RESEARCH REPORT

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Student's perspectives of inclusive practices in anatomy education

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Abstract

There is a drive to implement inclusive practices in anatomy by adapting curricula and utilizing inclusive language and resources that negate biases. However, to date there is no data regarding student's perception of inclusivity. Therefore, the study aims to investigate anatomy student's opinions on inclusive practices in anatomy education based on the protected characteristics of age, disability, ethnicity, gender affirmation and sex. One hundred and forty-five students completed a questionnaire with 21 Likert-scale and two open-ended questions. Kruskal–Wallis tests compared responses by groups defined by the protected characteristics of the Equality Act (2010). Most students (71.2%; $n=84$) agreed or strongly agreed that "improving inclusivity in anatomy education should be educator's priority". In terms of representation, there was a statistically different response rate from students from different ethnic backgrounds to the statements "there are anatomy educators" ($p<0.001$), "images in textbooks" ($p<0.001$) and "models in the dissection room" ($p<0.001$) "that look like me". Most students agreed or strongly agreed to statements relating to the protected characteristics of age (70.4%; $n=68$), disability (78.6%; $n=77$), ethnicity (59.8%; $n=64$), gender affirmation (46.3%; $n=46$) and sex (51.5%; $n=62$). Themes identified relating to improving inclusivity included "reflecting reality", "teaching the truth", "the invisibility of women" and the "learning environment". Students have confirmed that anatomists, as gatekeepers of the knowledge of the human body, should foster inclusive teaching practices that will benefit all students and potentially future patient care.

KEYWORDS
anatomy, diversity, education, equality, inclusion, inclusivity

INTRODUCTION

Everyone has the right to education and thus *inclusive education* is an essential part of an equitable and just society. Inclusive education aims to ensure that learners, regardless of individual characteristics, can learn together without discrimination and receive equal opportunities. Inclusive educational practices anticipate the diverse needs of learners; improve student retention and attrition; and ensure that all students achieve their personal, economic, and social outcomes as graduates.[1–3]

The need for inclusive education is of vital and increasing importance, particularly as the student population becomes increasingly

diverse. As the Office for Students, the higher education regulator for England reported, over the decade between 2010–2011 and 2020–2021 the proportion of females entering higher education had risen to 56.5%, while 1.4% had a gender different to that assigned at birth.[4] Over the same period, the proportion of students from Asian, Black and mixed ethnic backgrounds increased to 13.2%, 9.3% and 4.9%, respectively. In addition, the number of full-time students that had declared a disability had risen to 14.8%.[4] While the increasing diversity of the student population should be celebrated, persistent gaps remain in the experiences and outcomes for these student groups. These gaps have the potential to negatively impact attainment and subsequent levels of employment.[5] For instance, in the United Kingdom (UK), the General Medical Council (GMC) reports that graduates of Black/Black British heritage have lower pass rates in specialty exams (62%) than White (79%), Asian (68%) and mixed heritage trainees (74%), and fewer Black/Black British (75%) trainees receive an offer when applying to specialty training than White trainees (82%).[6] The increasing diversification of the student population has meant that higher education institutions (HEIs) must respond by developing inclusive environments and designing inclusive curriculums.[7,8]

These responses are driven further by legal frameworks of inclusivity. In the United Kingdom (UK) for instance, nine "protected characteristics" i.e., age, disability, gender reassignment, marriage and civil partnership, race, religion and belief, sex, sexual orientation, pregnancy, and maternity are protected by the Equality Act.[9] The Act requires HEIs (and other organizations) to ensure equitable experience for staff, students, and visitors without discrimination or disadvantage on the grounds of these protected characteristics.[10] However, it is recognized that there are limitations in legislative language used to describe particular characteristics and there is thus a need for more inclusive terms to replace the current limited terminology. For instances, the term "gender affirmation" could be used instead of "gender reassignment" as it emphasizes the process of aligning one's gender with their identity rather than focusing solely on medical or surgical aspects.[11] In addition, the terms "ethnicity" or "cultural background" could be considered instead of "race".[12] This is because race is a social construct and using terms that emphasize our common humanity rather than perceived differences is much more inclusive.[11–13]

For anatomy educators many protected characteristics relate directly to the human body (i.e., anatomy) and could be addressed during anatomy classes to improve inclusive practices. Tordoff et al.[14] argue that implementing inclusive language that is "respectful, deliberate and scaled to one's needs" throughout anatomical learning can have a positive impact across psychological, medical, and social situations. This is one of many examples of inclusive educational practices in anatomy education that have been described (Table 1).

More broadly in anatomical education, there is a lack of visual ethnicity, age, body type, sex, and gender diversity in most anatomical textbooks.[20–23] The lack of visual exposure to diversity during medical education can result in implicit bias, impacting clinician's attitudes and behaviors towards patients, especially women and historically underrepresented groups.[17,24–27] Unfortunately, such bias can result in health disparities and altered outcomes for patients

TABLE 1 Suggestions of inclusive practices for anatomy educators within the literature.

Suggestions of inclusive practice	References
Incorporate sexual minority (LGBTQAI+) considerations	[15–17]
Incorporate gender-neutral considerations	[16]
Explain the difference between sex and gender	[15,16,18,19]
Define sex beyond the male/female binary	[15,17–19]
Use inclusive language	[14,16,18]
Improve the diversity of resources in relation to ethnicity, age, body type, gender and sex	[7,15,20–23]
Discuss ethical and religious beliefs about body donation	[15]
Acknowledge the uncomfortable history of anatomy and body dissection	[24]
Awareness of the hidden curriculum	[7]

based on socioeconomic status of ethnicity, religion, gender, disability, location, and age.[28] As such, addressing implicit bias in medical curriculums and providing an awareness of inequalities is imperative in healthcare education, as it can positively impact a current student/future clinician's approach to treatment and care.[28–30]

Despite the awareness of the importance of inclusive practice and education in anatomy, there is nothing in the literature regarding student's perceptions and how these might impact future practice. It is clear that the "student voice" does offer invaluable and insightful contributions to inclusive curriculum development that can empower and engage students.[31–34] This study, therefore, aimed to contribute to fill the gap in knowledge relating to student perspectives on inclusive practice in anatomy education.

METHODS

Context and inclusion criteria

A convenience sample of undergraduate and postgraduate students who were learning anatomy as part of their degree program at St George's, University of London participated in the study. This included students from medicine (year 1–6), biomedical science (year 1–3) and allied healthcare subjects (year 1). At the time, anatomy was taught through a hybrid modality, with asynchronous lectures and synchronous in-person, hands-on-practical sessions. The resources utilized to teach anatomy included plastinated and potted specimens, plastic, and three-dimensional digital models with cadaveric and medical imagery.

Survey instrument

An online survey was designed using Qualtrics survey software (Appendix). The survey consisted of two main sections. The first

section related to university enrolment and demographic information. The second section contained 21 Likert-scale items (enabling students to select one response from "strongly disagree", "disagree", "neither disagree/agree" (i.e., neutral), "agree" or "strongly disagree") and two open-ended questions regarding student's perceptions of inclusive practices in anatomy education. The 21 Likert-scale items were written based on suggestions of inclusive practices on inclusivity from the literature as described in the introduction (Table 1).

The Likert-scale items were organized into six groups; the first related to overall opinions of inclusivity in anatomy education, and the subsequent groups related to the UK's protected characteristics of age, disability, race, gender reassignment, and sex in relation to anatomical education (Table 2). The definitions of these five characteristics, as per the Equality Act[9], were provided within the survey. The authors recognized that some of the some of the terms and definitions referenced in the Equality Act[9] are no longer considered inclusive. Therefore, an objective decision was made to refer to the category of "race" as "ethnicity", and "gender reassignment" as "gender affirmation" (Table 2).

Participants were able to skip questions if they did not want to disclose the requested information. Therefore, the questions have varying response rates. This survey was pilot tested with 10 students, prior to dissemination.

Data analysis

As the survey contained Likert-scale and open-ended questions it allowed for a mixed-methods approach to data analysis to account for the limitations and potential biases in the research process. Indeed, a post-positive and constructive approach to quantitative and qualitative data analysis, respectively, recognizes that complete objectivity cannot be obtained due to the authors (GL, PB, GF) assumptions and biases and that the context in which the data was collected can influence the results.

Statistical analysis

Frequency distributions and statistical analysis of the data were performed using the Statistical Package for Social Sciences (SPSS) for Windows, version 22 (IBM Corp., Armonk, NY). Survey items were assessed with Cronbach's alpha for internal consistency, reliability, and validity. Cronbach's alpha showed acceptable reliability of the questionnaire (0.79).

For responses to the first groups of statements, i.e., students' overall opinions on inclusivity and representation, Kruskal–Wallis tests, with pairwise comparison post-hoc tests, were performed to compare the responses from protected groups of people as defined

TABLE 2 Likert items in the survey and the statistical analysis performed.

