ORIGINAL COMMUNICATION

Student perceptions of the value of potted anatomical specimens in relation to dissection and other anatomical teaching resources

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Anatomy remains an uncontested cornerstone of medical education; however over the past decade the method through which it is taught has been debated. This debate has focused mainly on the use of traditional human dissection compared to modern alternatives. Yet there appears to be a paucity of literature discussing the value of potted anatomical specimens. The aim of this study was to compare the perceived value of potted specimens with that of other resources used to teach anatomy to pre-clinical medical students at University College London (UCL). During the 2013/2014 academic year, anonymous closed questionnaires were analysed prior to (n = 433) and following (n = 474) simple interventions, such as additional signage, corresponding labelled images and requesting anatomy demonstrators to make use of potted specimens in their teaching sessions. The results suggest that potted specimens are more useful to students during their second year compared to their first year (i.e. after the interventions). Potted specimens were also more helpful to this year's first years compared to last year's first year cohort (i.e. after the interventions). In conclusion, human tissue remains a vital resource for teaching anatomy at UCL. The data suggests that the use of simple interventions increases the utility of potted specimens. The authors recommend that medical schools increase awareness of potted specimens as part of the rich tapestry of learning methods available to students.

Keywords: Potted anatomical specimens, medical education, human anatomy

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INTRODUCTION

The anatomy laboratory at UCL comprises of dissecting and embalming facilities with the surrounding laboratory walls housing computers, models and potted specimens. The 20 dissecting tables (where full body dissection takes place) are supplemented with prosections. In the first year, students learn the thorax and abdomen. In the second year, using a different cadaver, students learn the limbs, head, neck and pelvis. Both years total 146 hours in the anatomy laboratory. The lecture course is run simultaneously with the dissection course. Students are assumed to have no prior anatomy knowledge on commencing the course. The structure of anatomy teaching at UCL is similar in years one and two.

The anatomy laboratory at UCL has over 100 anatomical and pathological potted specimens presented around the room on shelves, divided into body systems. A comprehensive photographic catalogue accompanies each system.

The potential of potted anatomical specimens. Potted anatomical specimens (hereafter 'potted specimens') are defined as

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dissected human specimens, immersed in preservative solution, contained in sealed glass or acrylic pots.

The production of potted specimens has similar requirements to cadavers, in terms of initial preservation of the body, and the expertise and considerable time required to dissect the specimens to a standard acceptable for teaching. However, potted specimens require less maintenance. For example, at UCL potted specimens require a 'top up' or complete change of preservative on average every five years (unless damaged). In comparison, at UCL cadavers are used for one academic year before cremation, which itself is expensive. Therefore one cadaver can produce multiple specimens to be used by multiple groups of students for multiple years, making potted specimens a more cost effective resource. Furthermore, as undergraduates are inexperienced dissectors, learning from potted specimens may be a better use of their limited time in the anatomy laboratory.

Potted specimens are precious resources due to consent limitations and the time and cost involved in processing them. Yet, some medical schools are recycling their collections for other means, such as digitalisation (Venkatesh et al. 2013). Medical museums have a substantial history in anatomy education (Reinarz 2005), yet many schools no longer have medical museums or the specimens once contained within them despite the evidence that students find them useful (Marreez et al. 2010).

Potted specimens, as at UCL, are often hidden away or on cluttered shelves, rendering them easily ignored. The usefulness of a resource is compounded by its usage. Therefore, in the context of the debate over how best to teach anatomy, this current work is a preliminary exploration of the potential value of potted specimens to medical students at UCL. We hypothesised that interventions to increase student awareness of potted specimens in the anatomy laboratory would increase the perceived use and helpfulness of this resource by pre-clinical medical students. This study is focused on student perceptions of the resources available to them, focusing mainly on the use of potted specimens and the simple interventions that were applied with no further analysis of objective outcomes.

METHODS

Interventions. Several deliberately simple interventions were carried out throughout the academic year (2013/2014) to increase student awareness of the potted specimens available to them:

1. Additional signage was placed over specimen shelves enabling students to identify each system more easily.

2. A sample of potted specimens was photographed and significant structures labelled. These were laminated and displayed with the specimens to assist Student Directed Learning (SDL).

