables. To describe the completed surveys, we stratified the medical students into Bachelor and Master students. Differences between Bachelor and Master students were tested using Pearson's Chi-squared test and the non-parametric Mann-Whitney U test for dichotomous and ordinal scores. P-values smaller than or equal to .05 were considered to indicate statistical significance. Data from the focus group were analysed using qualitative content analysis (Bowling, 2014). All analyses were performed using IBM SPSS version 23.

3. Results

The following are the five principal themes that emerged from the survey: importance of studying anatomy, appreciation for studying anatomy, assessment of the student's own knowledge of anatomy and of learning tools that could be used to improve the anatomical knowledge of students in the future, and attitude about studying anatomy in the Bachelor phase compared to that in the Master phase (e.g. study time and resources).

3.1. Characteristics of the survey respondents

In total, 497 medical students completed the survey. During the study period 1890 medical students were registered at the MU, but it was impossible to keep track of how many students were invited to participate either by the authors or by other students. Therefore it was impossible to compute a response rate. Of the completed surveys, two (.4%) had to be excluded from the analysis because of an incomplete response. Table 1 shows some of the characteristics of the medical students who participated in the survey. The skewed sex distribution (29.1% male, 70.9% female) is representative for the actual sex distribution of medical students in the Netherlands. According to the *Dienst Uitvoering Onderwijs* (DUO), a Dutch institution that is responsible for educational laws and legislation for the Ministry of Education, Culture and Science, the percentage of female first-year students in the academic year 2015–2016 in Maastricht was 68.3%. The difference between our gender ratio and that reported by the DUO was not statistically significant ($p = .248$).

Table 1
Characteristics of 495 respondents who filed in the survey at Maastricht University in 2016.

	Total sample (n = 495)	Bachelor (n = 337)	Master (n = 157)
Female		n = 351 (71.1%)	n = 246 (73.0%)
Male		n = 143 (28.9%)	n = 91 (27.0%)
Study year students	–	Year 1: n = 120 (24.3%)	Year 4: n = 47 (9.5%)
	Year 2: n = 115 (23.3%)		Year 5: n = 56 (11.3%)
	Year 3: n = 102 (20.6%)		Year 6: n = 54 (10.9%)
Mean age		21.5 year (range 18–30)	20.4 year (range 18–30)
Previous education	Yes	n = 186 (37.7%)	n = 119 (35.3%)
	No	n = 308 (62.3%)	n = 218 (64.7%)
Preference for future specialisation	Yes	n = 244 (49.4%)	n = 128 (38.0%)
	No	n = 250 (50.6%)	n = 209 (62.0%)
			n = 105 (66.9%)
			n = 52 (33.1%)
			n = 67 (42.7%)
			n = 90 (57.3%)
			n = 116 (73.9%)
			n = 41 (26.1%)

Data are presented as n (%) or mean (range).

3.2. Students' opinion regarding the importance of anatomy

None of the medical students found anatomy to be a completely unimportant part of the medical curriculum. Regarding becoming a competent medical practitioner, respondents considered studying anatomy to be: not important (1.2%), moderately important (20%), very important (50%) or extremely important (28.7%). There was no significant difference between the answers of Bachelor and Master students ($p = .596$). Nevertheless, most Master students (68.6%) found anatomy to be more important in their current phase compared to their Bachelor phase of the curriculum. Respondent characteristics (i.e. gender, age, previous education and preference for future specialization) did not significantly affect the students' opinion on the importance of anatomy (data not shown).

3.3. Appreciation for studying anatomy

Just over half of the medical students (55.6%) do not find anatomy to be an attractive subject (in the sense of arousing interest) while 44.4% of the students do find it to be an interesting subject. Bachelor students found studying anatomy significantly more attractive than Master students (47.9% and 36.8% respectively, $p = .024$). Medical students who had a preference for a surgical specialization in the future were significantly more likely to find studying anatomy attractive compared with students who had a preference for a non-surgical specialization (57.7% and 38.5% respectively, $p = .007$).

3.4. Students' assessment of their own anatomical knowledge

Almost half of all medical students (47.9%) rated their anatomical knowledge as sufficient, and slightly fewer (42.1%) rated it as insufficient. Only a few students (9.3%) rated their knowledge as good or excellent (.6%). There was no difference in this respect between Master and Bachelor students (46.7% of the Master and 40.2% of the Bachelor students, $p = .287$). Respondent characteristics (i.e. gender, age, previous education and preference for future specialization) did not significantly affect the students' assessment of their own anatomical knowledge.

