

## **The context of learning anatomy, does it make a difference?**

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## Abstract

This study set out to ascertain if the context in which anatomy is learnt made a difference to students' perceptions of learning. An Approach to Learning Inventory (ASSIST) and a 31 item Anatomy Learning Experience questionnaire (ALE) was administered to 224 students (77 dental, 132 medical and 19 speech and language) as a multi-site study. Results revealed 45% adopted a strategic approach, 39% deep and 14% surface. Trends between professions are similar for a deep or strategic approach (both~40%). However a surface approach differed (7% dentistry, 16% medicine 26% speech and language science). Dental students responded to being able to use their knowledge more than other groups ( $p=0.0001$ ). Medical students found the dissecting environment an intimidating one and subsequently reported finding online resources helpful ( $p= 0.015$  and  $0.003$  respectively). Speech and language science students reported that they experienced greater difficulties with learning anatomy; they reported finding the amount to learn daunting ( $p=0.007$ ), struggled to remember what they did last semester and were not confident in their knowledge base ( $p=0.032$  and  $p=0.0001$ ). All students responded highly to the statement 'I feel that working with cadaveric material is an important part of becoming a doctor/dentist/health care professional.' A high response to this statement was associated with students adopting a deep approach ( $p=0.0001$ ). This study has elucidated that local curriculum factors are important in creating an enabling learning environment. There are also a number of generic issues that can be identified as being inherent in the learning of anatomy as a discipline and are experienced across courses, different student groups and institutions alike.

**Key words:** Teaching Anatomy, Anatomy Education, Approach to Learning

## Introduction

One of the goals of higher education is to create an environment in which quality student learning can occur (Biggs 2011). If effective learning is to occur then the design of courses needs to be underpinned, either explicitly or implicitly both by theories of student learning but also by the more practical theories of instructional learning and course design that seek to give practical guidance to the designing of courses (Moseley 2005). The design, content and structure of anatomy courses have come under scrutiny from a several directions in recent years. A number of studies have claimed to document a decline in the knowledge of anatomy acquired by students, recent graduates and newly-qualified trainees. This decline in anatomical knowledge has been cited as one reason for increasing surgical errors and the consequent increases in medico-legal litigation (Ellis 2002; Older 2006). One reason for this decline in anatomical knowledge is likely to be as a consequence of a general reduction in the time available for anatomy teaching (and other biomedical science teaching) in medical curricula (Drake, Lowrie et al. 2002; Drake, McBride et al. 2009); a decline that is often a feature generally of professional curricula in which anatomy is taught. This reduction in time is due to a combination of pressures; the sense from a number of quarters that anatomy has, in the past, been overtaught and the need also to accommodate newer knowledge of various kinds into medical, dental and other professional curricula. Thus, anatomy, in common with many other subjects in professional courses, finds itself caught between those who argue that too little and those who argue that too much is being taught. Whatever the merits

of these debates it has clearly never been more important to ensure that the time available on teaching anatomy is effectively deployed and that an optimal learning environment is created, This requires that we understand better how students might approach learning anatomy that we can in turn understand why students might be failing to understand and apply anatomy effectively. This will mean that it is necessary to draw on educational theory to investigate students' perceptions of learning and the approach to learning they adopt. In so doing we will be making an important transition from high quality teaching to high quality teaching underpinned by theory (Kreber 2002).

Our understanding of how students learn has been critically shaped by the seminal work initially of Saljo and Marton (Saljo 1979) and later of Marton and Pong (Marton and Pong 2005) and Ramsden (Ramsden 2003) through their investigated how students tackled various learning tasks. These authors were able to identify qualitatively different approaches to learning characterized by the students' conceptions of learning, their perceptions of the learning context, the influence of their previous learning experiences, their intentions for learning, and their learning preferences. The main approaches to learning identified were conceptualised as "surface learning" and "deep learning". Subsequent work led to the identification of a further distinct approach of "strategic" (or "achieving") learning. A deep approach to learning is characterized by a motivation to understand the topic. In contrast a surface approach to learning is characterized by rote learning and the simple regurgitation of facts. A strategic approach to learning is one that is focused on assessment where students adopt whatever method of learning they

perceive will achieve the best test results. In recent work Hattie (2009) has suggested that a further approach to learning can be recognized which is termed constructed understanding (Hattie 2009). Constructed understanding is defined as learning which builds upon surface and deep learning and is where the learner shapes their own ideas that allows them to identify general rules and make predictions based upon defensible theories.