3. Anatomy demonstrators were briefed to use potted specimens during their small group teaching.

4. A sample of relevant potted specimens (with labelled photographs) was displayed prominently in the anatomy laboratory during each session.

In addition, three optional one hour revision sessions were also run for each year group using potted specimens and labelled photographs after their anatomy teaching finished for the year. These sessions were supervised by demonstrators and question sheets were supplied to assist students with their SDL. This allowed students to use the potted specimens freely to revise in whichever way they felt appropriate, using the question sheet as an optional tool for directing their revision. This was a new provision developed for the purpose of this research.

No further interventions were carried out with regards to other the teaching resources provided for students during these years.

Student surveys. The research presented here was performed with the complete understanding and consent of all the participants. Anonymous questionnaires were provided as hard copies before or after dissection sessions in order to maximise sample size.

Closed questions asked students to rate criteria. Current second years were asked to rate their experiences of their first year (2012-13) in October 2013. They were then asked to complete the same survey towards the end of their second year (2013-14) in March 2014. Current first years were asked to rate their expectations before commencing dissection in January 2014 and their subsequent experiences rated in March 2014. For both year groups this encompassed their full academic year in the anatomy laboratory. Both year groups were asked about their frequency of use ('every session', 'often', 'occasionally', 'rarely' or 'not at all') and perceived helpfulness ('extremely', 'very', 'quite', 'not very' or 'did not use') of teaching resources including compulsory full body dissection and the optional use of prosected specimens, computer-based resources (which included imaging), plastic models and potted specimens. Survey results from the beginning and end of the year were collated and compared.

Students who attended revision sessions were asked about their experiences using similar criteria directly after these sessions held in March 2014. Questions included their likelihood to recommend potted specimens for learning anatomy and their frequency of use of potted specimens before and expected use after the revision session.

Data from the written questionnaires was transferred to Excel ® (2010, Microsoft) and graphs were produced using this software. Questionnaires were excluded if they were incomplete or the answers given were unclear (see **Table 1**).

Table 1: *Number of included and excluded questionnaires in each group/year*

	Completed	Unclear	Incomplete	Total excluded	Included
1st year beginning of year (January 2014)	200	3	1	4	196
2nd year beginning of year (October 2013)	238	0	1	1	237
1st year end of year (March 2014)	239	1	6	7	232
2nd year end of year (March 2014)	246	2	2	4	242
Revision session 1st years (March 2014)	69	0	2	2	67
Revision session 2nd years (March 2014)	64	0	2	2	62

RESULTS

The comparative use of various anatomy resources: expectations and reality. First year students' expectations prior to entering the anatomy laboratory were compared to their actual experiences (Figure 1). Second year students' experiences of their first year (2012-13) in the anatomy laboratory were compared to their experiences in their second year (2013-14) (Figure 2).

First years used all the resources, except dissection, *less* frequently than they expected. They rated all resources *less* helpful than they expected. Conversely, second years used all resources, except dissection, *more* frequently in their second year than their first. Furthermore, they rated all resources *more* helpful in their second year compared to their first, except dissection.

For both year groups, dissection was the most frequently used resource; however, second years used it less in their second year than their first. First year students found dissection the most helpful resource with 50.9% rating it extremely helpful. Only 26.4% of second years rated dissection as extremely helpful in their second year, despite 43.5% rating it so in their first year. Models surpassed dissection as the most helpful resource for second years.

The value of potted specimens. In comparison to dissection, potted specimens were not as popular. Almost half of first year students used them rarely or not at all and only 2.2% used them every session. More second years than first years used potted specimens, although only 4.1% used them every session. Notably, second years found potted specimens more helpful in their second year than in their first year (i.e. after the interventions described earlier were included), which is clearly illustrated in Figure 3. The questionnaires at the beginning of the year predicted that potted specimens would be the least used and least helpful resource for both year groups; however, it was the computer-based resources that were identified as the least used and least helpful resource by both year groups in the 2013-14 academic year.

Figure 4 shows the helpfulness of potted specimens in the first year of anatomy education. These data are from the previous first year cohort in 2012-13 (the current second years) and this year's cohort (2013-14). This also shows that this year's cohort found potted specimens more helpful than last year's.

