

## Should drawing be incorporated into the teaching of anatomy?

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### ABSTRACT

**Introduction:** Art has played a pivotal role in the understanding and teaching of human anatomy for centuries, and the use of drawing as a teaching tool had been well documented. With the global modernization of medical education, the teaching of anatomy has diminished. We present a model of teaching anatomy through drawing, and assess its efficacy in improving students' retention of anatomical knowledge.

**Methods:** We designed a series of four anatomy drawing workshops (upper limb, lower limb, thorax, and head & neck) for students studying medicine, dentistry, and allied science degrees. Students were only allowed to attend one of the four workshops. Workshops were delivered by medically-qualified anatomy demonstrators using a combination of "whiteboard drawing demonstrations" and "cadaveric demonstrations and drawings." A pre- and post-anatomy test consisting of 12 multiple choice questions (MCQs) and quantitative self-score questionnaires on "confidence in drawing anatomy" and "anatomical knowledge" were completed. Qualitative questionnaires on "reasons for attendance," "skills learnt," and "what improvements could be made" were also completed.

**Results:** A total of 49 students attended the drawing workshops, the majority studied medicine (58.3%). Twenty-seven pre- and post-anatomy MCQ tests were completed, and demonstrated a significant mean improvement of 1.11 points ( $p = 0.001$ ). "Confidence in drawing anatomy" and "Knowledge of anatomy" significantly improved by 43.2% and 41.4% ( $p = 0.001$ ), respectively. Only 13% of students used drawing as their "main learning tool." The most commonly reported barrier in using drawing as a revision tool was "time constraints." Qualitative feedback was excellent. Students suggested that these workshops should be integrated into the core anatomy curriculum.

**Conclusion:** Learning anatomy through drawing, is not only more engaging and fun, encourages students to visualize and better understand anatomical planes, thus, allowing them to retain anatomical knowledge easier. The two-part nature of our sessions enabled students to apply and translate the more conceptual knowledge from the "whiteboard drawing demonstration" onto the more "real-life" structures in the "prosection and cadaveric demonstration." With the decline in anatomy teaching throughout universities, most prominently dissection, drawing may offer an alternative and economical way of training students to learn anatomy.

### ARTICLE HISTORY

Received March 30, 2018

Accepted April 11, 2018

Published April 18, 2018

### KEYWORDS

Anatomy; drawing; teaching; medical curriculum

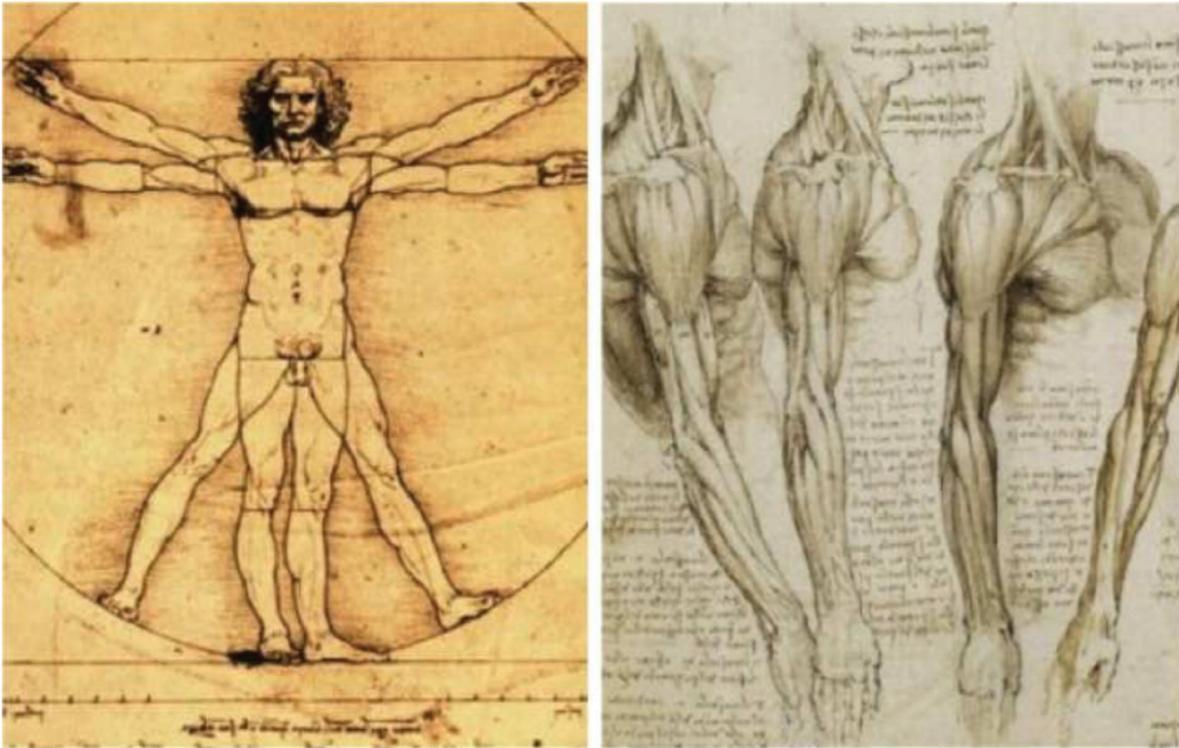
### Introduction

The importance of good anatomical knowledge of the human body is fundamental in clinical practice, and underpins the safety in the field of surgery [1–5]. In recent years, due to the modernization of the medical curriculum, the volume of anatomy teaching in medical schools had gradually

declined worldwide, including the United Kingdom (UK), Europe, and the United States (US) [6–9]. There had been a shift from the traditional style of teaching, such as cadaveric dissection and didactic lectures, toward problem-based learning (PBL), self-directed learning, and computer-assisted learning [6–9]. In general, these new curricula dedicate less time to anatomy teaching compared

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**Figure 1.** Drawings by Leonardo Da Vinci: Vitruvian Man (left); anatomical drawings of the upper limb (right).