Likert-scale group	Statements related to students' opinions of protected characteristic	Definition of protected characteristic as defined by the Equality Act[9]	No. of Likert items	Statistical analysis performed to compare the responses from protected groups
1	Inclusivity in anatomy education	n.a.	6	Age; disability; ethnicity; gender reassignment; sexuality
2	Age in anatomy education	A person belonging to a particular age (for example 32-year-olds) or range of ages (for example 18- to 30-year-olds)	3	Age
3	Disability in anatomy education	A person has a disability if she or he has a physical or mental impairment which has a substantial and long-term adverse effect on that person's ability to carry out normal day-to-day activities	2	Disability
4	Ethnicity[a] in anatomy education	Refers to the protected characteristic of race. It refers to a group of people defined by their race, color, and nationality (including citizenship) ethnic or national origins	3	Race
5	Gender-affirmation[b] in anatomy education	The process of transitioning from one sex to another	3	Gender; sexuality; gender affirmation
6	Sex in anatomy education	A man or a woman[c]	4	Gender; sexuality; gender affirmation

Note: 15 Likert-items were collated into six groups (Group 1: Inclusivity in anatomy education; Group 2: Age in anatomy education; Group 3: Disability in anatomy education; Group 4: Ethnicity in anatomy education; Group 5: Gender affirming in anatomy education; and Group 6: Sex education in anatomy education).

Abbreviation: n.a., nonapplicable.

[a]Term objectively amended from "race".

[b]Term objectively amended from "gender reassignment".

[c]Definition is no longer considered inclusive as intersex are omitted.

by the characteristics of the Equality Act[9] (i.e., age, disability, ethnicity, gender affirmation, sex).

Further Kruskal–Wallis tests with pairwise comparison post-hoc tests were performed to compare the responses from protected groups of people, as defined by the Equality Act[9], to the subsequent groups of statements related the five selected protected characteristics of age, disability, ethnicity, gender affirmation and sex in anatomy education (Table 1). Due to the number of tests, only statistically different ($p < 0.05$) results are reported.

Thematic analysis

A reflexive thematic analysis, as described by Braun and Clarke[35], was utilized by all authors to analyze free-text responses. This included six stages of analysis (GL); familiarization (GL), data coding (GL), theme generation (GL, GF, PB), theme reviewing and development (GL, GF, PB), theme refining (GL, GF, PB), defining and name (GL, GF, PB), and finally writing the results (GL).

Due to the reflective nature of constructive thematic analyses, it is imperative to understand the researchers' backgrounds. GL is a White cis female with a passion to improve inclusive practices in anatomy education. Her former research focused on breaking through taboos and understanding the anatomy of external genitals and the lack of representation within anatomy textbooks. GF is also a White cis female who has taught anatomy and anatomy pedagogy. She has a research focus on inclusive education, anatomy pedagogy, gender discrimination, feminist theory, and Equality, Diversity and Inclusion (EDI). PB is a black cis male has previous institutional strategy and reform as "diversity champion" and "academic lead for widening participation in medical education".

The research team engaged in reflexive practice throughout the research, discussing their biases, assumptions, presuppositions, and positionality.

RESULTS

Details of university enrolment

Approximately 800 students were invited to participate in this study as they met the inclusion criteria. Of those, 145 completed the survey (18.1% response rate). The majority were medical students ($n = 105$; 72.4%) and 30 (20.7%) were biomedical students. Five (3.5%) were enrolled on an allied healthcare course and five (3.5%) students did not disclose. Of the 145 students that participated, the majority were undergraduate students ($n = 134$; 92.4%) and only four (2.8%) were postgraduate students. Seven (4.8%) did not disclose. Just over half of students were in the first year of their studies ($n = 74$; 51.0%) and over a quarter were in their third year ($n = 43$; 29.0%). Twelve (8.3%) students were in second year, seven (4.8%) were in fourth year, three (2.1%) were in fifth year and one (0.7%) was in their sixth year of study. Six (4.1%) students did not disclose their year of study (Figure 1 and Table A1).

Age groups

Most students were aged between 20 and 24 years old ($n = 78$; 53.8%). Thirty-six (24.8%) students were younger than 19 years old, 14 (9.7%) were aged between 25 and 29 years-old, two (1.4%) were aged between 30 and 34 years-old and one (0.7%) was aged between
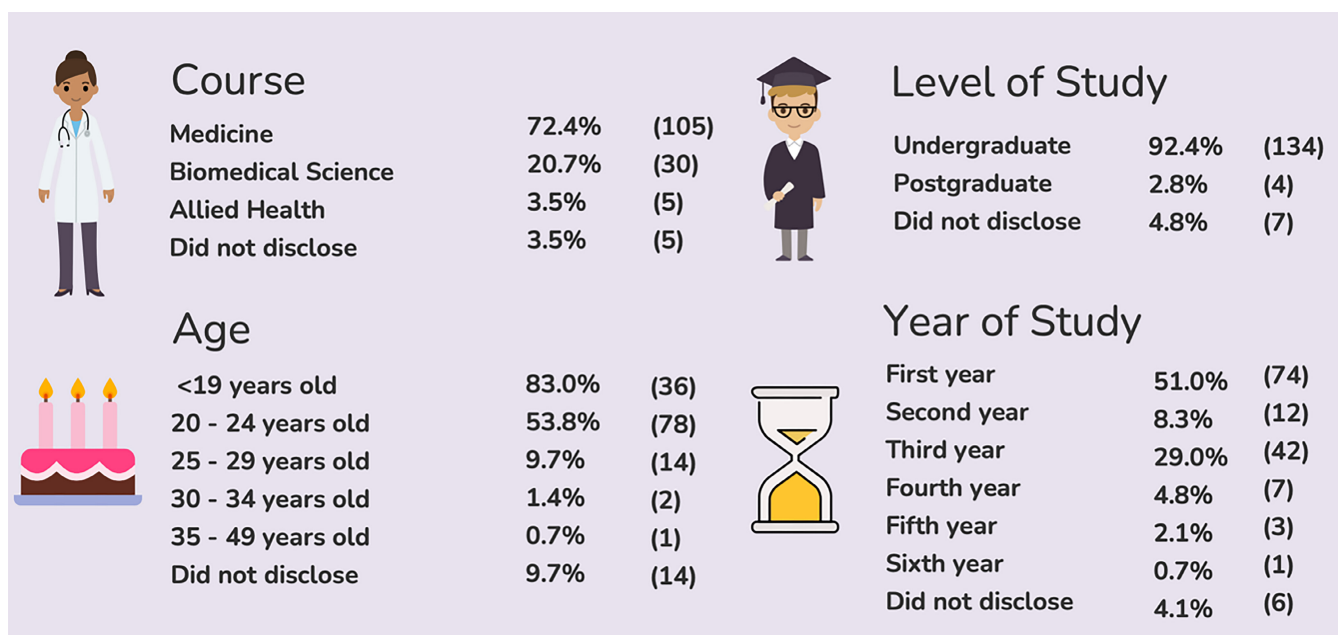

Course		
Medicine	72.4%	(105)
Biomedical Science	20.7%	(30)
Allied Health	3.5%	(5)
Did not disclose	3.5%	(5)

Age		
<19 years old	83.0%	(36)
20 - 24 years old	53.8%	(78)
25 - 29 years old	9.7%	(14)
30 - 34 years old	1.4%	(2)
35 - 49 years old	0.7%	(1)
Did not disclose	9.7%	(14)

Level of Study		
Undergraduate	92.4%	(134)
Postgraduate	2.8%	(4)
Did not disclose	4.8%	(7)

Year of Study		
First year	51.0%	(74)
Second year	8.3%	(12)
Third year	29.0%	(42)
Fourth year	4.8%	(7)
Fifth year	2.1%	(3)
Sixth year	0.7%	(1)
Did not disclose	4.1%	(6)

FIGURE 1 Demographic information of participating students.

35 and 49 years old. Fourteen (9.7%) students did not disclose their age (Figure 1 and Table A2).

Gender identities of participating students

Most participants identified as female (n = 88; 60.7%), with 40 (27.6%) participants identified as male, two (1.4%) students identified as nonbinary and one (0.7%) identified as genderfluid. Fourteen (9.7%) students did not disclose their gender identity. Nonbinary and gender fluid students were grouped to allow for statistical comparison. Seventeen (11.7%) participants stated that their gender identity was different from that of birth (Figure 2 and Table A2).

Sexual orientation of participating students

The majority of students identified as heterosexual (n = 103; 71.0%) and 18 (12.4%) students identified as a sexual minority (LGBTQIA+). Twenty-four (16.6%) did not disclose their sexual orientation (Figure 1 and Table A2).

Disabilities of participating students

The majority of students stated that they did not have a disability (n = 108; 74.5%), whereas 22 (15.2%) disclosed a disability (Figure 1).