Revision sessions. The revision sessions held for both first and second year students produced positive results (Figure 5). After their revision session the vast majority of first years were 'likely' (61.2%) or 'very likely' (29.9%) to recommend using potted specimens to learn anatomy. None were 'not at all' or 'somewhat likely' to recommend using potted specimens. Furthermore, the students indicated they would use potted specimens more in future with no students saying they would use them 'rarely' or 'not at all'. The number of students who said they would use potted specimens 'often' or 'every session' increased from 9.0% to 80.6% following the revision sessions.

Similarly, the majority of second years were 'likely' (41.9%) or 'very likely' (27.4%) to recommend the use of potted specimens after their revision session. The students also indicated they would use the potted specimens more: over half would use them 'every session' or 'often' in future compared to 17.7% before.

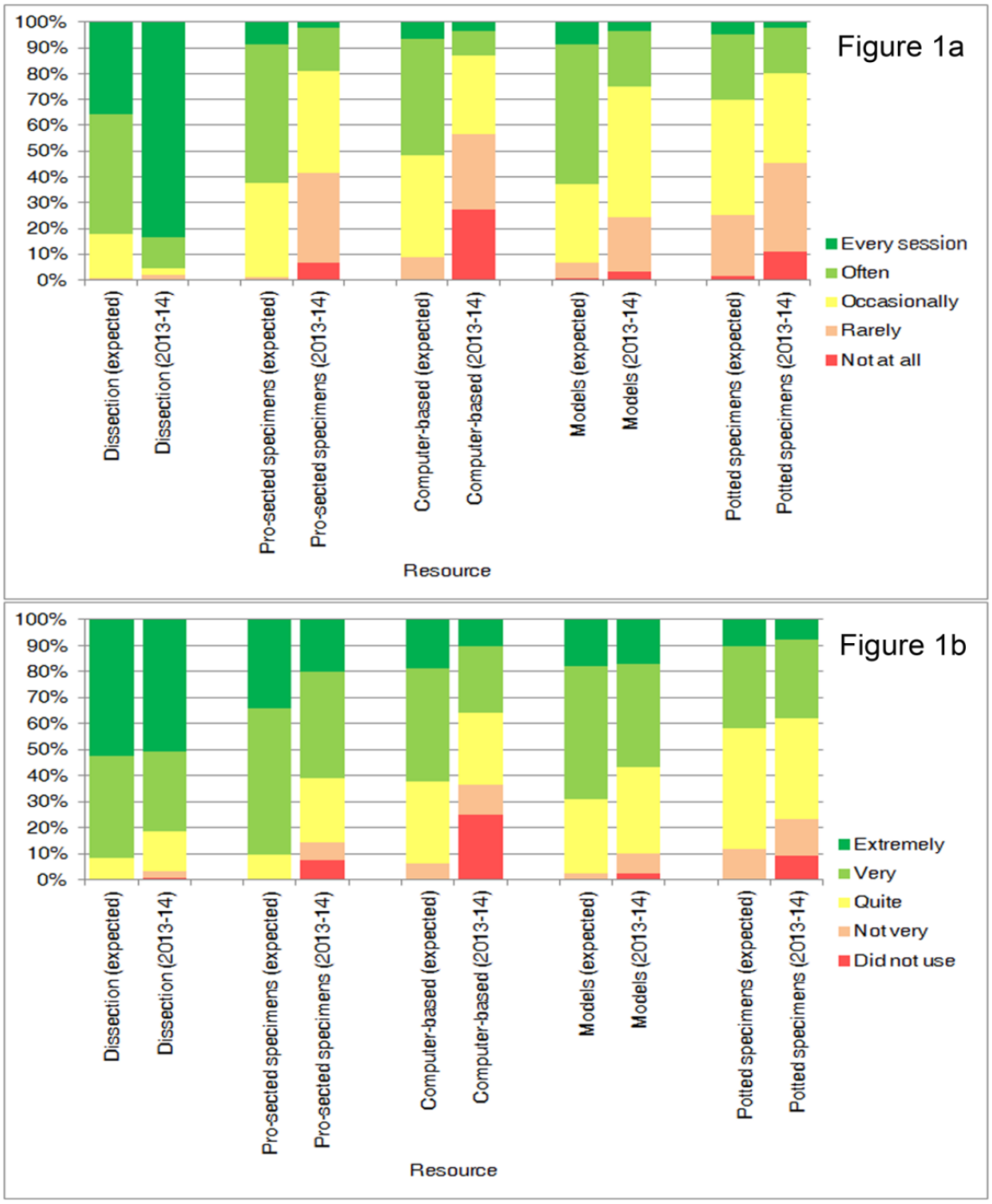
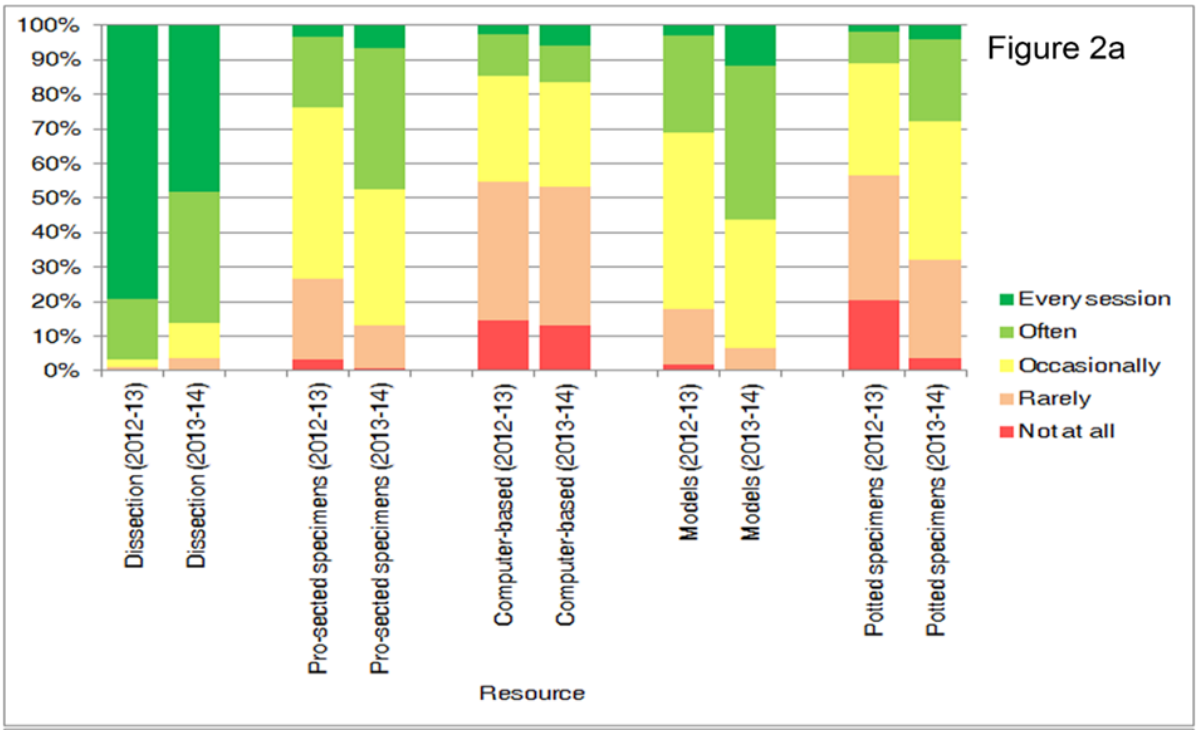