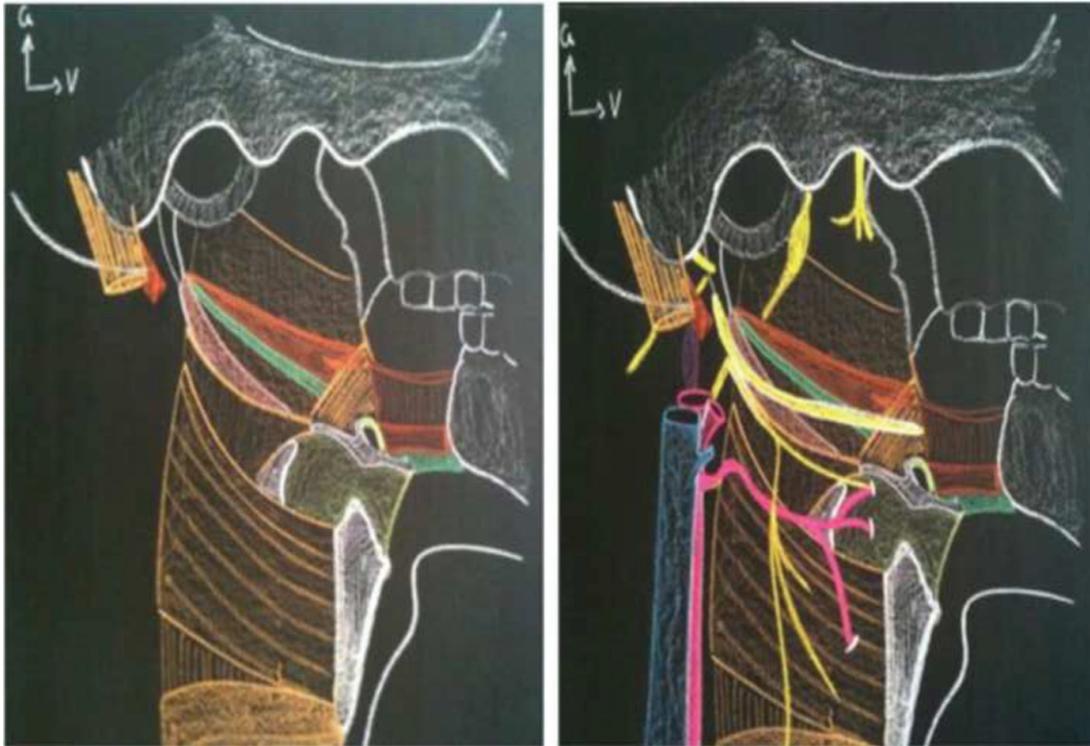
to the traditional methods [10,11]. Students who received PBL-based anatomy teaching reported that they are feeling more deficient in their basic knowledge of human anatomy [12]. A national survey revealed medical students were not pursuing a career in surgery due to a lack of confidence in their anatomical knowledge, with more than half of respondents (56.7%) reporting “poor teaching as a medical student” as a contributing factor [13]. Furthermore, less than one-third of doctors starting their jobs in the US feel adequately prepared in their knowledge of anatomy [14]. The falling standard of anatomy knowledge in qualified doctors is hazardous to both the medical profession and society [15]. A recent report from the Medical Defense Union revealed that 32% of medical claims in general and vascular surgery were related to poor knowledge in anatomy [16–20].

Art and drawing, despite their long established history with the teaching and learning of anatomy, had received relatively few literature to describe its efficacy within the medical education at recent times [21,22]. This historic link can often be symbolized by Leonardo Da Vinci’s Vitruvian Man (Fig. 1). In France, it is a custom for medical students to receive their basic anatomy teaching through “blackboard” drawing demonstrations, this allowed tutors to highlight anatomical structures in a clear

visual manner that were easier to understand and visualize compared to dissections and cadavers (Fig. 2) [23]. The literature from France suggests that drawing has proven to be an extremely effective technique of teaching anatomy [23,24].

In the UK, drawing is not a formal tool for the teaching of anatomy and is only offered in some universities as a student selected component (SSC). For example, in Barts and The London School of Medicine and Dentistry, an SSC program is organized by a professional medical artist to teach students on how to draw anatomy [26]. Furthermore, numerous “Drawing for Surgeons” and “Sculpture for Surgeons” workshops had been created by the Royal College of Surgeons of England to enhance surgeons’ spatial awareness and appreciation for form and structure through the use of art [27,28]. However, these workshops are often unavailable to undergraduate students.

We believed that the use of drawing as a tool for teaching anatomy can play a larger role in the current medical curriculum. We therefore designed a series of anatomy sessions taught through drawing at Kings College London (KCL) targeting students studying medicine, dentistry, or allied science degrees. We aim to assess the effectiveness of these sessions through pre- and post-course anatomy tests and questionnaires.



**Figure 2.** “Blackboard” drawings used in the initial phase of anatomy teaching in France [25].

## Methods

### Overview

We designed an experimental study to assess the efficacy of drawing as a tool for teaching anatomy. The study was organized by the KCL Undergraduate Anatomical Society and was conducted at the dissecting room at KCL between 2015 and 2017. Permission for the use and to take photographs of the dissecting room was granted by the head of department. Four anatomy teaching sessions (3 hours each) titled “Anatomy Revision: Drawing Workshops” were organized, each independently covered: the upper limb, lower limb, thorax, and head and neck. The sessions were delivered through a combination of “whiteboard drawing demonstrations” and “cadaveric demonstrations and drawings.” An anatomy test [12 multiple choice questions (MCQs)] and a questionnaire were completed before and after the workshop by the students, to assess its efficacy.

### Participants

The workshop was free of charge, and was open to all undergraduate or postgraduate medical, dental, or science student from any university in this country. Recruitment was via university-affiliated social media pages, with no set exclusion criteria.