Six (27.3%) of these respondents stated that they had more than one disability. Fifteen (10.3%) participants did not respond to this question.
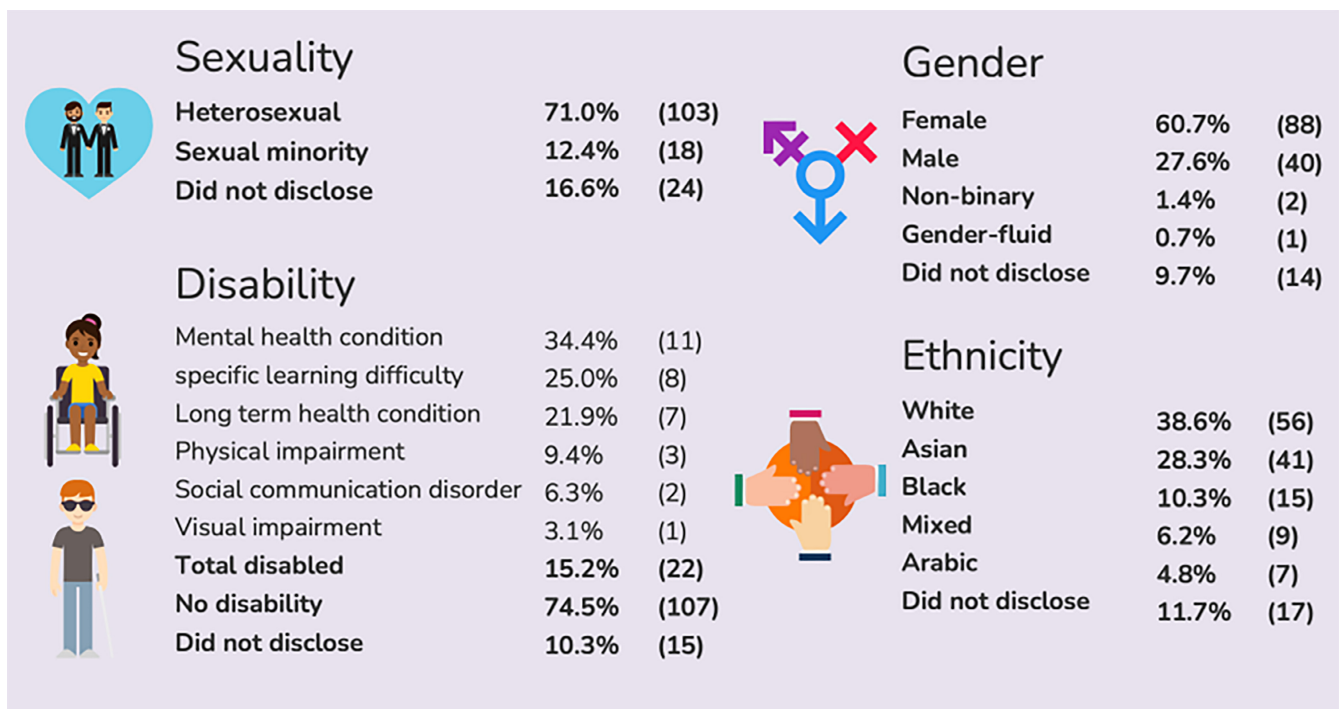
In total, 11 (34.4%) students reported a mental health condition, eight (25.0%) reported a specific learning difficulty, seven (21.9%) suffered from a long-standing illness or health condition, three (9.4%) had a physical impairment or mobility issue. Two (6.3%) stated they had a social communication/autistic spectrum disorder and one (3.1%) had a visual impairment (Table 3).

Ethnicity of participating students

The majority of the students identified as White (n = 56; 38.6%), 41 (28.3) identified as Asian, 15 (10.3) identified as Black, nine (6.2) were from a mixed ethnic group and 17 (11.7) did not disclose (Table 4).

TABLE 3 Details of the disabilities of participating students.

Disability	n	%
Mental health condition	11	34.4
Specific learning difficulty	8	25.0
Long-term health condition	7	21.9
Physical impairment/Mobility condition	3	9.4
Social communication/Autistic spectrum disorder	2	6.3
Visual impairment	1	3.1

Sexuality
Heterosexual	71.0%	(103)
Sexual minority	12.4%	(18)
Did not disclose	16.6%	(24)

Disability
Mental health condition	34.4%	(11)
specific learning difficulty	25.0%	(8)
Long term health condition	21.9%	(7)
Physical impairment	9.4%	(3)
Social communication disorder	6.3%	(2)
Visual impairment	3.1%	(1)
Total disabled	15.2%	(22)
No disability	74.5%	(107)
Did not disclose	10.3%	(15)

Gender
Female	60.7%	(88)
Male	27.6%	(40)
Non-binary	1.4%	(2)
Gender-fluid	0.7%	(1)
Did not disclose	9.7%	(14)

Ethnicity
White	38.6%	(56)
Asian	28.3%	(41)
Black	10.3%	(15)
Mixed	6.2%	(9)
Arabic	4.8%	(7)
Did not disclose	11.7%	(17)

FIGURE 2 Protected characteristics of participating students.

Likert responses to statements related to overall opinions on inclusivity

A large majority of students agreed or strongly agreed that "improving inclusivity in anatomy education should be educators' priority" (71.2%; $n=84$) (Figure 3). When analyzing the responses to this statement by gender there was a statistical difference in responses [χ^2 (2, $N=118$) $=9.154$, $p=0.010$]. Pairwise post-hoc tests demonstrated that there was a statistical difference in the responses between female and male students ($p=0.046$), female and genderfluid/nonbinary students ($p=0.046$), and between male and genderfluid/nonbinary students ($p=0.007$) (Tables 4 and A3).

Just under half (47.5%; $n=59$) of all students agreed or strongly agreed with the statement "I feel the anatomy curriculum is inclusive of all backgrounds" (Figure 3). When analyzing the responses to this statement by gender, a Kruskal–Wallis test demonstrated that there was a statistical difference in responses [χ^2 (2, $N=125$) $=6.430$, $p=0.040$]. Pairwise post-hoc tests demonstrated that there was a statistical difference in the responses between female students and genderfluid/nonbinary students ($p=0.021$), and between male students and genderfluid/nonbinary students ($p=0.011$) (Tables 4 and A3).

Regarding questions related to representation, just over half (53.2%; $n=67$) agreed or strongly agreed that "anatomy educators looked like them", and just over a third strongly agreed or agreed that "anatomical models in textbooks (38.9%; $n=49$) and "in the dissecting room" (33.9%; $n=42$) looked like them" (Figure 3). When analyzing the responses to these statements by ethnicity, a Kruskal–Wallis test demonstrated that there was a statistical difference in responses to the respective statements that educators, [χ^2 (4, $N=121$) $=37.831$, $p<0.001$], images in textbooks [χ^2 (4, $N=121$) $=31.058$, $p<0.001$] and models in dissecting room, [χ^2 (4, $N=119$) $=24.115$, $p<0.001$] (Tables 5 and A3) looked like them (Tables 5 and A3).

Overall Likert-scale responses to questions relating to protected characteristics

When analyzing all the responses from students to the Likert items related to the protected characteristics of age, disability, ethnicity, gender affirmation and sex within anatomy education, the majority (59.5%) of students agreed or strongly agreed to the statements, nearly a quarter (24.9%) remained neutral, only 15.6% disagreed or strongly disagreed to the statements (Figure 4). There was only one statement, ("anatomical differences between races should not be discussed in anatomy class") where the majority of students (63.1%) disagreed or strongly disagreed.

TABLE 4 Ethnicity of participating students.

Ethnicity/Background	n	%	n	%
White			Total White	
White—English/Welsh/Scottish/Northern Irish/British	42	29.0	56	38.6
White—Irish	3	2.1		
Any other White background	11	7.6		
Asian			Total Asian	
Indian or Indian British	12	8.3	41	28.3
Pakistani or Pakistani British	9	6.2		
Bangladeshi or Bangladeshi British	0	0.0		
Chinese or Chinese British	6	4.1		
Any other Asian background	14	9.7		
Black			Total Black	
African or African British	11	7.6	15	10.3
Caribbean or Caribbean British	2	1.4		
Any other Black/African/Caribbean background	2	1.4		
Mixed/Multiple			Total Mixed/Multiple	
White and Black Caribbean	0	0.0	9	6.2
White and Black African	4	2.8		
White and Asian	4	2.8		
Any other Mixed/Multiple ethnic background	1	0.7		
Arabic			Total Arabic	
Arab or Arab British	7	4.8	7	4.8
			Total did not disclose	
Did not disclose	17	11.7	17	11.7
Total	145	100	145	100
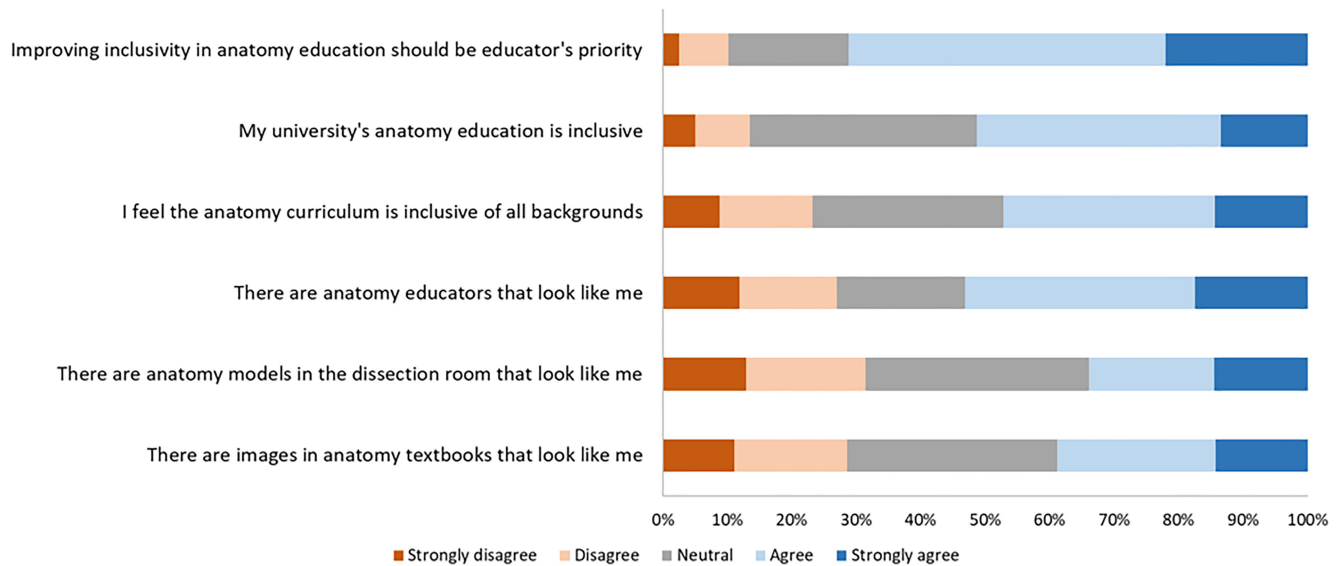
FIGURE 3 Responses to Likert-scale items relating to student's overall opinions of inclusivity in anatomy education.