Unlike learning styles which are preferences linked to psychometric variables, learning approaches are very much dependent upon the context in which learning takes place. Thus, learning approaches are not relatively fixed aspects of a students' personality for instead a student may adopt a surface approach to one facet of their learning but a deep approach to another (Ramsden, 2003). It is crucial that we as teachers recognize and understand that the learning approaches students adopt are influenced by the things we do. It is also important to recognise that surface learning is not, of itself, a bad thing. Instead a balance has to be sought for if deep learning is to occur then this has to be preceded by some surface learning and both surface and deep learning are a necessary part of understanding (Hattie, 2009).

The reason for understanding how students approach their learning is that this will influence course design. A number of models of instructional design have been proposed (reviewed in Moseley et al 2005). One of the most influential models is by Bloom (Bloom 1956) and to varying extents his work has influenced all subsequent work in this area. A model that has been especially influential in higher education is the Structure of the Observed Learning

Outcome model (SOLO taxonomy) of Biggs and Collis (Biggs 1982; Biggs 1999). There are clear linkages between the levels of taxonomy proposed by Biggs and Collis and the conceptions of learning formulated by Saljo. Approaches to learning categorized as deep are associated with learning outcomes that map to higher levels of the SOLO taxonomy relating to understanding of a topic. If, as teachers we seek to foster understanding then we must endeavor to ensure our students adopt progressively deeper learning approaches once they have mastered an introduction to the subject through the acquisition of requisite surface learning.

Various methods have been used to determine the approaches to learning that students are adopting. This has involved the use of both interviews and questionnaires, the two most commonly used questionnaires are those devised by Biggs and by Entwistle and colleagues. In this study we used the Approaches and Study Skills Inventory for Students (ASSIST) (Entwistle 2006) to measure learning approaches.

Approaches to learning inventories alongside qualitative methods have been utilized to understand anatomy learning around the world (Pandey and Zimitat 2007; Smith and Mathias 2007; Smith and Mathias 2009; Ward 2011). These studies have all shown consistent findings illustrating that a deep approach enables high quality learning and application of knowledge. A weakness of these studies is that they are limited to one institution and single programmes. There has been very little work comparing the learning of anatomy by students preparing to work in different professions in which the need for

anatomical knowledge and its applicability to professional practice will necessarily be very different.

The purpose of this study is to contribute to our understanding of how students learn anatomy by examining student learning of anatomical information in different professional disciplines and in different institutions to test the generalizability of any conclusions we reach.

Specifically this project aimed to:

1. Further develop our current understanding of the approaches to learning adopted by students studying within medical, dental and speech and language science curricula.
2. Compare findings across other institutions and other disciplines within and outside of the UK to test the generalisability of the conclusions made by other studies.



## **Methods and materials**

### **Study Design**

The study is a cross sectional, comparative multi-site study. The study explored students' approaches to learning anatomy during a single academic year. The study involved 3 institutions and 3 different professions. (Refer to Table 1). The study received ethical approval by all participating institutions (SOMSECsc0809.01).

### **Context**

The three institutions involved in this study (Newcastle, Computense and Southampton) use similar anatomy teaching methodologies involving lectures, small group sessions and practicals to teach anatomy to students in their first two years of their programme. Students experience a similar number of taught timetabled hours devoted to anatomy in each institution. Dental students at Newcastle receive 100 hours. Dental students at Computense receive 130 hours and Medical students at Southampton 130 hours. Speech and Language students receive a smaller amount of 60 hours of anatomy teaching. The students have access to human cadaveric material through prosection and dissection and a range of other resources including models and e-learning. Assessment is through a combination of integrated questions, objective testing and practical examinations.

### **Participants**

All potential participants n=500 (selected by their registration on a Bachelor of Medicine, Dentistry or Speech and Language Science Course in one of the

three participating institutions) were invited by email to participate in the study. Individuals who selected to participate n=228 (45.6%) were provided with a Participant Information Sheet and if they agreed to participate were required to sign a consent form. Table 1 provides details of the sample. Due to the curriculum at Southampton spiralling through the early years it was appropriate to invite both year and 1 and 2 students to participate.