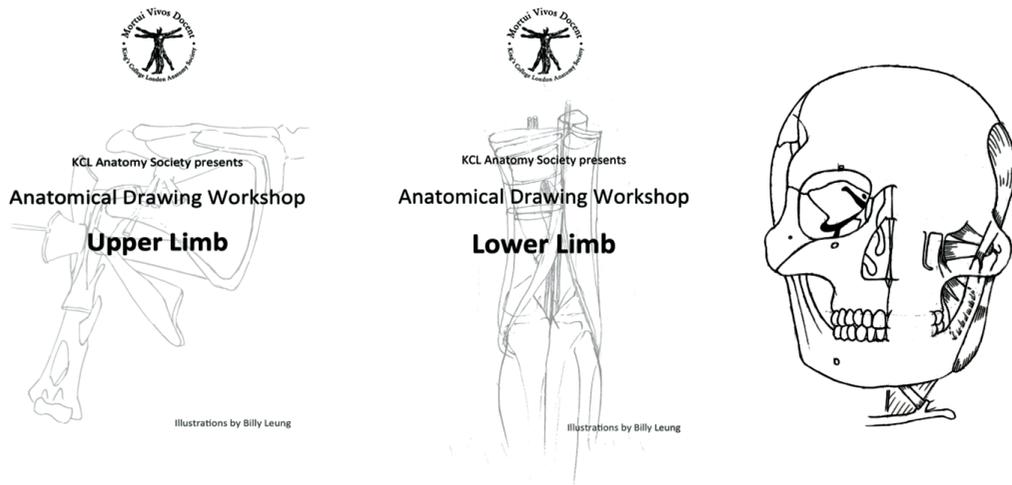
Each session had the capacity of up to 25 students. Students were only allowed to attend one of the sessions. No control or comparison group (i.e., lecture-based teaching group) was used due to restricted availability of staff and teaching facilities.

### Pre-session format

Students were briefed regarding general rules and regulations of the dissecting room. A pre-session presentation on the “history of anatomical art” was also given, so as to provide students a background of the origin of art and anatomy. This was followed by an anatomy test and questionnaire prior to the commencement of the workshop, and a course booklet containing unlabeled sample drawings was provided to students for reference and the labels for sample drawings were completed during the course (Fig. 3).

### Whiteboard’ drawing demonstrations

The first half of each session was delivered through drawing demonstrations on a whiteboard by one or two demonstrator(s), whilst the group of students imitated those drawings “live” with pencils on their paper and board provided (Fig. 4). The drawings focused on bones, muscles and attachments, neurovascular bundles, anatomical spaces (e.g., carpal tunnel), and relevant clinical features



**Figure 3.** Course booklet (left and center): cover page of upper limb and lower limb session. Sample drawings (right): skull and facial musculature. Note: Drawings were not labeled to encourage students to complete during the teaching sessions.



**Figure 4.** The whiteboard drawing session: (top left) tutors illustrating on the whiteboard, whilst students imitate; (top right) examples of the tutors' anatomy notes; (bottom) whiteboard drawings from the upper limb session.

(e.g., anatomical neck of the humerus with fractures, or facial spaces relating to dental infections). All topics covered followed the anatomy syllabus at KCL. Students were encouraged not only to draw but also to refer to the course booklet for more

complex structures and annotate the unlabelled drawings.

Several drawing techniques were introduced. Firstly, line work should be clean and well defined; any line intersections must be clear and should not



**Figure 5.** Cadaveric demonstration and drawing session: (top) tutors checking students' drawings, and reinforcing knowledge and drawing techniques; (bottom) tutor demonstrating "real life" observational drawing of cadaveric specimens.

overlap. Secondly, anatomical layers must be clearly demonstrated either through shading or illustrated through cut or retracted structures. The use of color is also an option, but basic line work should be acquired first. In general, red is for arteries, blue is for veins, and green is for nerves. Thirdly, there are no strict rules on medium selected, but our preferences are black ball pens and thick, cream-colored paper. Fourthly, one should not focus on creating a "life-like" drawing, e.g., proportionally alike, but rather focus on accurate demonstration of key relations that translates to better understanding of the anatomy. Finally, keep it simple and make each line count.

### **Cadaveric demonstrations and drawings**

The second half of each session involved the drawing of "real" cadaveric specimens. The demonstrators first demonstrated and described the key structures on the cadaveric specimens that were previously covered in the initial "whiteboard" session (Fig. 5). Students were then guided into drawing these specimens by observation, similarly with pencil on board.

### **Post-session round up**

On completion of both sessions, students were asked to complete a post-session anatomy test and questionnaire. A small prize of an anatomy book was awarded for the "most-engaged" student at the end of each session. All students produced a set of drawings to take home (Fig. 6).

### **Anatomy tests**

An anatomy test was completed by the students before and after each workshop, under exam conditions in 20 minutes. The upper limb session did not include an anatomy test. The question bank was designed after the first session on the upper limb. Each student was given a unique and anonymous identifier to avoid any assessor bias during marking. Students completed two sets (pre- and post-) of 12 MCQs on the specific anatomical region covered on the session. A bank of 20 questions for each anatomical region, concurrent with the KCL anatomy syllabus, was created by a committee member (fourth year medical student) who was not involved in the teaching of the sessions. The questions were verified and approved by a senior academic lecturer of anatomy in the department for quality control. Figure 7 shows examples of some of the MCQs.

Of the 20 questions, four were "core" or "anchor" questions that were to be included in both papers, and 16 were "non-core" questions that were randomized (using a random sequence generator) into 10 unique sequences and randomly allocated into the pre- and post-question set. This method ensured that every participant answered the full 20 questions over the course of the workshop in a randomized order. The demonstrators were also blinded from the question bank generated, to eliminate any experimental bias. The "core" questions allowed some standardization of the assessment. Figure 8 explains how two question papers were formed.

### **Questionnaires**

A questionnaire was completed before and after the workshop (Fig. 9). It included demographic details such as current degree and year of training, and drawing-specific questions such as experience with drawing as revision tool (never, sometimes, and often). It included a quantitative self-score on "confidence in drawing anatomy" and "anatomical knowledge" (the latter was not included for the upper limb session). The questionnaire also



- 1) Which nerve supplies the medial compartment of the thigh
  - a) The femoral n.
  - b) The obturator n.
  - c) The peroneal n.
  - d) The pudendal n.
  - e) The sciatic n.
  