TABLE 5 Statements related to overall opinions on inclusivity where there was a statistically different response within the protected groups of students.

Statement related to overall opinion of inclusivity	Protected characteristic	p Value	Pairwise comparison	p Value
Improving inclusivity in anatomy education should be educator's priority	Gender	0.010	Female—Male	0.046
			Female—Genderfluid/nonbinary	0.046
			Male—Genderfluid/nonbinary	0.007
I feel the anatomy curriculum is inclusive of all backgrounds	Gender	0.040	Genderfluid/nonbinary—Female	0.021
			Genderfluid/nonbinary—Male	0.011
There are anatomy educators that look like me	Ethnicity	<0.001	Black—Asian	0.043
			Black—White	<0.001
			Mixed—White	<0.001
			Asian—White	<0.001
			Arabic—Asian	0.047
There are anatomy images in textbooks that look like me	Ethnicity	<0.001	Black—White	<0.001
			Mixed—White	0.008
			Asian—White	<0.001
			Arabic—White	0.050
There are anatomy models in the dissection room that look like me	Ethnicity	<0.001	Black—White	<0.001
			Mixed—White	0.006
			Asian—White	<0.001
	Sexuality	0.046	Heterosexual—LGBTQAI+	0.045

Protected characteristic of age

The majority (mean = 70.4%; mean n = 68) of students agreed or strongly agreed with the three statements related to the protected characteristic of age. Students agreed or strongly agreed that "the anatomy of development" (84.4%; n = 81) and "aging" (83.5%; n ota = 81) should be taught in anatomy class. In addition, a Kruskal–Wallis test revealed there was no statistical difference

in the responses to these two statements when analyzing by the age-group (Table A4). Conversely, only 43.3% (n = 42) of students agreed or strongly agreed that "geriatric cadavers limit understanding of anatomical differences due to age". Kruskal–Wallis tests revealed that there was a statistical difference [χ^2 (2, N = 96) = 7.210, p = 0.027] between the responses to this statement when analyzing the responses by age group. Pairwise comparison post-hoc tests revealed there was a statistical difference

(p = 0.013) between students aged under 19 years and those aged between 20 and 24 years (Figure 5).
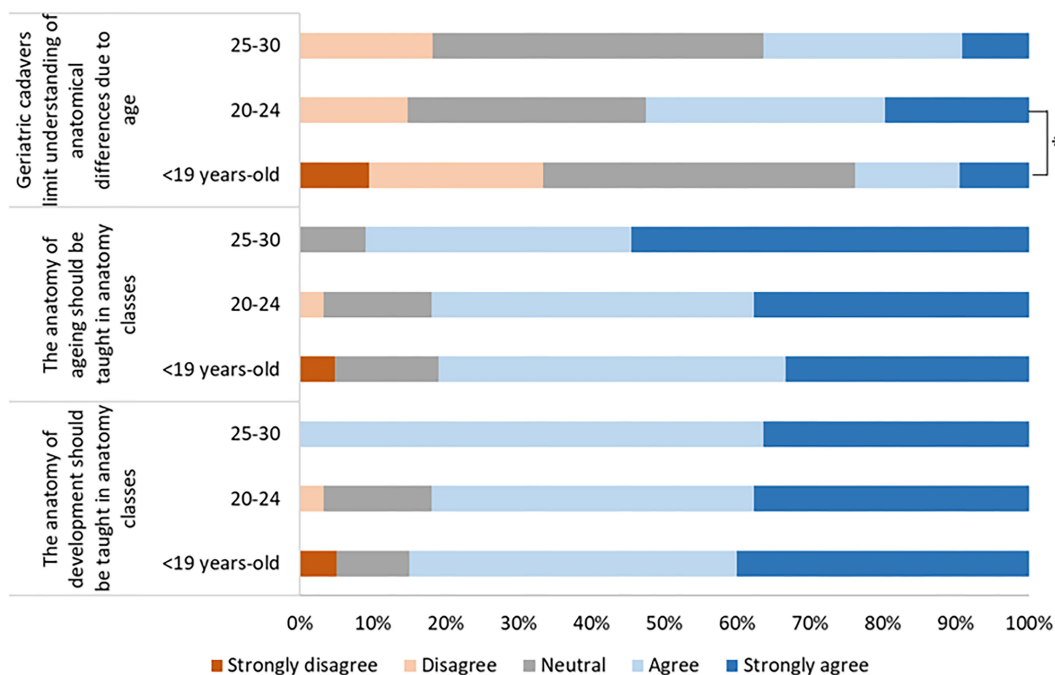
Protected characteristic of disability

The majority (mean = 78.6%; mean n = 77) agreed or strongly agreed with the two statements related to the protected characteristic

of disability. Students agreed or strongly agreed that "how disabilities/impairments affect the body should be taught in anatomy class" (83.7%; n = 82) and that "it is important to include imagery depicting people with disabilities in anatomy classes" (73.5%; n = 72). The Kruskal–Wallis test revealed that there was no statistical difference between the responses to these statements from students who declared a disability and those that did not (Figure 6 and Table A4).
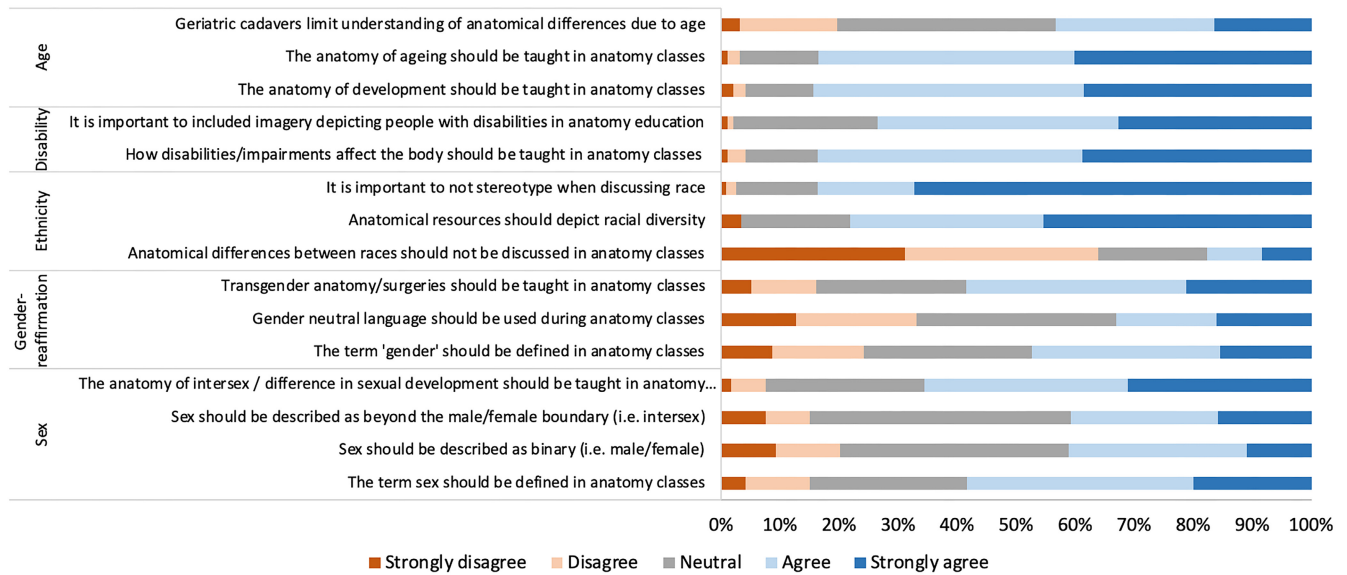
FIGURE 4 The overall responses from students on their opinions of the protected characteristics (age, disability, ethnicity, gender-affirmation and sex) in anatomy education.