### **Questionnaire**

Two elements were brought together through one Likert scale questionnaire. The elements were the ASSIST fifty two question inventory (Entwistle 2006) which had been adapted with permission to insert the word 'anatomy' as appropriate and an Anatomy Learning Experiences Questionnaire (ALE) a thirty one question inventory designed to ascertain students' perceptions and experiences at their institution. Use of the ALE made it possible to relate the ASSIST inventory to the context of learning anatomy. The anatomy component (Anatomy Learning Experience questionnaire ALE), was divided into the following clusters.

- Cluster 1. The activities students prefer to do to learn anatomy
- Cluster 2. Students' experiences and feelings about working on cadavers
- Cluster 3. The problems students encountered
- Cluster 4. How students currently use their anatomy knowledge
- Cluster 5. Students' overall perceptions of anatomy

The anatomy component of the instrument had been previously validated and reported in Smith and Mathias (Smith and Mathias 2007; Smith and Mathias 2010). The questionnaire was distributed in paper format during the first Semester and took students no more than thirty minutes to complete. Where required the questions from ASSIST and ALE questionnaire elements were translated into Spanish. The ASSIST component has been widely used internationally but this is the first time the ALE has been used in Spain so double back translation was used to check that original meanings within the content had been preserved.

The returned questionnaires were then optically scanned and the data entered into IBM SPSS™ version 19. For the purposes of subsequent data analysis results were considered significant if  $p < 0.01$ . Within the data 7 missing values were shown. The original paper versions were checked and no entry was found to have been missed by the optical scanning process, the student had simply not entered a value. So as to not lose all the rest of that individual's data a 3 'unsure' neutral value was inserted in these cases.

ASSIST scores were calculated as detailed in ASSIST inventory instructions (Entwistle 2006). In brief each question is categorised as representing a deep, surface or strategic approach. The scores from the 52 questions were totalled. The highest scoring category is defined as the predominant approach. The dominant approach was given a nominal number (1= deep, 2= strategic, 3=surface). In five cases, students had equal preference this was denoted by a number 4. Results are expressed with significance set at  $p \leq 0.01$ .

Non parametric tests were performed to ascertain differences between variables. To explore any relationship between approach to learning and the course of study percentage comparisons were utilised (Table 2). To establish if there was any relationship between how students responded to the ALE and their course of study a Kruskal Wallis test was performed (Table 3). To explore the inter play between approach to learning and how individuals responded to the ALE a Kruskal Wallis test was performed (Table 4). Finally to see if gender exerted any effect on the responses to the ALE a further Kruskal Wallis Test was performed.

### **Focus groups**

A series of seven structured focus groups were undertaken with students (n=37). Due to translation costs these were only transcribed at the UK institutions. The focus groups were transcribed verbatim and subjected to nodal analysis by line by line coding. Phenomenographic bracketing (to suspend preconceptions) was used where appropriate to allow for theory generation (Marton and Pong 2005). Each node was then brought into categories that emerged from the data from a grounded theory approach (Glaser and Strauss 1999). These then formed the following main themes; stages of learning, approaches to learning, learning pathologies, assist to learning and institution specific issues.

## Results

The response rate of the study (45.6%) might be considered low, but the researchers approached this study in a conformational manner. The study as a whole aims to contribute to our understanding of how students learn anatomy. We believe that this exists as real and relatively stable entities that can be explored in a rigorous manner. Therefore, a post-positivist stance has been adopted in this study acknowledging that as researchers we can be “neither totally objective nor unquestionably certain” (Crotty 2003). We are capturing our data through participant reports but are not interpreting them as reality with unwarranted assertability (Crotty 2003). We thus consider the response rate to be good and reflective of the population. The gender ratios are also reflective of the whole populations (Table 1).

### **Approaches to learning:**

Overall the majority of students favoured either a deep or strategic approach. (Refer Table 2). With a slight majority in dentistry favouring a strategic approach. All three approaches, deep, strategic and surface were observed in students' experiences from the focus groups. In exploring if gender exerted an effect on the approach to learning it was found that a strategic and surface approach was favoured by a significantly larger number of females ( $p=0.009$ ) and ( $p=0.003$ ) respectively. For students adopting a deep approach no significant difference was found, however more males (117) than females (110) adopted a deep approach.