- 2) Which ligament is taut during flexion of the knee?
  - a) Medial Collateral Ligament
  - b) Posterior Cruciate Ligament
  - c) Anterior Cruciate Ligament
  - d) Lateral Collateral Ligament
  - e) Patellar Ligament
  
- 3) What is the longest muscle in the leg?
  - a) Gastrocnemius
  - b) Rectus Femoris
  - c) Vastus Lateralis
  - d) Semitendinosus
  - e) Sartorius
  
- 4) Which muscle(s) insert into the pes anserinus?
  - a) Sartorius and gracilis
  - b) Sartorius and semimembranosus
  - c) Sartorius, gracilis and semitendinosus
  - d) Sartorius, gracilis and semimembranosus
  - e) Sartorius, semimembranosus and semitendinosus

**Figure 7.** Sample MCQs used for the lower-limb session.

A model for teaching examined

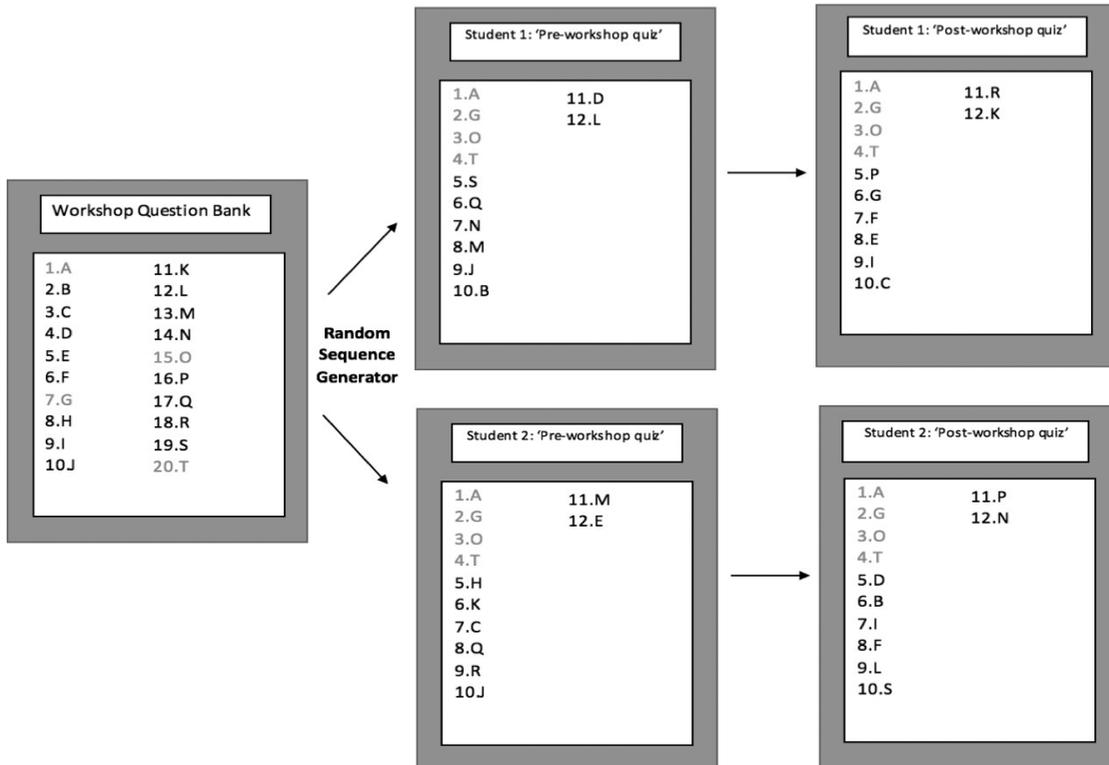


Figure 8. Figure illustrating how the questions were formed.

Anatomy Society Drawing Workshop  
The Lower Limb  
Wednesday 25<sup>th</sup> of January

*(The questions below are to be completed after the workshop is complete)*

Student K Number.....  
Degree Programme and year.....

*(The questions below are to be completed before the workshop begins)*

- What is your reason for attending this course?  
.....
- How often do you use drawing as an anatomy revision tool?  

Never	Rarely	Often	Main learning tool
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- What is your greatest barrier to using drawing as a revision tool?  
.....
- From a scale of 1 (least) – 10 (most), how confident are you in your ability to draw anatomy?  

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----
- From a scale of 1 (least) – 10 (most), how confident are you in your knowledge of lower limb anatomy?  

1	2	3	4	5	6	7	8	9	10
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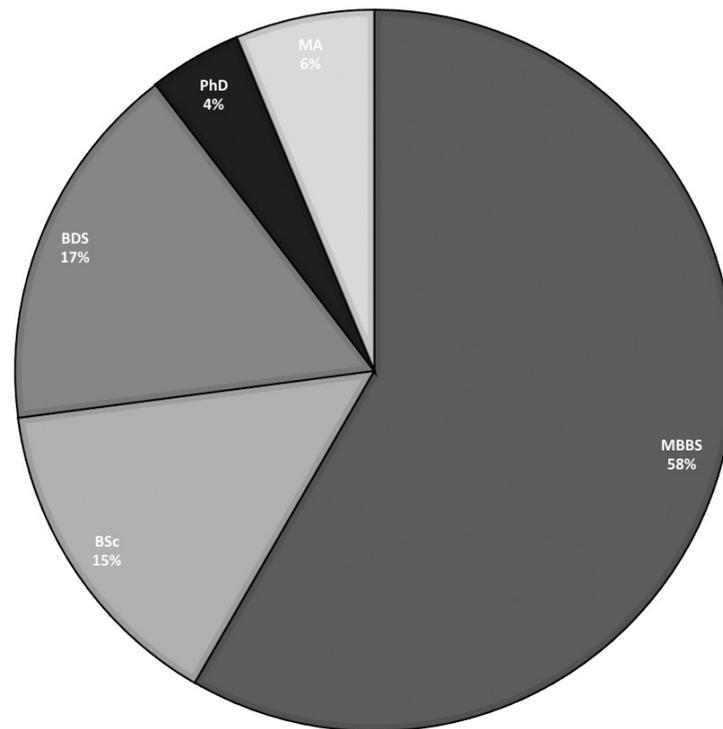
*(The questions on the reverse side are to be completed after the workshop is complete)*

- From a scale of 1 (least) – 10 (most), how confident are you in your ability to draw anatomy?  

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----
- From a scale of 1 (least) – 10 (most), how confident are you in your knowledge of lower limb anatomy?  

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----
- What skills have you learnt from this workshop?  
.....
- How could this workshop be improved?  
.....

Figure 9. An example of a post-session questionnaire used for the lower-limb session.