3.5. Attitude towards studying anatomy in the Bachelor phase compared to the Master phase

3.5.1. Study time

Table 2 shows the amount of time that the medical students spent studying anatomy. It is noteworthy that 89.0% of all medical students who filled in the survey spent less than 20 h per 8 weeks studying anatomy and that a significant percentage of these students (48.4%) spent less than 10 h doing so. Of all Bachelor students, 46.1% spent less than 10 h per 8 weeks studying anatomy compared to 53.5% of all Master students ($p = .300$). Remarkably,

Table 2

Study time of all respondents of the survey, Bachelor students and Master students.

	Total sample (n = 495)	Bachelor (n = 337)	Master (n = 157)
0–10 h	48.4%	46.1%	53.5%
10–20 h	40.6%	43.9%	33.1%
30–40 h	9.5%	8.8%	11.3%
40–50 h	0.9%	0.6%	1.4%
50–60 h	0.2%	0.3%	0.0%
>60 h	0.4%	0.3%	0.7%

n = number of students, p-value = .300.

42.9% of the medical students who spent less than 20 h per 8 weeks studying anatomy reported that they found doing so interesting.

3.5.2. Study resources

Table 3 shows an overview of all study resources used by respondents of the survey, as well as a list stratified by Bachelor and Master students. Most of the students (92.7%) used at least one anatomy book (Prometheus or Sobotta) for studying anatomy. More than half of the students (59%) also used video clips about anatomical structures (e.g. on YouTube) to study anatomy. Other study resources used by students to study anatomy are notes from attended surgical operations (10.5%), notes from lessons in the dissection room (67.8%), internet sites (other than YouTube) (25.1%), and other sources (33.6%).

3.6. Students' opinions regarding tools to improve the acquisition of anatomical knowledge

Fig. 1 illustrates the medical students' perspective on digital feedback in an e-learning tool, the attractiveness of studying three-dimensional anatomical images compared to a traditional book, whether interactive media (e.g. computers and using 3D) would help students learn anatomy, and whether having a case as a guide makes it easier to remember anatomy. Regarding the improvement of anatomical studying in the future, of all students who filled in the survey, 15.6% totally agree and 52.6% agree with the following statement: 'It makes it more enjoyable to study anatomy with a case as a guide'. Only 1.7% of the students totally disagree with the statement above and 7.9% of the students disagree. Some students (22.2%) had no opinion.

4. Discussion

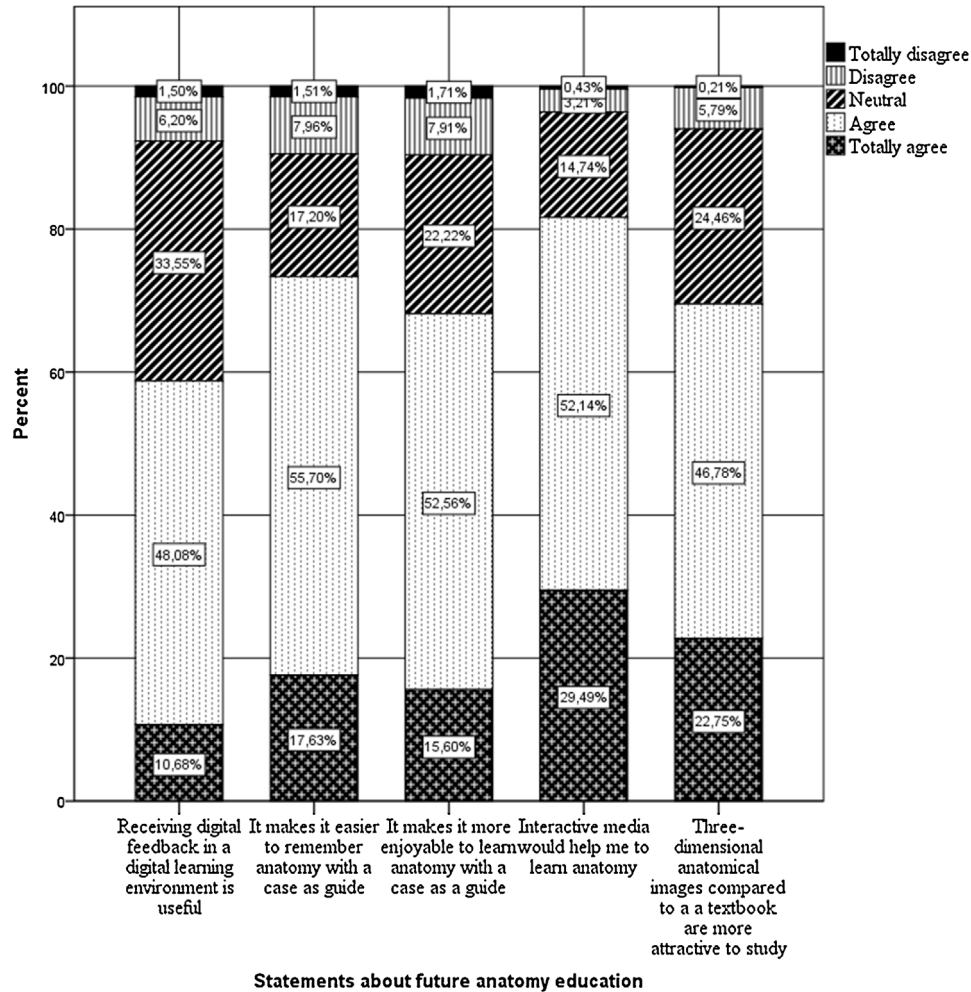
Half of all medical students (50.0%), in both the Bachelor and Master phases, considered anatomy to be very important. Furthermore, 28.7% of all medical students considered it to be extremely important to have sound knowledge of anatomy. This finding is in agreement with literature (Moxham and Plaisant, 2007; Choi-Lundberg et al., 2016b). The majority of all Master students (68.6%) found studying anatomy to be more important during clerkships