FIGURE 5 The responses to statements related to the protected characteristic of age in anatomy education from students of different age groups. *Statistical difference ≤0.05 in responses.
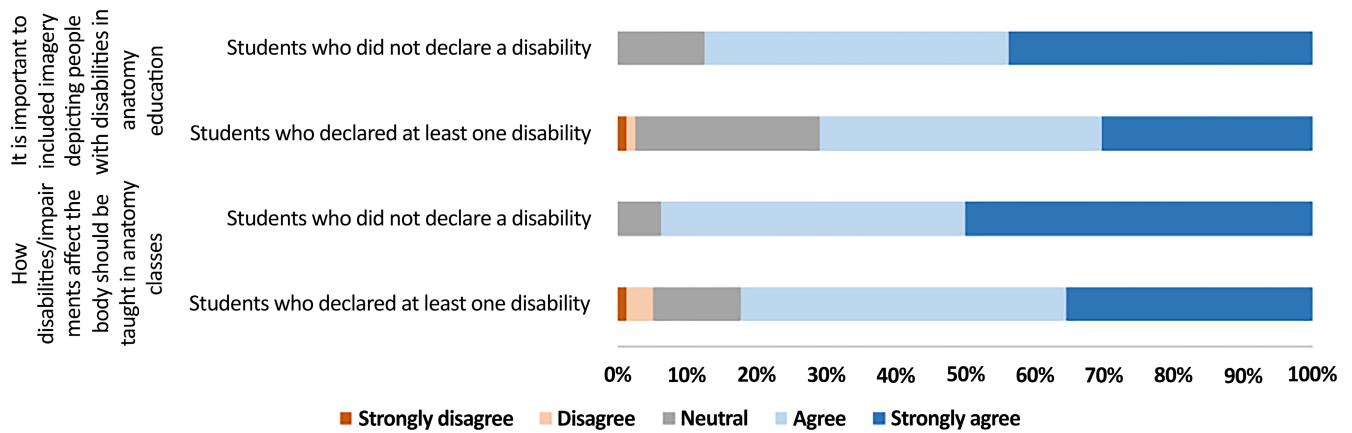
Protected characteristic of ethnicity

The majority (mean = 59.8%; mean n = 64) agreed or strongly agreed with the three statements related to the protected characteristic of ethnicity. The majority of students agreed or strongly agreed that "it is important to not stereotype when discussing race" (83.6%; n = 97) and "anatomical resources should depict racial diversity" (78.2%; n = 93). Conversely, the majority (63.9%; n = 76) of students disagreed or strongly disagreed with the statement "anatomical differences between races should not be discussed in anatomy class".

Kruskal–Wallis tests demonstrated that there was a statistical difference between the responses to the statement "it is important to not stereotype when discussing race" [χ^2 4(N = 111) 9.905, p = 0.042]. A pair-wise comparison post hoc test demonstrated there was a statistical difference between Asian and White students (p = 0.004) in addition to Asian and Black students (p = 0.047) (Figure 7).

Kruskal–Wallis tests demonstrated that there was a statistical difference between the responses to the statement "anatomical resources should depict racial diversity" from different ethnic groups [χ^2 4(N = 114), 15.747, p = 0.003]. A pairwise comparison post-hoc test demonstrated that there was a statistically different response from Arabic and White students (p = 0.044), Asian and White students (p < 0.001), and Asian students and those with a mixed ethnic heritage (p = 0.019) (Figure 7 and Table A4).

FIGURE 6 The responses to statements related to the protected characteristic of disability from students that did not declare a disability and those that declared one or more disability.
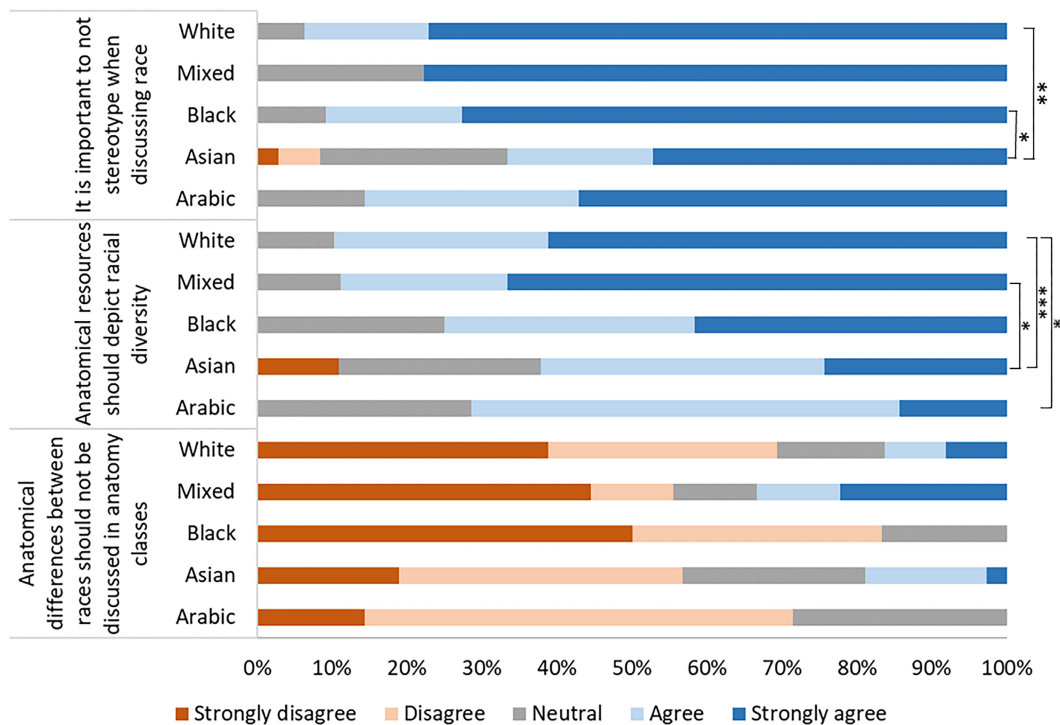
FIGURE 7 The responses to Likert statements related to the protected characteristic of ethnicity from Asian, Arabic, Black, White students, and those with mixed ethnic backgrounds. *p ≤ 0.05; **p ≤ 0.01; and ***p ≤ 0.001.

Protected characteristic of gender affirmation

On average, 46.3% (mean=46) of students agreed or strongly agreed to the three statements relating to the protected characteristic of gender-affirmation. The majority of all students agreed or strongly agreed to the statements "the term gender should be defined in anatomy class" (47.4%; $n=55$) and "transgender anatomy/surgeries should be taught in anatomy classes" (58.5%; $n=69$). For the statement "gender-neutral language should be used during anatomy classes" approximately a third agreed or strongly agreed (33.1%; $n=39$), remained neutral (33.9%; $n=40$), or disagreed or strongly disagreed (33.1%; $n=40$).

When analyzing these statements by sexuality, Kruskal–Wallis tests demonstrated that there was a statistical difference between the responses to the statements "transgender anatomy/surgeries should be taught in anatomy classes" [$\chi^2 1(N=113)$ 12.09, $p<0.001$] and "gender-neutral language should be used during anatomy classes" [$\chi^2 1(N=113)$ 3.955, $p=0.047$] from students who identified as heterosexual and those who identified as a sexual minority (LGBTQIA+) (Figure 8).

When analyzing these statements by gender, Kruskal–Wallis tests demonstrated that there was a statistical difference between the responses to the statements "gender-neutral language should be used during anatomy classes" [$\chi^2 2(N=118)$ 11.985, $p=0.002$]. A post-hoc pairwise comparison test demonstrated there was a statistical difference between males and females ($p=0.034$), males and students who identified as nonbinary or gender fluid ($p=0.001$), in addition to females and students who identified as nonbinary or gender fluid ($p=0.015$). A statistical difference was also demonstrated in the responses to the statement "the term gender should be defined in anatomy class" [$\chi^2 2(N=116)$ 6.747, $p=0.034$]. A post-hoc pairwise comparison test demonstrated that there was a statistically different response from male and female students ($p=0.046$), and from males and students who identified as nonbinary or gender fluid ($p=0.035$) (Figure 9 and Table A4).
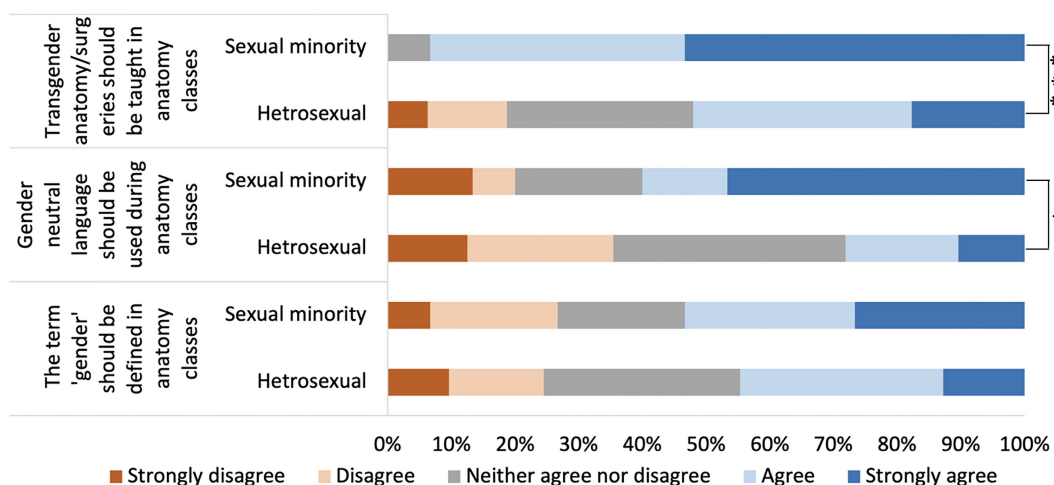
Protected characteristic of sex