**Figure 10.** Pie chart showing the percentage breakdown of students who attended, Total  $N = 49$  students. MBBS = Bachelor of Medicine and Surgery; BSc = Bachelor of Science; BDS = Bachelor of dentist surgery; PhD = post-doctorate; MA = Masters of art.

attended cohort included 28 (58.3%) medical students, 8 (16.7%) dental students, 7 (14.6%) science students from varying backgrounds including anatomy, biomedical sciences, neurosciences, 3 (6.3%) Masters of Art students, and 2 (4.2%) PhD students (Fig. 10). Medical and dental students ranged from year 1–5. No additional demographic details were recorded, such as age or gender. Students reported their frequency of using drawing as learning tool: main learning tool 13%, often 37%, rarely 32.6%, and never 17.4% (Fig. 11).

#### **Anatomy test**

A total of 27 (out of 32) students completed the pre- and post-anatomy MCQ test (Table 1). The test was not offered in the upper limb workshop. The mean score for pre-workshop was 4.93/12 (41.1%), and the post-workshops was 6.04/12 (50%) (Fig. 12). There was a statistically significant mean improvement across all of workshops of 1.11 points ( $p = 0.001$ ) with a confidence interval (CI) (0.52–1.71). The mean score of the “anchor” questions pre-workshop was 1.59/4 (39.8%) and post-workshop was 2.63/4 (65.8%). There was a statistically significant mean improvement of 1.04 ( $p < 0.0001$ ) with a CI (0.63–1.44) (Fig. 13).

#### **Questionnaire—quantitative outcomes**

All 49 students responded to the self-score (out of 10) in “confidence in drawing” in the questionnaire, and showed a significant post-workshop improvement of two points (43.2%) ( $p < 0.0001$ ) with a CI (1.5–2.5). The mean and SEM of pre-workshop was  $4.625 \pm 0.293$  and post-workshop was  $6.625 \pm 0.218$ . (Table 1) (Fig. 14). “Knowledge of anatomy” was not included in the upper limb workshop questionnaire. Thirty-one (out of 32) students completed the self-rated “knowledge of anatomy,” and showed a significant post-workshop improvement of 1.77 points (41.4%) ( $p < 0.0001$ ) with a CI (1.28–2.26), and mean and SEM of  $4.29 \pm 0.363$  (pre-) and  $6.064 \pm 0.286$  (post-) (Fig. 15). The overall course satisfaction score was 9.12/10 (91%).

#### **Questionnaire—qualitative outcomes**

The most common reasons for attending the workshop were: for revision purposes, to improve the understanding of anatomy, and to explore new revision techniques (Table 2). Other reasons included: to enhance or gain confidence in drawing techniques, sounded interesting or fun, or that they enjoy drawing. The most commonly reported skills acquired from the workshop were: ability to identify key

**Table 1.** Table demonstrating the number of attended students and response rate to the MCQ anatomy test and “confidence in drawing” in the questionnaire.

Session	Number of students attended (N)	MCQ anatomy test response rate [% (N)]	Confidence in drawing questionnaire response rate [% (N)]
Upper limb	17	-	100 (17/17)
Lower limb	8	100 (8/8)	87.5 (7/8)
Chest	4	75 (3/4)	100 (4/4)
Head and neck	20	800 (16/20)	100 (20/20)
Average	12.25	84.38 (27/32)	98.0 (48/49)

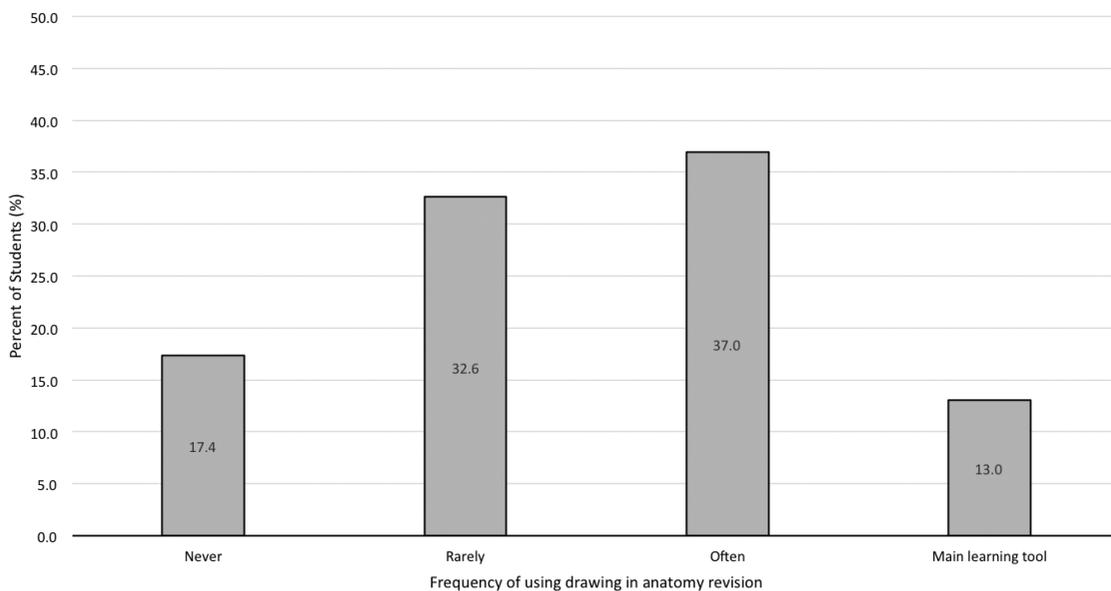
Note: The anatomy test was designed after the upper limb session. Weighted means were used to calculate average response rate for both anatomy test and the questionnaire.

anatomical features, and ability to simplify bones and muscle attachments in their drawings. Other feedback included improvements in drawing more confidently, accurately, and efficiently, i.e., “how to draw anatomy.” Some students found that the workshops aided them to recap previous knowledge, and prompted them to better appreciate and visualize anatomical compartments and planes. When asked about how the course should be improved, students reported: “should be integrated into curriculum,” “more sessions on other anatomical regions,” and “more drawing time.”