Table 3

Overview of the used sources of all respondents of the survey, Bachelor students and Master students.

	Total sample (n = 495)	Bachelor (n = 337)	Master (n = 157)
Traditional anatomy book	92.7%	92.9%	92.4%
Movies on the internet (i.e.YouTube)	59.1%	60.8%	55.4%
Notes from surgical operations	10.5%	2.1%	28.7%
Notes from dissection room	67.8%	72.7%	57.3%
Other internet sites	25.1% (like: Wikipedia, pictures from Google)	22.0%	31.8%
Other sources	33.6% (like: lectures, notes from PBL cases, applications on phones)	31.8%	37.6%

n = number of students.

**Fig. 1.** Statements about future anatomy education.

compared to the Bachelor phase. However, not all Master students found studying anatomy to be important. This may be due to the fact that these Master students, as mentioned before, are no longer confronted with anatomy lessons and anatomy tests. Furthermore, these Master students may have less time to study anatomy or they may already have sufficient anatomy knowledge.

It is remarkable that almost half of the respondents (47.9%) rated their knowledge of anatomy as sufficient. Several studies have found, however, that this is not the case (Fitzgerald et al., 2008). Many surgeons, anatomists and also the general public share the view that medical students' anatomical knowledge is insufficient for today's clinical setting (Turney, 2007; Standring, 2009). A study showed that even laypersons strongly believe that gross anatomy is crucial for medical education, holding the view that medical profession's esteem would be diminished if anatomy is not a significant part of the medical curriculum (Moxham et al., 2016). Despite

this fact, our results show that students spent a relatively small amount of time, 10 h on average per study block of 8 weeks, studying anatomy. Our results, however, do not explain why, on average, students would only spend 10 h per 8 weeks studying anatomy. It is unlikely that 10 h per study block is a sufficient amount of time to fully study and comprehend the anatomy of that block; it is more likely that anatomy questions are underrepresented in exams and therefore considered not worth the time investment. It is known that examinations are extrinsic motivators to learn (Choi-Lundberg et al., 2016a). In the current curriculum at MU, no separate anatomical tests are used to test the students' anatomy knowledge. Another reason that could possibly explain a deficiency in knowledge is a lack of time to teach anatomy (Bergman et al., 2011; Lewis et al., 2016). Anatomy is often difficult to learn and therefore investment in study time is necessary (Bergman et al., 2011).

Regarding the amount of study time, a difference between Bachelor and Master students was expected. The results showed that 90.0% of all Bachelor students spent less than 20 h per 8 weeks studying anatomy compared to 86.6% of all Master students. It can be assumed that Master students spend more time studying anatomy to gain enough anatomical knowledge for the clinical phase. This assumption was based on the fact that Master students start with clerkships in which they need to apply their anatomical knowledge in clinical settings. In contrast, for the Bachelor students, anatomy is still abstract and not linked to a patient. As expected, medical students who are interested in becoming surgeons found studying anatomy more attractive compared to medical students who have a preference for a non-surgical specialization. It is not clear whether the students who are interested in surgical specialization have more anatomical knowledge. Furthermore, learning strategy could play an important role especially because only 10% of the final medical test relates to anatomy. Students probably particularly study content that they expect they should know for a test. For these reasons it is not surprising that students do not diligently study anatomy.