The majority (mean 51.5%; mean $n=62$) of students agreed or strongly agreed to the four statements relating to the protected characteristic of sex. The majority of students agreed or strongly agreed that "the anatomy of intersex/difference in sexual development should be taught in class" (65.5%; $n=78$), "the term sex should be defined in anatomy classes" (58.3%; $n=70$) and that "sex should be described as binary" (41.2%; $n=49$). Conversely, the majority neither disagreed nor agreed to the statement that sex should be described beyond the male/female boundary (i.e., intersex)" (44.2%; $n=53$).

Kruskal–Wallis tests demonstrated that there was a statistical difference between the responses to the statements "sex should be described beyond the male/female boundary" [$\chi^2 2(N=120)$ 9.458, $p=0.009$] when analyzing by gender. Pairwise comparison post-hoc tests revealed there was a statistical difference in responses from gender fluid or nonbinary students and male students ($p=0.003$) and female students ($p=0.011$) (Figure 10 and Table A4).

Thematic analysis of long-answer questions

Thirty-five students provided responses to the long-answer question "How do you think the anatomy curriculum at university can become more inclusive?" and thirty responded to the question "What do you think anatomy educators have done to ensure the curriculum is inclusive?". The responses contained similar themes, therefore the responses from both questions have been reported together. The themes identified included "resources reflecting reality"; "invisibility of women in anatomy education"; "teaching the (relevant) truth; and "the learning environment cultivated by educators".

Students suggested that anatomical resources should "reflect reality" by increasing the representation of the diverse global

FIGURE 8 The responses from students for the statements related to the protected characteristic of gender reassignment from sexual minority (LGBTQIA+) and heterosexual students. *$p \leq 0.05$; **$p \leq 0.01$; and ***$p \leq 0.001$.
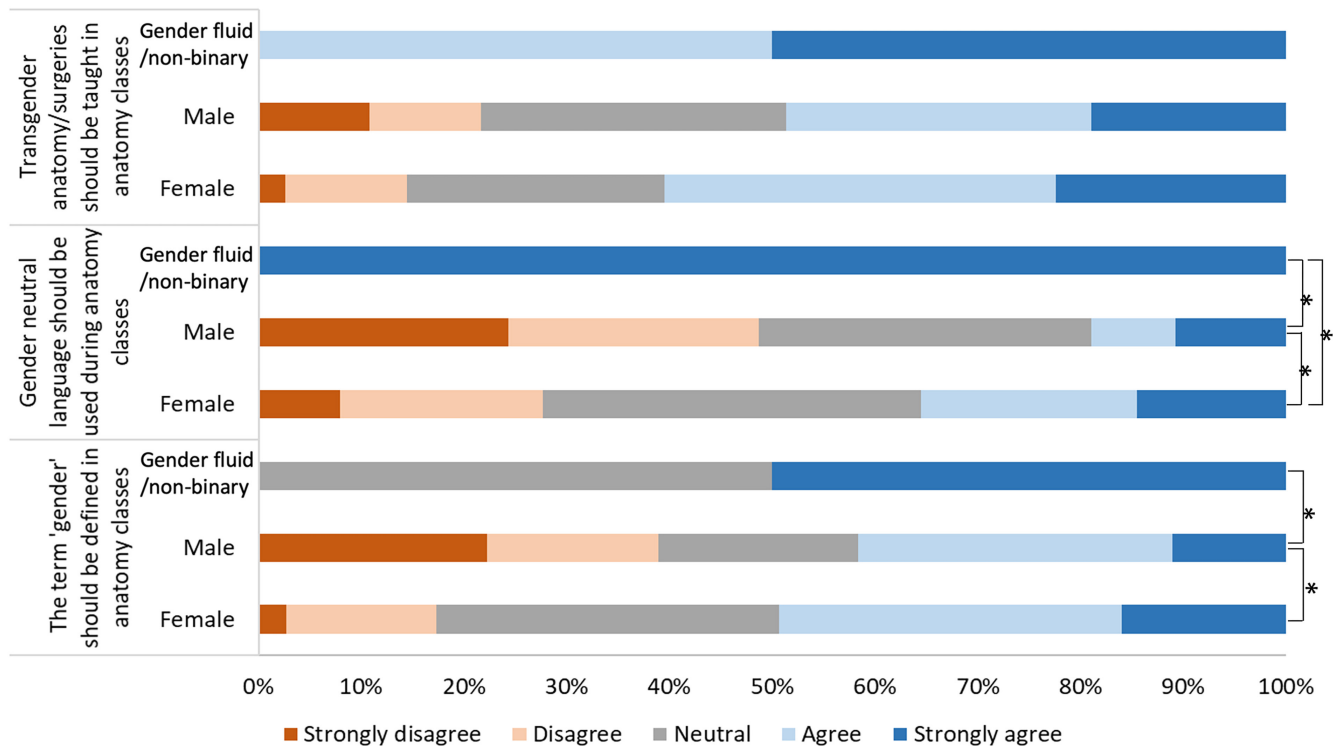
FIGURE 9 The responses from students for the statements related to the protected characteristic of gender reassignment from students of different genders. *$p \leq 0.05$; **$p \leq 0.01$; and ***$p \leq 0.001$.

population within resources. In terms of anatomical models in the dissection room, a valuable suggestion was to:

> Teach anatomy using models that are more representative of the world population i.e., a variety of ages, ethnicities, disabilities, genders, normal anatomical variations.
>
> 20–45-year-old, White, straight, female, with a specific learning difficulty, mental health condition, a long-standing illness or health condition, and a physical impairment or mobility issues. (ID: 35)

Whilst another said using:

> Models which include a diverse range of individuals (e.g., not just White, able bodied) would be incredibly valuable.
>
> 25–29-year-old, White, bisexual/pan sexual, female without a disability. (ID: 09)

Other students commented on the "Whiteness" of donors in the anatomy laboratory. For example, one student suggested that anatomy education should include:

> Cadavers with different types of people not just same old White person.

20–24-year-old, Black, straight, female, without a disability. (ID: 19)

However, another student appreciated that educators did not have the capability to select cadavers based on skin tone, but offered a suggestion on how to alleviate the lack of diverse body donations:

> I don't think it is entirely in [the educators] control as they cannot control who decides to donate their body to science. However, when looking at a cadaver I believe it would be beneficial for demonstrators to describe how the prosections would differ in different types of people.
>
> 20–24-year-old, White, lesbian, female, with a mental health condition. (ID: 26)

A second theme identified was the invisibility of women in anatomy education. Students observed and commented on a male-centric anatomical curriculum. In fact, one student stated:

> We barely spoke about women.
>
> 20–24-year-old, White, lesbian, female, with a mental health condition. (ID: 72)