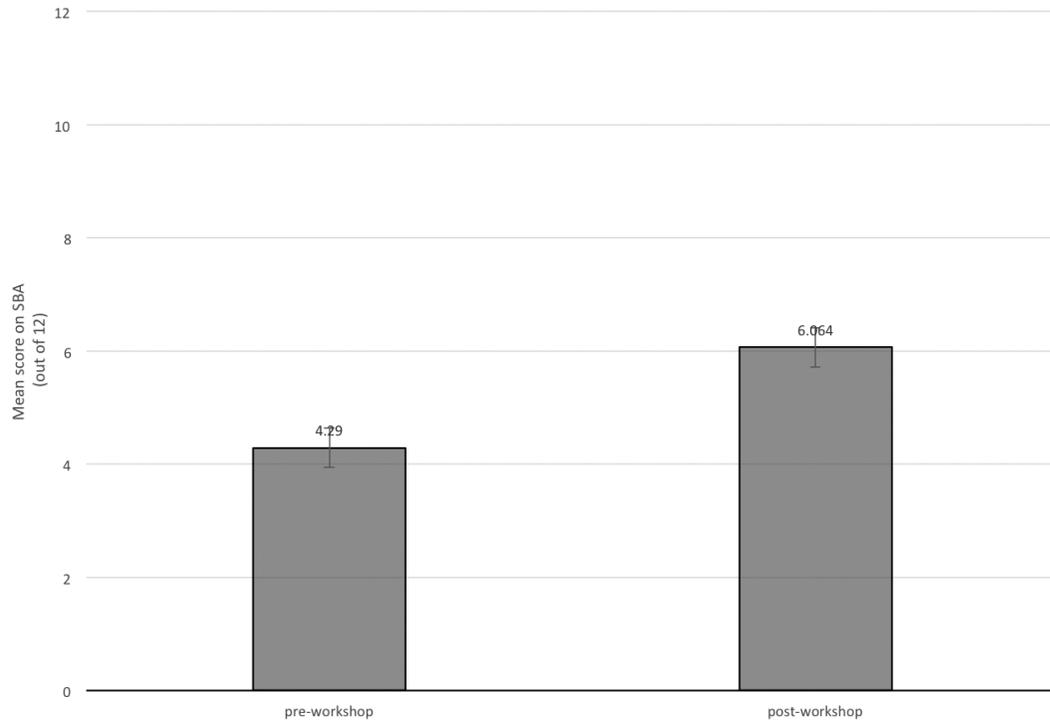
## Discussion

Retention of anatomical knowledge can often be challenging without a clear appreciation and visualization of its three-dimensional make-up, thus, students often regard dissection as the best tool for learning anatomy [1,2,4–8]. However, in recent decades, the medical curriculum had undergone significant reforms, which had led to reduction in anatomy teaching as a whole as well as the use of dissection [9,10,25]. This decline in anatomy teaching, has had major negative impacts on surgical training recruitment, but most importantly, has had potential adverse clinically outcomes demonstrated in several cases of clinical negligence related to poor anatomical knowledge [17,29]. Thus, there is a much need to review our current anatomy education, and suggest potential alternatives that may enhance students’ and future clinicians’ knowledge.

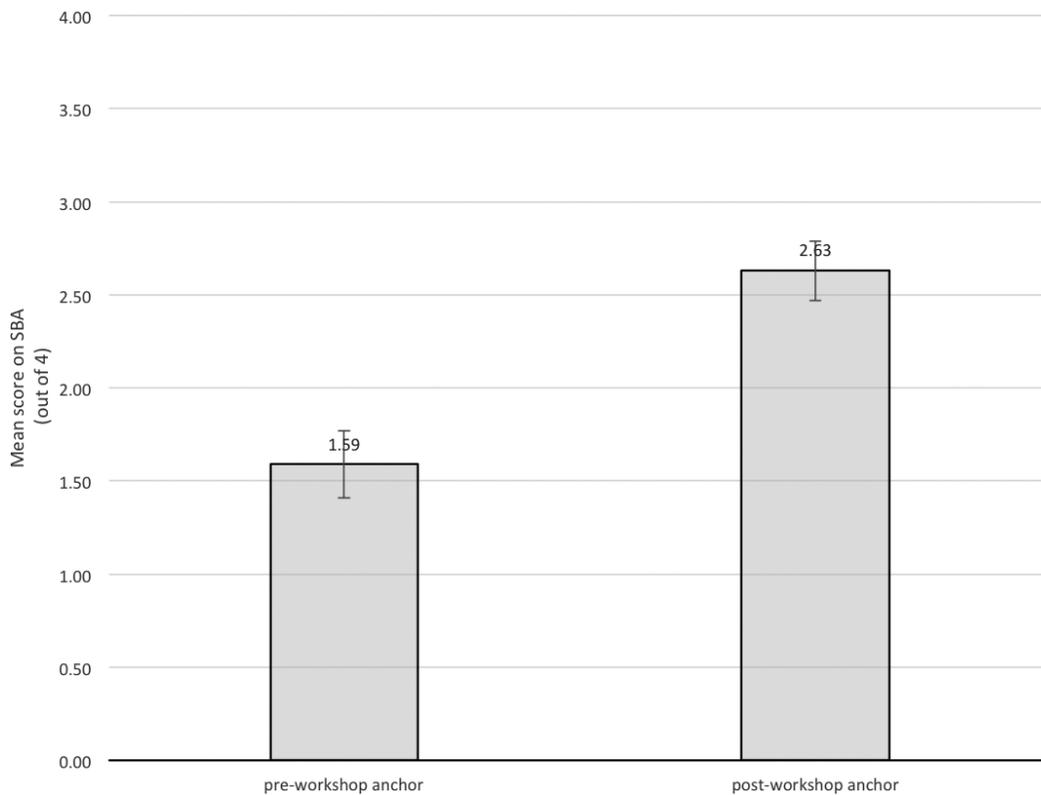
The use of drawing as a method to teach or learn anatomy may aid in students conceptualization of the 3-D nature of anatomy in a similar way that dissection can offer, such as the creation of anatomical planes and layers that can be understood more easily. A recent article from France had pledged for the inclusion of drawing to the current anatomy curriculum [13]. The Medical Artist’s Association (MAA) of Great Britain 66th Annual Conference in April 2015 also highlighted the role of art in the medical education in their displays of obstetric models used in stimulation training to reduce incidences of



**Figure 11.** A graph and table showing the frequency of students that used drawing as a learning tool for anatomy. Results are shown out of the 46 students who answered this question. Number inside the bars show the percentage of students in each category.