### **Anatomy Learning Experience:**

In exploring students' experiences of learning anatomy many students exhibited the same perceptions and experiences, for example: all students responded highly to the statement 'I feel that working with cadaveric material is an important part of becoming a doctor/dentist/health care professional.' A high response to this statement was also associated with students adopting a deep approach ( $p=0.0001$ ). Students also commonly highly rated course handbooks and mock examinations as being helpful to their learning.

Some noticeable differences could be seen between students studying for different professions (Refer Table 3). Dental students responded to being able to use their knowledge more than other groups ( $p=0.0001$ ). Medical students found the dissecting environment an intimidating one and subsequently reported finding online resources helpful ( $p= 0.015$  and  $0.003$  respectively). Speech and language science students reported that they experienced greater difficulties with learning anatomy; they reported finding the amount to learn daunting ( $p=0.007$ ), struggled to remember what they did last semester and were not confident in their knowledge base ( $p=0.032$  and  $p=0.0001$ ).

### **Focus Group Trends:**

Analysis of the focus groups using nodal analysis from the transcripts of medical and dental students and moderation by the research team identified three key trends.

1. Genres of learning

When describing learning, different learning activities can be divided into genres often based around a set curricular activity (Calkins 2009). Whilst there were two separate and quite different courses involved in the focus groups (medicine and dentistry) in both cases students were learning anatomy in the first two years of their course. Students in these courses at both institutions reported that their view of the role of the lecture was to summarise and to provide a theoretical perspective. At some point either after or sometimes before the lecture students reported that they engaged in an amount of preparation work for the practical session. In some cases this resulted in almost a day's work! Preparation could involve any of the following activities; highlighting text in supplied practical handbooks, reading, drawing, colouring in pictures, watching DVDs, printing diagrams, creating lists of things to see. It was interesting that one medical student commented that good preparation work enabled you to ask good questions in the practical, this was reflected in a number of quotes for example from a Year 1 medical student. *"I can't actually ask about this because I don't understand it enough to be able to ask a question yet"*

During the practical session the activities students undertook varied but there was the sense for all groups that it was an opportunity to see it and feel it and talk it over with members of staff. After the practical further work occurred that could include; reading, watching DVDs, interaction with testing material, looking things up, but the time devoted to these activities seemed to be less than time devoted to the preparation work.

## 2. Difficulties encountered in learning anatomy

A common theme appropriate to many courses but perhaps even more allied to a professional course such as dentistry and medicine was the constraints on the time available for study. This affected many areas of students' work, from the preparation time, to the time in a laboratory setting, to the revision time. Anatomy appeared to be heavily time-dependant with a number of students observing that the hours of study required for anatomy was greater in comparison to other subjects. Possibly linked to the time constraints is the perception that in anatomy there is too much to learn, too much detail with students reported being unsure as to the depth of knowledge required. As a result of this perception was the feeling that there were too many names and mnemonics to learn, Taken together this would imply the adoption of a surface approaches to learning anatomy. Such issues are highlighted by a quote from this Year 1 dental student *"I really have a problem with all the nerves in the head and neck. And I don't really get don't know the names of each I get confused with all the nerves."*

A lack of relevance and an understanding as to why the material was important was noted as a hindrance, although there appeared to be an amount of trust *"they must know what we need to learn so we learn it"*.

Students also struggled with the three dimensional component especially reported having difficulty with orientation and judging the scale. Students reported some negative feelings which are interlinked; lack of confidence, lack



of confirmation and never being 100% sure that they had identified something correctly.

### 3. Factors promoting or stimulating learning

A major factors stimulating learning of anatomy was being able both to see and feel structures in the practical. A Year 2 medical student described it this way *“I think it is good to see it on a real body as opposed to just visualising it or something else, even when you look it up in a text book and you get in the Dissecting Room (DR) and you realise it is completely different and I am sure again its different in a live specimen in a surgical setting.”*

An understanding of the relevance of the material helped students' motivation to learn, especially when other parts of the course required them to apply knowledge into a professional setting, this was sometimes described as parts coming together. Working with other students in the class in the form of peer teaching was described as helpful, it appears that this was informally organised amongst friends or colleagues who work in a similar way.