To address this, another student suggested educators should:
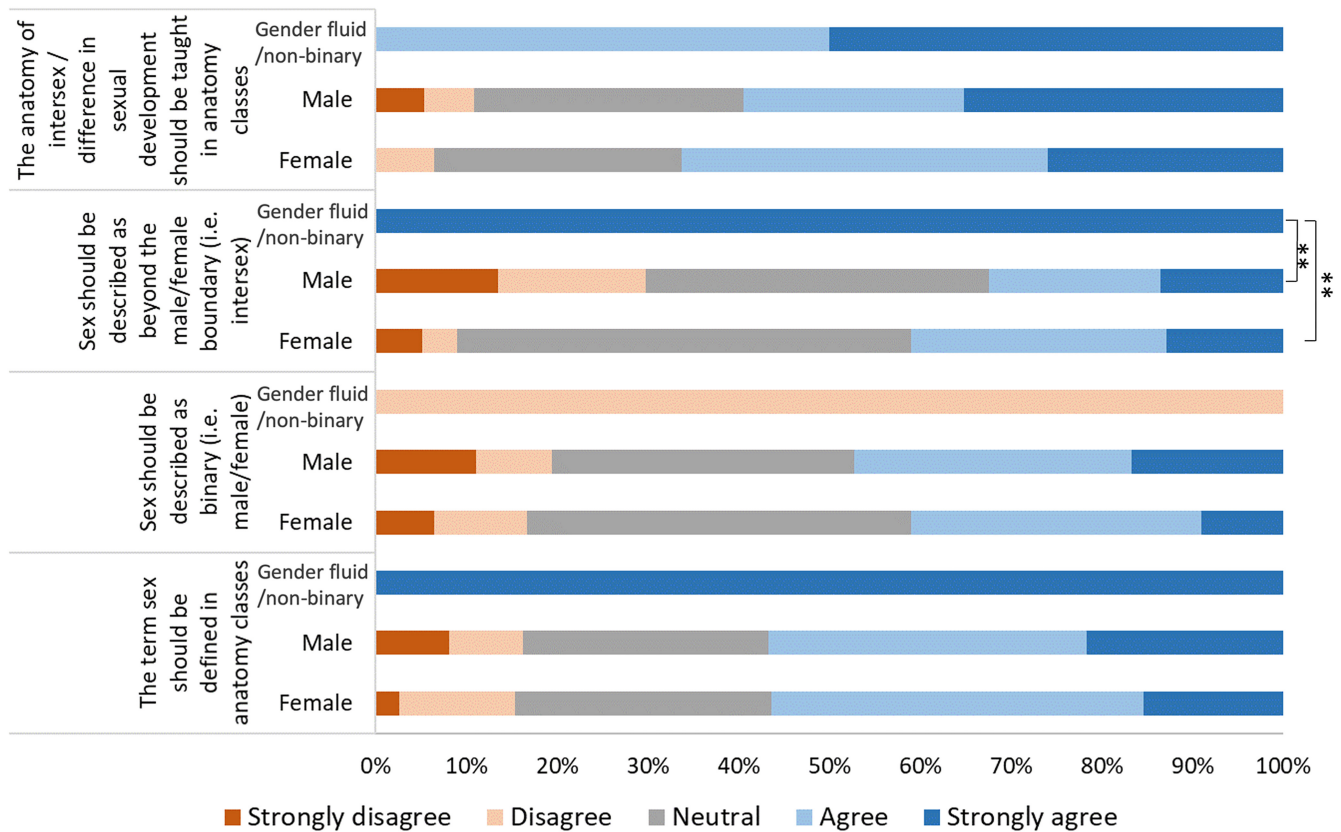
FIGURE 10 The responses from students for the statements related to the protected characteristic of sex from students of different genders. $*p \leq 0.05$; $**p \leq 0.01$; and $***p \leq 0.001$.

Stop making male anatomy the standard with women's bodies simply being compared.

20–24-year-old, White, lesbian, female, with a mental health condition. (ID: 76)

A third theme was related to the "teaching the (relevant) truth". This could be viewed in the context of reviewing and redesigning the curriculum and what is taught during anatomy class. Specifically, students commented on how learning objectives should be rewritten to address inclusivity, as these are what they use to guide them in their learning. Additionally, some students commented on the actual content of the curriculum in relation to differences in race and the anatomy of disabilities.

For example, one student stated:

If definable differences can be observed anatomically in different races, then this should be taught. If there aren't then it's fine. E.g., dermatological differences should be taught, but I doubt that is in the domain of anatomy.

20–24-year-old, Black, straight, female. (ID: 125)

Whilst another said:

More disability understanding: sometimes the term "inequality of life" is used too often rather than simply explaining the consequence of anatomical variants or pathologies.

20–24-year-old, straight, White, female. (ID: 59)

Furthermore, a student stated:

When we are looking…at conditions, differences in development or disabilities (congenital or as a result of illness/trauma) would be helpful from an anatomical perspective.

35–49-year-old, straight, White, female. (ID: 11)

A fourth theme was related to the learning environment cultivated by educators. Students valued the positive attributes of educators and their ability to adapt and foster an inclusive space to learn. For example, students described educators as.

"Friendly",

20–24-year-old Gay, White, male. (ID: 4)

"welcoming",

20–24 years-old, straight, Black, female. (ID: 37)

"approachable",

25–29-year-old, straight, White, female. (ID: 5)

and "diverse".

20–24 years old, straight, White, female. (ID: 59)

and stated educators made:

Appropriate adaptations to students who struggle in anatomy.

20–24-year-old, straight, White, female, with a long-standing illness or health condition. (ID: 71)

It was evident that utilizing appropriate language can help cultivate an inclusive learning environment as one student stated educators should:

Use of gender-inclusive vocabulary and removing cis-normativity from vocab.

<19-year-old, White, nonbinary student. ID: 121

DISCUSSION

At the time of writing, this is the first time the student voice has been heard in relation to inclusive educational practices in anatomy. We have considered, and valued, the opinions of students from diverse backgrounds ensuring that a broad range of perspectives and contexts are considered. We have also observed that many students feel passionately about inclusive education and the lack of diverse representation in anatomy. Furthermore, in this study a large majority (71.2%) of students believe that "improving inclusivity in anatomy education should be a priority of educators" and less than half (47.5%) "feel the anatomy curriculum is inclusive of all backgrounds". In general, these results suggest that inclusivity is a shared value amongst the student population and these perspectives should encourage educators to reflect on their teaching and consider implementing inclusive educational practices. For example, most students agreed that the anatomy of "aging", "intersex" and "gender affirmation surgeries" should be taught in anatomy class. Furthermore, resources used should "reflect the reality of the diverse global population". Moreover, educators should "teach the relevant truth" and "address the invisibility of women within anatomy". In doing so, educators can help to foster a fair, just, and inclusive environment, promoting equality and reducing discrimination and bias.

Previous studies have highlighted the lack of diversity within anatomical textbooks and resources.[20–22,36–40] However, we highlight, for the first time, that students are also conscious of the Euro, male and hetero-centric narrative of bodies, perpetuated by the lack of diversity within anatomical resources. For example, there was a statistical difference in responses to the statements "there are anatomy images in textbooks that look like me" and "there are anatomy models in the dissection room that look like me" between White and Black/Asian/Arabic/Mixed ethnic students, in addition to heterosexual and sexual minority (LGBTQAI+) students. Furthermore, in the thematic analysis, many students discussed the lack of diversity within anatomical resources and suggested that resources should "reflect the reality of the global population". This study, therefore, supports the necessity of diversification of resources. This is imperative moving forward as the lack of representation in medical education has led to implicit bias and healthcare inequalities.[41] For example, racial bias in the United States, it is argued, had resulted in a lower life expectancy for Hispanic and non-Hispanic Black groups compared to non-Hispanic White groups.[42] Similarly, Lyman et al.[43] argue that the higher rate of misdiagnosis of skin rashes on Black skin in England is directly linked to the limited volume of teaching and exposure demonstrating how rashes present in "pigmented" skin.

However, improving racial diversity within anatomy is only the first step in improving inclusivity in anatomy education. In addition, educators must be confident in "teaching the relevant truth" regarding inequality in health and/or living standards as demonstrated in this study. Finn et al.[7] have previously highlighted the importance of providing an environment to discuss race and racism within anatomy classes and ensuring this does not become a taboo. An example of a difficult discussion point is the fact that in the United Kingdom, Black and Asian people are and four and two times, more likely to die during pregnancy or childbirth compared to White people, respectively.[44] This could be linked to historic anatomy education and the false narrative that childbirth was easier, and less painful, for Black people, due to inaccurate assumptions of pelvic morphology in relation to clinical pelvimetry and the Caldwell–Moloy classification system (used to define and classify pelvises). This may have resulted in differences in medical treatment of pregnant people.[45–48]

Our study also highlighted that LGBTQAI+ students feel underrepresented in anatomy classrooms compared to heterosexual students as there was significantly less sexual minority (LGBTQAI+) students who agreed that "there are anatomy models in the dissection room that look like me", compared to heterosexual students. Some educators may argue that sexual orientation does not relate to anatomy,[49] however, in recent review, Smith[40] demonstrates how anatomy has played major roles in sex, gender, and sexual orientation throughout history and argues that and educators have an ethical duty to address the connections of this history, both in research and classrooms. This review demonstrates how anatomy has affected the social organization of human culture and society, and how society has affected anatomical knowledge in return. Educators could use some of the examples within Smith's[40] article to illustrate to students how the queer community has been negatively affected by society's understanding of the human body. In fact, our results clearly demonstrate how genderfluid, nonbinary and sexual minority (LGBTQIA+) students would benefit from improvements to inclusivity in anatomy

education. All but one of these students, agreed that "trans gender anatomy/surgeries should be taught in anatomy class". Breaking down taboos and educating students on gender affirmation surgeries is important as transgender people experience healthcare bias, resulting in decreased psychological health and increased rates of suicide.[50] We observed that all gender fluid and nonbinary students agreed that "the anatomy of intersex/differences in sexual development should be taught" and that "sex should be described beyond the male and female boundary". In doing so, anatomists will support transgender and nonbinary students and may reduce problematic practices such as nonconsensual "normalizing" surgeries.[18,19] Despite these benefits, it is important to note that less than half of male and female students agreed to this binary approach of defining sex. Therefore, these results stress the importance of "teaching the relevant truth" based on science and ensuring a safe space within the anatomy classroom. Moreover, anatomists should refrain from pathologizing or diminishing biological variation and complex human experiences, as this can be destructive for marginalized communities.[51–53]