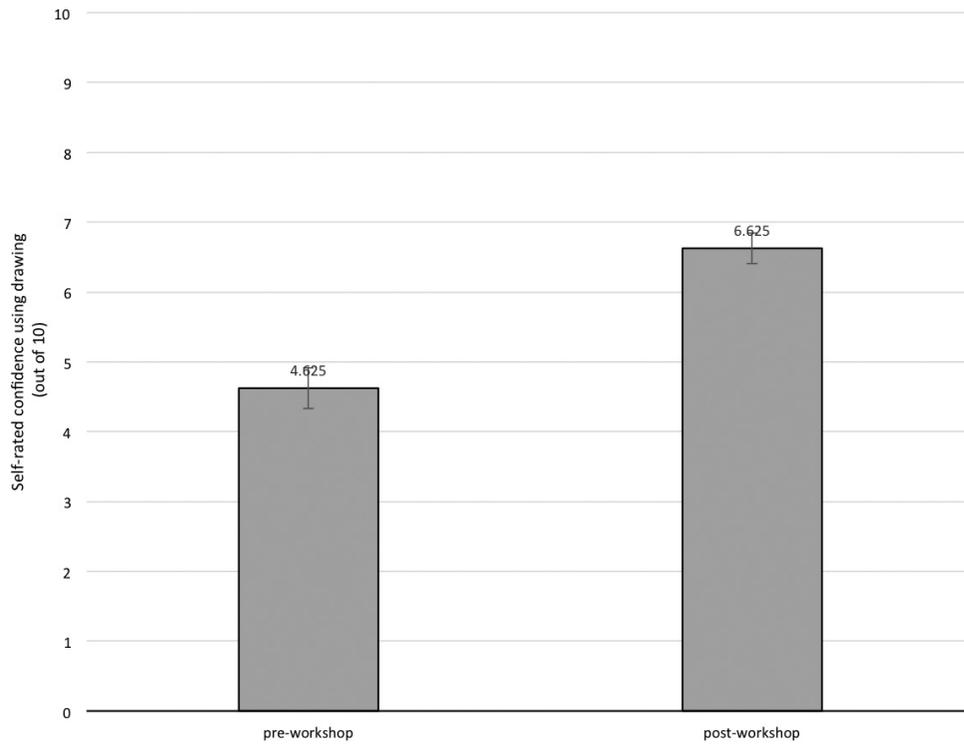


**Figure 12.** A graph comparing the mean anatomy test scores before and after the course (Total  $N = 31$ ). Error bars represent the SEM. There was a statistically significant mean improvement of 1.11 points across all workshops ( $p = 0.0007$ ) with a CI (0.52–1.71)

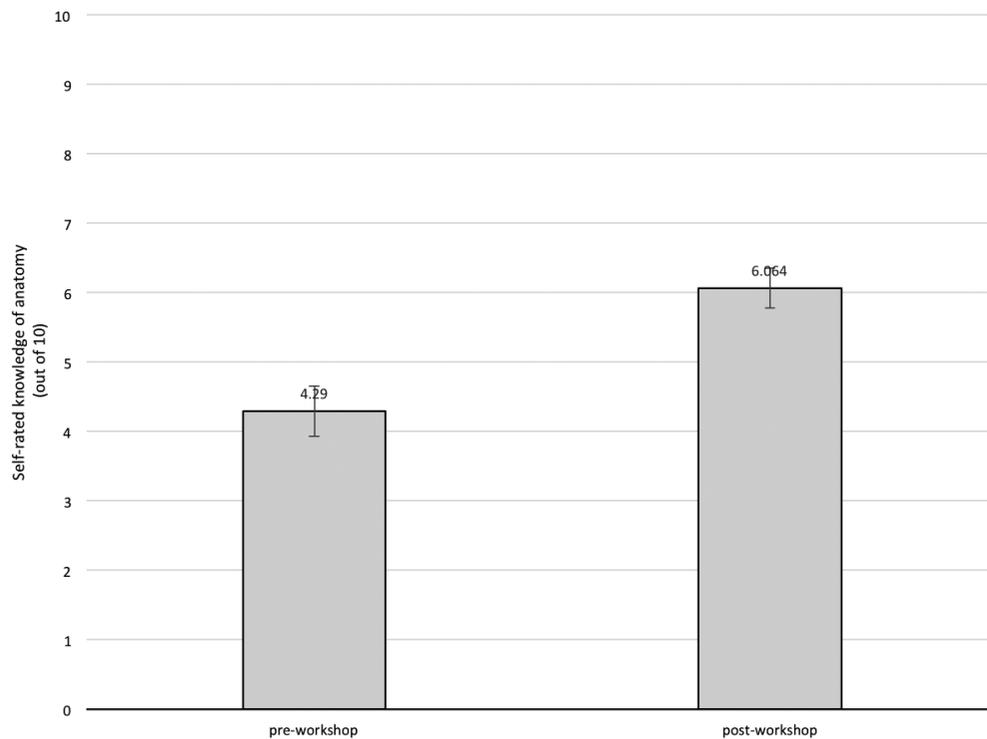


**Figure 13.** A graph comparing the mean anatomy test ‘core’ scores before and after the course (Total  $N = 31$ ). Error bars represent the SEM. The mean score of the participants’ “anchor questions” “pre” and “post” workshop were 1.59 and 2.63 respectively. There was a statistically significant mean improvement of 1.04 ( $P = 0.0001$ ) with a CI (0.63–1.44).

### A model for teaching examined



**Figure 14.** A graph comparing the mean self-scores on ‘confidence in drawing’ before and after the course (Total  $N = 48$ ). Error bars represent the SEM. There was a statistically significant mean improvement of two points across all workshops ( $p > 0.0001$ ) with a CI (1.5–2.5).



**Figure 15.** A graph comparing the mean self-rated knowledge of anatomy of the workshop topic area of focus (lower-limb, thorax, head & neck respectively, combined here) before and after the course (Total  $N = 31$ ). There was a statistically significant mean improvement of 1.77 points across all workshops ( $p < 0.0001$ ) with a CI (1.28–2.26)

**Table 2.** Examples of qualitative feedback.

Reason for attendance?	What skills have been learnt?	How can the course be improved?
"Sounded interesting, nothing like this on my course"	"How to draw anatomy, overall very useful"	"Integration with syllabus"
"Develop skills for use as a practical revision tool; fun"	"How to simplify complex anatomy"	"More structured session, so that everything can be covered efficiently"
"To see better diagrams than textbooks"	"Recognizing and highlighting important features"	"More frequent sessions, covering all aspects of anatomy"

shoulder dystocia during childbirth, and sculpture courses for plastic surgeons to improve their spatial awareness in cleft palate surgery [14,30]. The title of the forth-coming 67th MAA Annual Conference in 2016: "Art in Medicine: Are the two now mutually exclusive?," further illustrates this important relationship between art and medicine [30].