## Discussion

Syllabuses in medical and dental education display many similarities, in the methods of teaching adopted which frequently differ from methods students have been used to, the fact that a variety of disciplines are taught, the breadth of new information students are required to grasp, and that new skills and attitudes have to be mastered. A large common denominator is the study of the human form and hence it is therefore not surprising that this study showed many similarities between the medical and dental students. As shown in Table 3, similar percentages of students from different courses are adopting a strategic approach to learning by preference. With assessment an inevitable and major part of professional courses this result might be expected as students are responding to the pressures of their environments (even if it is a little disappointing). Should we as educators though be satisfied with this? We believe not. If we are seeking to develop deeper approaches to learning we need to design assessment tasks that reward a deep approach to learning as well as reinforce already grasped concepts (Logan J 2011). We also need to be aware of the different roles of anatomy in different professions that are required to study it as a part of their initial education and how this might relate to different deep and surface learning requirements between different student groups. Thus, assessment design too will need to reflect those different requirements and emphasise the different relevancies that anatomy will have for students studying for different professions.

In common with many other studies and the perceptions of professional anatomists (Winkleman 2007; Plaisant 2011) we found that, irrespective of the profession students studying anatomy recognised that using dissecting room specimens was of benefit to their learning. This three-dimensional and practical subject requires examination of the human form both in the living and in the cadaver. The findings from our study provide yet more support for retaining anatomical specimens as part of undergraduate education in anatomy.

The practicality of the pressures on students to learn and succeed are considerable (Smith and Mathias 2007 and 2010). Students know that they must pass examinations if they are to progress in their chosen course. There is also the pressure of the need to perform in an occupational role. At the outset of a course the perceptions of what that occupational role might be may not always be fully formed and an accurate reflection of what the profession might involve. It is not surprising that students are driven by assessment and report mock examinations as an effective way of learning. All students highly favoured clinically based teaching, demonstrating the relevance and application of knowledge and skills. Interlinked with the application all students understood that learning anatomy was important for their future career, as other studies have found (Ahmed, Rowland et al. 2010). However, if students have an inaccurate impression of what they might be undertaking when they qualify then relevance might be harder to reinforce. Dental students will have a reasonably clear notion of their future role whereas students of Speech Sciences may not appreciate how important

anatomy could be to their future were they to become involved with voice or swallowing disorders. Medical students might occupy a middle position here.

In exploring the differences between the groups (refer to Table 3) Dental students reported a greater confidence at using their surface and radiographic knowledge, the authors found this interesting because when examining the curriculum dental students had less exposure to radiological and surface anatomy than medical students. Interestingly Lindemann (Lindemann, Duek et al. 2001) found dental students used more achieving methods than medical students on entry but at graduation they were more similar so perhaps dental students can see the purpose of such material earlier on and feel more confident in it.

Speech and language science students exhibited more negative perceptions. These perceptions together with those associated with a surface approach (lack of confidence, volume to learn daunting, do not see the point, find it memorisation based, are only learning it for exams etc.) all reflect various interlinked learning difficulties. Such interlinking difficulties may result in failure to complete the course or a lack of confidence in their knowledge as found by Bhangu et al (Bhangu, Boutefnouchet et al. 2010). One explanation for this could be a failure to appreciate the relevance of the subject leading to the perception simply of a lot of material needing to be learnt simply to progress. This would be expected to reinforce a surface approach.

**Theory:**

The authors would like to propose at the early stages of learning content-rich subjects such as anatomy adoption of some of the perceptions associated with a surface approach to learning are probably very common in undergraduate students and such perceptions may result, at least initially in a surface-approach being adopted. The point needs to be made here that we would not regard surface learning as invariably to be avoided and that only deep learning should be fostered. As Hattie (2009) points out there needs to be a balance between surface and deep learning for without any surface learning then deep learning cannot occur in a subject. We would argue that in anatomy the burden of surface learning that needs to precede understanding is unusually high in comparison to some subjects. Arguably it is the amount of surface learning that students must initially undertake that represents a significant barrier for some. If that is accepted as the case then this may be one of the barriers experienced by students to gaining a full understanding of the subject and comes from a failure to pass across this barrier because they become daunted by the burden. Thus adequate surface learning, knowing the subject, may be more important in a subject such as anatomy at the initial stages of subject mastery on the way to deeper learning.