Figure 1 *Graphs showing the expectations (n=196) and experiences (n=232) of first year medical students of the perceived a) frequency of use and b) helpfulness of different learning resources in the UCL anatomy laboratory in the academic year 2013-14 (their first year of medical school)*



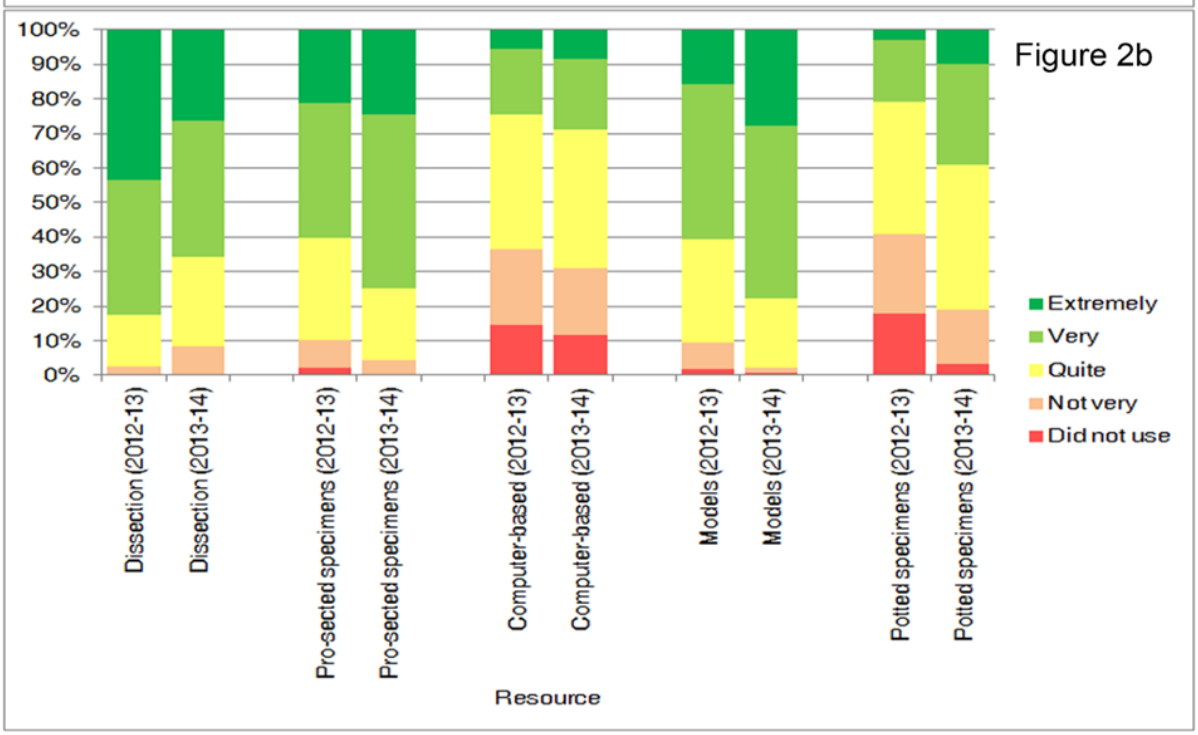


Figure 2 *Graphs showing the experiences of second year medical students in their first (2012-13, n=237) and second year (2013-14, n=242) of the perceived a) frequency of use and b) helpfulness of different learning resources in the UCL anatomy laboratory*

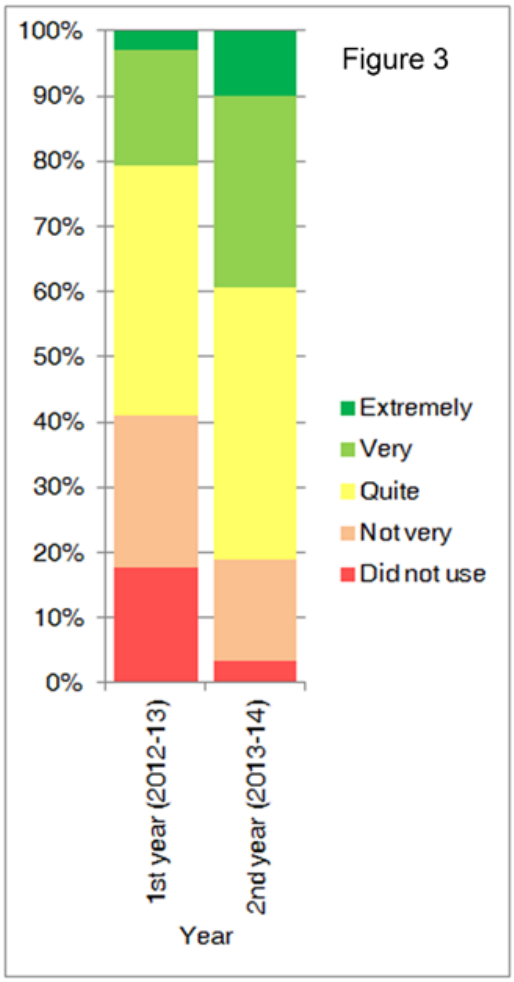


Figure 3 *Graph showing the experiences of second year medical students in their first (2012-13, n=237) and second year (2013-14, n=242) of the perceived helpfulness of potted specimens in the UCL anatomy laboratory*