In order to improve anatomical knowledge of medical students, it is important to understand how students study anatomy and which sources they use. Our results show that most of the medical students (92.7%) still use anatomical textbooks. Furthermore, movies on the internet about anatomical structures and notes from the dissection room are also used nowadays. Each student has his/her own preferences with regard to how anatomy is studied and teaching techniques vary between universities (Bergman et al., 2013; Yammine and Violato, 2015). It seems that the problem-based learning approach, which is used at MU, is not able to ensure an adequate acquisition of anatomy knowledge (Bergman et al., 2013). In contrast, in another study it was found that students at medical schools that used the problem-based-learning method reach the same perceived level of anatomy knowledge as students at medical schools that used other methods (Prince et al., 2003). In accordance with the respondents of our survey, another study suggested that teaching in context improves anatomy education (Bergman et al., 2013). Other investigated learning methods such as private study, formal lectures, practical work and informal discussions with peers are also referred to be effective (Jacobs et al., 2016).

The current medical students have grown up surrounded by digital applications on phones, tablets and computers and the pace of progress is very rapid. To increase their level of anatomical knowledge, three-dimensional tools for studying anatomy are nowadays available and under development (Azer and Azer, 2016). The new teaching methods, like online dissection or interactive anatomical and surgical live-stream lectures have proven to be beneficial for students' knowledge of clinical anatomy (Choi-Lundberg et al., 2016a; Shiozawa et al., 2017). Some medical students think that it is easier to learn using a three-dimensional tool than a book (Yammine and Violato, 2015). Furthermore, even social media could play an important role in studying anatomical structures (Hennessy et al., 2016). However, one study suggests that there is no difference between these two learning methods (Azer and Azer, 2016). Despite the increase in the availability of electronic tools and resources for studying anatomy, it is still unclear whether these tools are more effective than other methods like dissection or anatomical textbooks and whether they are easy enough to use. Investing in 3-D techniques for teaching anatomy could prove beneficial in the long run, as such techniques may make studying anatomy more attractive than traditional resources do (Yammine and Violato, 2015). At this moment, our study shows that the majority of medical students (55.6% of all medical students) did not find studying anatomy in the current PBL curriculum attractive. Using three-dimensional tools may make studying anatomy more attrac-

tive. Some students prefer digital applications to study anatomy while others prefer books (Yammine and Violato, 2015; Azer and Azer, 2016). The respondents of our survey confirmed that medical students would prefer using three-dimensional tools in the future. Development and improvement of these tools can be important for anatomy education. For future improvements, the students suggested that anatomy tools related to a clinical scenario can make studying anatomy more attractive.

4.1. Strengths and limitations

A major strength of this study is the large number of respondents ($N=495$). Because we were not allowed to send mass mails, it is unclear how many students we have actually reached. Therefore it is impossible to calculate a response rate or to assess whether any selection bias could have occurred. The fact that more Bachelor students filled in the survey than Master students is indication of the difficulty of reaching the latter group. Therefore, the analyses are stratified by Bachelor/Master. Another limitation of this study is the fact that it is unclear how representative our results are for other faculties in this country or for other countries. The curriculum regarding anatomy content, instruction and assessment is highly variable between universities. Nevertheless, it has shown that the medical curriculum in the Netherlands is based on CanMEDS and a framework for undergraduate medical education, which is equal for each medical university (Laan et al., 2010; Frank et al., 2015). The framework defines the learning outcomes of university programmes in medicine in terms of competencies in those roles that must be mastered by physicians in order for them to function as medical doctor. All students who study medicine in the Netherlands are subject to the exact same 'test of progress', a test that is the same at each university. As a result, the emphasis that anatomy receives is unlikely to differ between universities. Naturally, attitudes of students could differ between schools due to, amongst other reasons, differences in teaching personnel.

5. Conclusion

This study showed that students found it important to have sufficient knowledge of anatomy. Almost half of the respondents rated their knowledge as insufficient, while the majority of the students (89.0%) studied less than 20 h per study block of 8 weeks. Investing in three-dimensional techniques for teaching anatomy could help medical students study anatomy, but the educational effectiveness of three-dimensional tools compared to anatomical books should be further explored.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.aanat.2018.01.006>.

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