Our study presented a model of anatomy teaching through the use of drawing, and the results were positive. The post-workshop anatomy test demonstrated a significant improvement of anatomical knowledge of 22.5%, and students reported a significant increase in their self-reported "confidence in drawing anatomy" and "knowledge in anatomy" after the workshop, of 43.2% and 41.4%, respectively. Importantly, students enjoyed the experience, with an overall course satisfaction score of 9.12/10 (91%). This highlighted the efficacy of drawing as a tool for teaching anatomy, which may enhance their knowledge directly (e.g., provision of anatomical facts) or indirectly (e.g., equip them with approaches on how to draw and construct, thus learn anatomy).

Our qualitative data showed that 50% of students considered drawing as their main revision tool or used it "often" as a learning method, with the remaining 50% rarely or never used drawing as their learning tool. From the questionnaire, it was clear that many students wanted to learn about how to improve their anatomy drawing and believe that more similar workshops would be helpful. This feedback strongly highlighted the potential benefit of running additional courses or even to integrating art and drawing into the anatomy teaching curriculum. currently, there are very few medical drawing courses available to undergraduate students. Students commented that their biggest constraint for drawing anatomy was time and lack of skill, both we believe can be addressed with these training workshops.

Of interest, over half of the attending students were medical students, reflecting a perhaps obvious need of anatomical knowledge as a medical student. Also, the head and neck workshop was the most

heavily attended session, which may reflect on the complexity of this anatomical region that requires the most attention and the need for additional aids, such as drawing. The use of both whiteboard and cadaveric drawing sessions provided students a step-wise progression from the conceptual drawing of 2-D anatomy to "real" life 3-D drawing of specimens.

The ethos of drawing anatomy for learning is not to produce an esthetically "perfect" illustration or copy what you see, but to produce a drawing that describes clearly the key anatomical planes and structures, and that there is a thinking process behind every line. Thus, the ability to be able to draw is not essential. This method of teaching and learning, we believe, is engaging and encourages proactivity, it is cost-effective and can be easily integrated into the curriculum. Nevertheless, drawing should be an adjunct, and not a substitution, to other teaching methods such as didactic lectures or dissection. As clearly demonstrated in our feedback, the use of cadaveric demonstration to supplement the initial drawing demonstration was extremely popular amongst the students. Other studies have also demonstrated that the use of dual-teaching methods yields the best result, such as combining dissection with computer resources [17,31]. We also must bear in mind of the newer and more interactive technologies emerging onto the medical education scene, such as 3-D virtual reality anatomy models, which may play an important role in the future, but at present, are expensive and limited in accessibility.

### **Limitations**

There were several limitations in our study. The sample size of the study was relatively small, which maybe attributed by suboptimal advertising and concurrent period during exams. There were no control group due to limited resource to organize comparison group; however, we may aim to address this in our future workshops. There was a potential confound from the concurrent use of cadaveric demonstrations during the workshops

for accessing solely the efficacy of drawing and the teaching of anatomy. The workshops also required tutors that can confidently teach anatomy through drawing effectively. The anatomy tests were not used in the upper limb session, which reduced our sample size. Furthermore, the course was not mandatory, thus, the attending population was self-selected and likely to have a pre-existing interest in drawing or uses drawing as a learning tool. The use of MCQ's as a method of assessing retention of knowledge maybe debatable and other forms of assessment, such as essays or vivas, maybe more superior. However, due to time constrains and limited resources, MCQs were the most effective to capture before and after comparative data. Previous studies have suggested that the benefits of drawing on knowledge retention does not become visible by applying multiple choice tests, and can only be measured using a free recall type tests [18,19]. The assessment of retention was also immediate and short-term, a possible long-term assessment will truly assess the effectiveness, which we will focus in our future studies. Another limitation is that some challenging anatomical concepts, such as the autonomic system or neuro-anatomy, may not be best presented by illustrations, and may require more traditional style of didactic lecture-based teaching. Finally, it was not possible in the given time frame to cover all the essential anatomical features, such as the skull base foramina in the head and neck workshop.

#### **Future studies**

Our future studies will address the limitations discussed, which include using a control group (i.e., comparing drawing to lecture-based teaching), larger sample size, reduce cofounding from cadaveric demonstration, alternative assessment tools (i.e., essays or viva examinations), and finally, a more delayed assessment to assess long retention. We also aim to incorporate other regions of the body that was not covered by the previous workshops, e.g., the abdomen and digestive tract. Our hope is that other undergraduate anatomical societies or departments across the country would trial this method of teaching. The ultimate aim would be to formally incorporate drawing into the anatomy curriculum.

#### **Conclusion**

With the modernization of medical education, the quantity and quality of anatomy teaching in the medical curriculum had significantly declined.

Alternative approaches to anatomy teaching must be considered. The use of drawing to teach anatomy can help students visualize and conceptualize anatomical planes and structures more clearly, especially when the resources for prosections and dissection is limited in current era. Drawing is fun and it also engages students to proactively learn with their hands. Our study presented a series of workshops that used drawing as the method of teaching, and subsequently, demonstrated improvement in anatomical knowledge, both subjectively and objectively. The workshops yield high student satisfaction and were cost-effective and easily replicable. We believe that this model of teaching should be incorporated into the anatomy teaching curriculum, either as a SSC or core component. This is a small study and findings are based on a limited population but results were encouraging and we hope to continue to replicate these findings and help students benefit from learning anatomy through art.

#### **Ethical standards**

Study complied with the current laws of the country.

#### **Conflict of interest**

None to declare.

#### **Funding**

None to declare.

#### **Acknowledgments**

Dr. Hunter, Academic Head Dissection Room

Dissection room staff (manager Kirsty Thompson)

KCL Anatomy Society committee

#### **List of Abbreviations**

KCL = Kings College London; RCSeng = Royal College of Surgeons of England; BAPRAS = British Association of Plastic, Reconstructive, and Aesthetic Surgery; MAA = Medical Artist Association, M.B.B.S. = Bachelor of Medicine and Surgery.

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