This presents a significant challenge for assessment design as; on the one hand assessments must encourage students to learn sufficient anatomy to manipulate concepts but on the other hand must seek to foster deep learning typologies. This is because although surface learning involves knowing a fact, learning at this level can result in quite limited levels of understanding and will

not lead to relational or elaborated thinking characteristic of deep learners (Hattie 2009). In relational thinking learners are able to bring together more than one set of facts and/or organise and classify knowledge. Elaborated thinking is defined as a further stage of thinking and involves taking knowledge thus organised and using it to deduce rules or concepts. Hattie (2009) argues that a further kind of learning can be identified which he terms constructed learning where learners become able to shape their own ideas and so construct new knowledge for themselves allowing them to develop general rules and make predictions. Clearly, we would wish to move our students into these more elaborate forms of learning as the means to help them apply their knowledge but also as part of a virtuous circle in which they can see the relevance of what they are learning to their future clinical practice serving to act as further motivation to learn. Recent evidence shows that anatomical knowledge and understanding is used most in diagnosis (Lazarus 2011). Such constructed learning may be one of the links between deep learning and knowledge restructuring and encapsulation that is proposed in illness script formations (Schmidt and Rikers 2007).

If one threshold can be represented simply by the amount of knowledge necessary to be able to manipulate concepts a possible further threshold, but this time of understanding, is suggested by the work of Meyer and Land (Meyer and Land 2003). Meyer and Land (2003) developed the idea that within subjects there are threshold concepts, concepts which form conceptual gateways to subjects which it is necessary to grasp if progress is to be made in understanding a topic. This underlies the point that memorisation alone,

characteristic of surface learning, will not, itself allow students to progress in a subject. In anatomy students have to engage in surface learning to be able to manipulate concepts that then allow a deep understanding but the work of Meyer and Land (2003) would suggest this has to be combined with mastery of difficult topics. Concepts that represent these thresholds may be common across different student groups but it should not be expected that this would be invariably the case. Different courses with their different entry requirements will attract students of differing backgrounds. Consequently the difficulties they experience with threshold concepts may also differ.

A further potential difficulty faced by some students studying anatomy, since it involves study of human cadavers is the anxiety they may experience with this aspect of the subject as reported by Plaisant et al (Plaisant 2009, 2011). Since we know that deep understanding of anatomy is at least partly dependent upon 3D understanding (Fernandez 2011) this anxiety might represent a further barrier for some of our students.

#### Limitations:

The authors recognise the limitations of this study. It has utilised experiences from different institutions and it could be argued that they are too different to compare, however the level and teaching modes are relatively stable. The sample is representative of approximately 45.6% of the population, this may be considered small, and however, we set out to explore and gain understanding rather than to represent everything.

## **Concluding remarks**

The study's findings highlight that the differences seen are elements controlled by course design and teaching rather than inherent in anatomy as a discipline, for example the use of textbooks or online resources is influenced by what the curriculum and teachers are pointing students towards, the lack of relevance as perceived by the speech and language science students and negative feelings are possibly related to how anatomy is integrated into the curriculum, hence some elements we as educators have the power to exert influence over.

Following this study a resource comprising of a power point presentation with a video and light hearted animation has been created for students to help them understand their approach to learning and this is receiving favourable feedback.

As students move through a curriculum the longitudinal and often spiral nature means students come back to topics and advice on learning should be appropriately placed throughout the curriculum. It may be necessary to recognise that in the early stages of a new topic a surface approach is needed but that there is the opportunity and support for further development of clinical engagement to enable a student to pass through the gateway. It might also be necessary to recognise that the idea that surface learning as being bad and deep learning is good is misplaced (Hattie, 2009). What is required is a balance between these two activities as a means to move students onto more constructed forms of knowing that will be of use in clinical practice.



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## Tables

Table 1. Participating Institutions and sample details.

Institution	Course	Year of Study	Number of participants	Gender	Gender % of course
University of Newcastle	Bachelor of Dental Sciences (BDS) (1)	Year 1	29	11M 18F	M 50% F 50%
	Bachelor of Speech and Language Science (2)	Year 1	19	4M 15F	M 5% F 95%
University of Complutense de Madrid	Bachelor of Dental Sciences (BDS) (3)	Year 1	48	13M 35F	M 40% F 60%
University of Southampton	Bachelor of Medicine 5 year Course (BM5) (4)	Year 1 and 2	65 67	47M 85F	M 40% F 60%
			Total 224		



Table 2. Approaches to Learning and percentages relative to course.