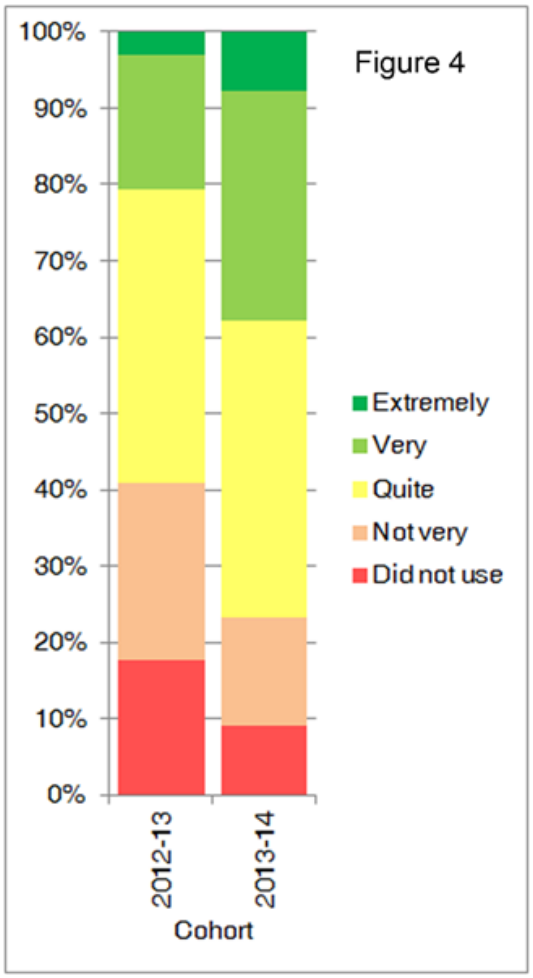


Figure 4 *Graph showing the experiences of previous first years (2012-13, current second years, n=237) compared to current first year students (2013-14, n=232) of the perceived helpfulness of potted specimens in the UCL anatomy laboratory*