Course (number for reference)	Frequency of Deep Approach to Learning	Frequency of Strategic Approach to Learning	Frequency of Surface Approach to Learning	No preference in Approach to Learning
Dentistry (1)	12 (41%)	13 (45%)	2 (7%)	2 (7%)
Speech and Language Science (2)	7 (37%)	7 (37%)	5 (26%)	0 (0%)
Dentistry (3)	18 (38%)	26 (54%)	3 (6%)	1 (2%)
Medicine(4)	52 (39%)	57 (43%)	21(16%)	2 (2%)

Table 3. Relationship between courses and responses to Anatomy Learning Experiences Questionnaire.

Question	Course significantly responding	Kruskal Wallis p value
5. I find/found mock exams an effective way of learning anatomy.	Dentistry (1)	0.003
12. I feel that working with cadavers helped me to positively address the issue of death.	Dentistry (1)	0.005
21. I feel the course allows me to quickly use my anatomy knowledge.	Dentistry (1)	0.000
24. I find I am using anatomical terms and language at most clinical opportunities.	Dentistry (1)	0.009
26. I find I use my surface anatomy knowledge frequently in clinical situations.	Dentistry (1)	0.020
29. I feel that working with cadaveric material is an important part of becoming a doctor/dentist/health care professional.	Dentistry (1)	0.009
1. I find/found reading textbooks an effective way of learning anatomy.	Dentistry (3)	0.000
4. I find/found using imaging material (e.g. MRI) an effective way of learning anatomy.	Dentistry (3)	0.000
25. I find I use my anatomy radiology knowledge frequently in clinical situations.	Dentistry (3)	0.006
2. I find/found on-line material an effective way of learning anatomy.	Medicine (4)	0.000
10. I feel the Dissecting Room is a daunting environment to learn in.	Medicine (4)	0.006
14. I believe that the anatomy resources within the school are limited.	Medicine (4)	0.000
16. I have problems learning anatomy because the teaching styles do not suit me.	Medicine (4)	0.000
13. I find/found the amount of anatomy I need/ed to learn daunting.	Speech (2)	0.000
18. My main motivation for learning anatomy is to pass exams.	Speech (2)	0.007
20. I struggle to build on my anatomy knowledge as I often forget what I learnt last semester/year/s.	Speech (2)	0.005
22. I have problems using my anatomy knowledge because I am not confident in my knowledge base.	Speech (2)	0.000
31. Because of the speciality I am interested in I feel anatomy is not important to me.	Speech (2)	0.027

Table 4. Relationship between approach to learning preference and response to Anatomy Learning Experiences Questionnaire.

Question	Approach to Learning	Kruskal-Wallis p value
1. I find/found reading textbooks an effective way of learning anatomy.	Deep	0.037
13. I find/found the amount of anatomy I need/ed to learn daunting.	Surface	0.000
15. I have problems learning anatomy because I don't see the point to it.	Surface	0.000
16. I have problems learning anatomy because the teaching styles do not suit me.	Surface	0.019
18. My main motivation for learning anatomy is to pass exams.	Surface	0.000
19. I find anatomy learning difficult because it is memorisation based.	Surface	0.000
20. I struggle to build on my anatomy knowledge as I often forget what I learnt last semester/year/s.	Surface	0.000
22. I have problems using my anatomy knowledge because I am not confident in my knowledge base.	Surface	0.001
29. I feel that working with cadaveric material is an important part of becoming a doctor/dentist/health care professional.	Deep	0.000

Table 5. Relationship between gender and response to Anatomy Learning Experiences Questionnaire.

Question	P value	Male or Female Dominant (M/F)
13. I find/found the amount of anatomy I need/ed to learn daunting.	0.031	F
19. I find anatomy learning difficult because it is memorisation based.	0.019	F
20. I struggle to build on my anatomy knowledge as I often forget what I learnt last semester/year/s.	0.034	F
22. I have problems using my anatomy knowledge because I am not confident in my knowledge base.	0.015	F

## Legends

Table 1. Participating Institutions and sample details.

Table 2. Approaches to Learning and percentages relative to course.

Table 3. Relationship between courses and responses to Anatomy Learning Experiences Questionnaire.

Table 4. Relationship between approach to learning preference and response to Anatomy Learning Experiences Questionnaire.

Table 5. Relationship between gender and response to Anatomy Learning Experiences Questionnaire.