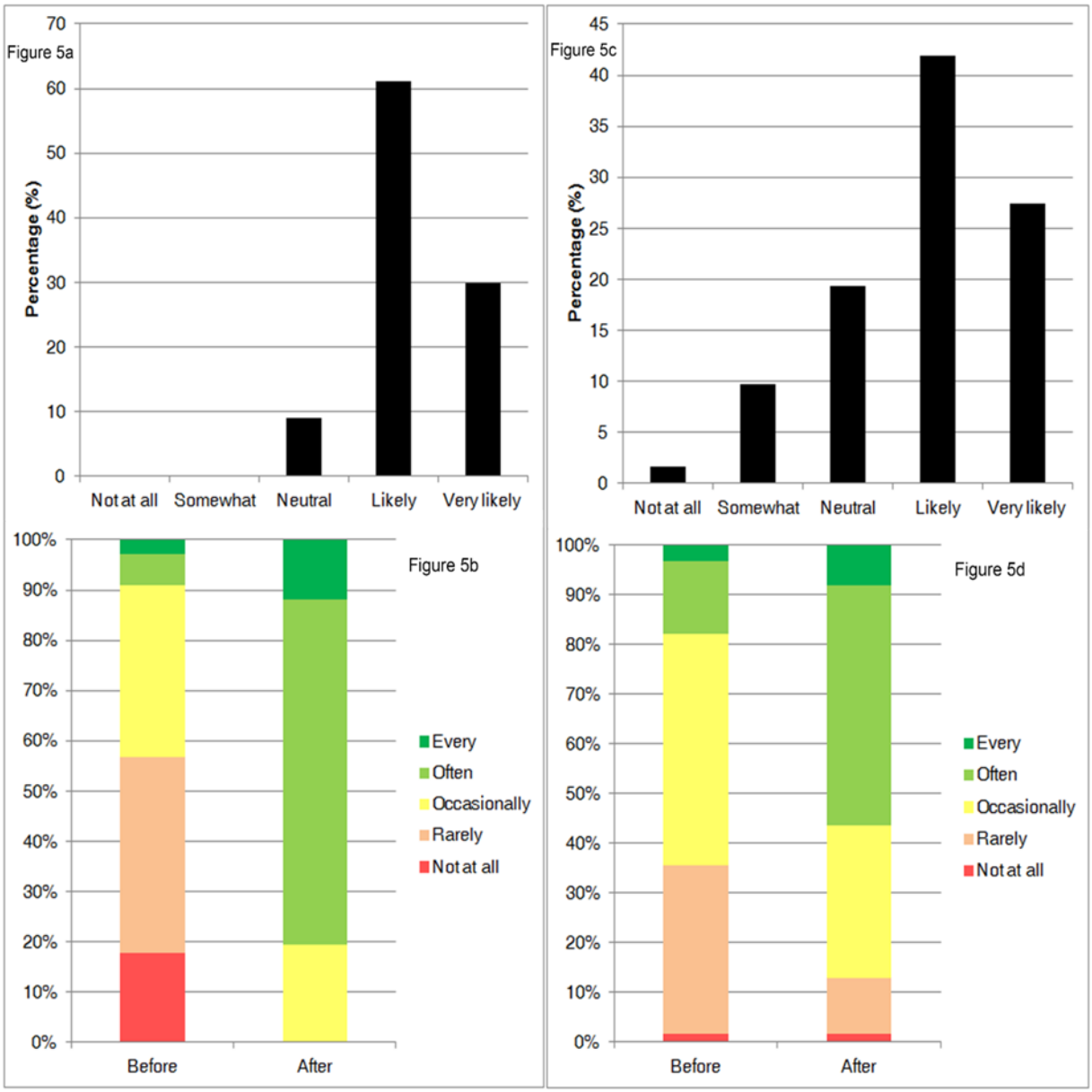


Figure 5 *Graphs showing the a) likelihood to recommend potted specimens to learn anatomy and b) frequency of use of potted specimens experienced before and expected after, rated by first year medical students after the revision session in the UCL anatomy laboratory (n=67). Graphs showing the c) likelihood to recommend potted specimens to learn anatomy and d) frequency of use of potted specimens experienced before and expected after, rated by second year medical students after the revision session in the UCL anatomy laboratory (n=62)*

DISCUSSION

It is widely understood that anatomy is a cornerstone of medical education, key to all disciplines within the profession (please see review article in this journal). Traditional teaching methods have used donated human tissue, including cadaveric dissection, pro-section and potted specimens. In the past decade some have questioned this and contemporary curricula now encompass a broader variety of teaching methods than previously.

It seems potted specimens are largely ignored by modern day medical students which has led

some institutions to dispose of or recycle their collections (Marreez et al. 2010). Yet potted specimens offer many benefits: opportunity for independent and group learning, improved observational skills, clear depiction of structural relationships, variety of pathology and representation of surgical cases (Marreez et al. 2010). Furthermore such collections can easily be arranged appropriately to reflect the learning needs of different student populations (Marreez et al. 2010).

This study explored the potential value of potted specimens by using simple interventions to increase awareness of them and then question medical students' subsequent frequency of use and perceived helpfulness.

The use of dissection. Human cadaveric dissection plays a key role in the UCL medical school curriculum. This study shows that the large majority of first years dissected every session, using this resource much more than the other resource. Dissection was also identified as the most helpful resource. It is likely first years found dissection to be slightly less helpful than expected due to unrealistic expectations and lack of insight into how difficult dissection actually is. However, this highly positive evaluation of dissection by the first years does support the extensive literature advocating the use of dissection to teach anatomy.

Interestingly, the data from the second years demonstrated a reverse trend to the first years, with every resource except dissection used more frequently and found to be more helpful in the second year than in the first year. Although dissection remains helpful in the second year, the other resources play a relatively greater role with models being identified as the most helpful resource for second year medical students.

One major reason for this is that first year topics (thorax and abdomen) are likely to be better learnt through dissection, as there is a lot of conceptual knowledge to be developed (such as the relationship of organs in the thoracic cavity). In comparison, the second year topics (limbs, head and neck and reproductive organs) require more learning of detail, for which dissection may be less effective. Other resources, including potted specimens, may therefore be more suitable for learning detail. It is surprising that models were the most popular resource for second years as this contradicts Patel and Moxham (2006) who found models were least preferred by anatomists.

There are other reasons that may explain why second years dissect less. There is an increase in workload in second year and, although effective, dissection is a laborious way of learning. The attitude of second year students is likely to have changed: perhaps the novelty of dissection fades and they have already gained the skills and 'rite of passage' that dissection offers. Furthermore, different learning methods may suit novices (that is, first year students) more than advanced learners.

The use of potted specimens. Second years used potted specimens more frequently and found them to be more helpful than in their first year. This may be secondary to the decreased reliability on dissection discussed above. It may also be due to the interventions imposed this academic year. Furthermore, although the comparators represent two different groups of students, the data in **Figure 4** shows that this year's first years found the potted specimens more helpful than last year's cohort. This may be due to changes in the delivery of the program or the student characteristics; however it could also suggest that the simple interventions introduced have increased the impact of potted specimens on learning first year anatomy.

Of all the resources, potted specimens had the worst reputation at the beginning of the year. They were rated the least used and least helpful resource by second years in their first year and had the lowest expectations from first years. However, computer-based resources were found to be the least used and least helpful resource by both year groups in 2013-14. The relative improvement in usage and helpfulness of potted specimens in the most recent academic year may have been due to

the newly introduced interventions. This increases the evidence for the potential value of potted specimens if utilised maximally and in the correct context.

Further evidence for the beneficial impact of potted specimens comes from the revision sessions. Both first and second years indicated that they intend to use potted specimens more frequently in the future. In addition, the majority of students were 'likely' or 'very likely' to recommend using potted specimens to learn anatomy. The data was particularly positive for first years, possibly because they were least aware of potted specimens prior to their sessions.

Limitations of the study. It is accepted that this study has major limitations. The data from the questionnaires has been quantified based on qualitative information. The constructs studied here, such as perceived helpfulness, are complex. A more detailed study is required to analyse the components of 'helpfulness'. Similarly, it is difficult to write a suitable range of answers and this leads to subjectivity of rating, with likely inter-student variability. Students may not have accurately considered the definition of each resource, particularly first years when evaluating their expectations. As such, the data from second years is likely to be more meaningful as previous experience is more tangible than expectation. In addition, students may have been biased in rating resources unhelpful because they had minimally used them. Finally, it is difficult to compare different year groups due to frequent changes in the delivery of anatomy teaching including the yearly change in demonstrators. It was not possible to establish a control cohort.

Future areas for research. Collaboration of multiple institutions would allow the creation of control and comparator cohorts. A focus on outcomes would provide further information on the value of potted specimens. It would also be interesting to study the potential of potted specimens for teaching anatomy to clinical medical students, particularly in regards to the use of pathological specimens.

Conclusion. Undoubtedly exploring human tissue remains the mainstay of understanding human anatomy. This research suggests that cadaveric dissection is perceived as vital for learning anatomy at UCL. Models and prosected specimens are also frequently used and helpful resources. Although potted specimens are unlikely to revolutionise the way anatomy is taught, they have potential, particularly relating to certain topics and educational contexts. As collections are relatively cheap to maintain, we recommend other medical schools encourage the use of potted specimens for SDL (provided they are accompanied by some form of labelling) and for small group teaching.

This study highlights a huge variety in individual responses: each resource played a major, sometimes even paramount, part in some students' learning. By providing a range of resources, students' are empowered to identify the learning styles that work best for them and they can tailor their learning accordingly. There are some unavoidable limitations to learning using human tissue. Models, computer-based resources and other techniques, such as peer-to-peer examination and imaging, can be used as adjuncts to support learning where human tissue is insufficient. We believe that this multi-modal approach is the best method of providing a comprehensive anatomy education.

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest and no potential competing financial interests regarding this article. The authors have presented the results of this work as a poster at the 2014 Anatomy Society meeting in Bradford.

EDITOR'S NOTE

The authors of this article have also included a brief review in the current issue of JIAS. As the article provides a review of the literature related to the use of dissection and human tissue, the editor highly recommends reading it alongside this original communication.