The thematic analysis also demonstrated that students are concerned about the "invisibility of women within anatomy education". This theme signifies a generation shift in student opinions compared to two studies by Morgan[39] and Moxham and Morgan[54] and colleagues where a majority of students and anatomists were "unaware" of the possible negative aspects of sexism within the culture of anatomy and are "not concerned" about gender imbalance within resources. The majority of the participating students within our study were female (60.7%) and perhaps this is why the "invisibility of women" was identified in the thematic analysis compared to other protected characteristics. However, it is no secret that the male form still represents the majority of models in anatomy textbooks, with female models used only in reproductive/pregnancy-based scenarios.[20,55,56] Lack of representation can result in gender bias, and this is prominent throughout healthcare. For example, a large Danish study illustrated that women were diagnosed later than men in more than 700 diseases.[57]

Limitations of study

As this was a convivence sample, the response rate could be considered low and is limited as the population was taken from only one university. However, when observing the demographics of the population, there is a diverse range of participating students, which reflects the population as a whole. Only one question did not follow the overall pattern of results, which may be a result of the wording of the questions, however the internal consistency of responses is high. In addition, as this study was based in the UK, it grouped participants in relation to the protected characteristics of the Equality Act[9] and due to statistical complexity, they do not consider factors relating to intersectionality. This term was initially coined to describe how race and gender are not mutually exclusive[58] and is the recognition that people do not fall into discrete categories, and that characteristics do not exist independently.[59] Furthermore, the critics of the Equality Act[9] also argue that the definitions are

outdated, hence we used terms such as gender affirmation rather than gender-reassignment in our study. In addition, defining characteristics, such as weight are omitted completely and hence not protected by the Equality Act[9]. While this is the first study to collect qualitative and quantitative data on inclusive practices within anatomy, a cross-institutional and global study would be beneficial for understanding the values of students across the world. In addition, further studies are needed to investigate educator's perceptions of inclusive practices. Interviews and focus groups on inclusivity within anatomy educators would provide a rich source of data to understand this topic further.

CONCLUSION

This study is the first to confirm that students of anatomy value inclusive practices. This mirrors a political trend by many universities and societies who are striving to foster more inclusive environments. For anatomy educators, inclusivity can be achieved by ensuring that resources reflect the reality of the diverse global population. This will ensure that students feel "seen", in addition to negating potential health biases. The former is important as we have demonstrated that Black, Asian, Arabic and students from mixed ethnic backgrounds, in addition to and sexual minority (LGBTQIA+) students do not feel represented within anatomy. Furthermore, educators should create space for authentic and, sometimes, difficult conversations regarding inequality of health care, misconceptions of the body and how this has influenced policy throughout history. These truths may empower students to ensure they can provide high quality health care and ensure that the injustices of healthcare bias do not happen again. Many students agreed that aging, development, disabilities, gender affirmation surgeries, and intersex differences should be discussed within anatomy class and have highlighted the invisibility of women within anatomy. As anatomy educators we should celebrate the body in all its glorious forms and foster a deep culture of respect and appreciation for all.

ETHICS STATEMENT
Ethical approval was granted by St George's, University of London research ethics committee 2022.0151.

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APPENDIX

TABLE A1 Details of participants' university enrolment.

Course	n	%
Medicine	105	72.41
Biomedical science	30	20.69
Allied health	5	3.45
Did not disclose	5	3.45
Level of study		
Undergraduate	134	92.41
Postgraduate	4	2.76
Did not disclose	7	4.83
Year		
First	74	51.03
Second	12	8.28
Third	42	28.97
Fourth	7	4.83
Fifth	3	2.07
Six	1	0.69
Did not disclose	6	4.14

TABLE A2 Gender, sexuality, and the age of participating students.

Gender	n	%
Female	88	60.69
Male	40	27.59
Nonbinary	2	1.38
Gender-fluid	1	0.69
Did not disclose	14	9.66
Gender different to birth		
No	113	11.72
Yes	17	77.93
Did not disclose	15	10.34
Sexuality		
Heterosexual	103	71.03
LGBTQIA+	18	12.41
Did not disclose	24	16.55
Age		
<19	36	24.83
20–24	78	53.79
25–29	14	9.66
30–34	2	1.38
35–49	1	0.69
Did not disclose	14	9.66

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TABLE A3 Statistical comparison of responses from protected groups to Likert-scale items related to student's overall opinions on inclusivity in anatomy education.

Likert item related to overall opinions of inclusivity	Age	Disability	Ethnicity	Gender reassignment	Sexuality
Improving inclusivity in anatomy education should be educator's priority	n.s.	n.s.	n.s.	0.001	n.s.
My university's anatomy education is inclusive	n.s.	n.s.	n.s.	n.s.	n.s.
I feel that the anatomy curriculum is inclusive of all backgrounds	n.s.	n.s.	n.s.	0.04	n.s.
There are anatomy educators that look like me	n.s.	n.s.	<0.001	n.s.	n.s.
There are anatomy models in textbooks that look like me	n.s.	n.s.	<0.001	n.s.	n.s.
There are anatomy models in the dissection room that look like me	n.s.	n.s.	<0.001	n.s.	0.046

TABLE A4 Overall responses of inclusivity survey, grouped by protected characteristic.

	Likert scale statement	Strongly disagree (%) (%)	Disagree (%)	Neither disagree or agree (%)	Agree (%)	Strongly agree (%)	Statistical difference by protected characteristic	Kruskal–Wallis p value	Pairwise comparison	Post-hoc p value
Inclusivity	Improving inclusivity in anatomy education should be educator's priority	2.5 (3)	7.6 (9)	18.6 (22)	49.2 (58)	22.0 (26)	Gender	0.010	Female–Male Female–Other Male–Other	0.046 0.046 0.007
	I feel the anatomy curriculum is inclusive of all backgrounds	8.8 (11)	14.4 (18)	29.6 (37)	32.8 (41)	14.4 (18)	Gender	0.040	Other–Female Other –Male	0.021 0.011
	My university's anatomy education is inclusive	5.0 (6)	8.4 (10)	35.3 (42)	37.8 (45)	13.4 (16)	n.s.	n.s.	n.s.	n.s.
	There are anatomy educators that look like me	11.9 (15)	15.1 (19)	19.8 (25)	35.7 (45)	17.5 (22)	Ethnicity	<0.001	Black–Asian Black–White Mixed–White Asian–White Arabic–Asian	0.043 <0.001 <0.001 <0.001 0.047
	There are anatomy images in textbooks that look like me	11.1 (14)	17.5 (22)	32.5 (41)	24.6 (31)	14.3 (18)	Ethnicity	<0.001	Black–White Mixed–White Asian–White Arabic–White	<0.001 0.008 <0.001 0.050
	There are anatomy models in the dissection room that look like me	12.9 (16)	18.6 (23)	34.7 (43)	19.4 (24)	14.5 (18)	Ethnicity Sexuality	<0.001 0.046	Black–White Mixed–White Asian–White Heterosexual v LGBTQIA+	<0.001 0.006 <0.001 0.046
Age	The anatomy of development should be taught in anatomy classes	2.1 (2)	2.1 (2)	11.5 (11)	45.8 (44)	38.5 (37)	n.s.	n.s.	n.s.	n.s.
	The anatomy of aging should be taught in anatomy classes	1.0 (1)	2.1 (2)	13.4 (13)	43.3 (42)	40.2 (39)	n.s.	n.s.	n.s.	n.s.
	Geriatric cadavers limit understanding of anatomical differences due to age	3.1 (3)	16.5 (16)	37.1 (36)	26.8 (26)	16.5 (16)	age	0.027	<19 years old–20 to 24	0.013

TABLE A4 (Continued)

	Likert scale statement	Strongly disagree (%)	Disagree (%)	Neither disagree or agree (%)	Agree (%)	Strongly agree (%)	Statistical difference by protected characteristic	Kruskal–Wallis p value	Pairwise comparison	Post-hoc p value
Disability	How disabilities/impairments affect the body should be taught in anatomy classes	1.0 (1)	3.1 (3)	12.2 (12)	44.9 (44)	38.8 (38)	n.s.	n.s.	n.s.	n.s.
	It is important to included imagery depicting people with disabilities in anatomy education	1.0 (1)	1.0 (1)	24.5 (24)	40.8 (40)	32.7 (32)	n.s.	n.s.	n.s.	n.s.
Ethnicity	Anatomical differences between races should not be discussed in anatomy classes	31.1 (37)	32.8 (39)	18.5 (22)	9.2 (11)	8.4 (10)	n.s.	n.s.	n.s.	n.s.
	Anatomical resources should depict racial diversity	3.4 (4)	0.0 (0)	18.5 (22)	32.8 (39)	45.4 (54)	Ethnicity	0.003	Arabic–White / Asian–White / Asian–Mixed	0.044 / <0.001 / 0.019
	It is important to not stereotype when discussing race	0.9 (1)	1.7 (2)	13.8 (16)	16.4 (19)	67.2 (78)	Ethnicity	0.042	Asian–White / Asian–Black	0.004 / 0.047
Gender-affirmation	The term "gender" should be defined in anatomy classes	8.6 (10)	15.5 (18)	28.4 (33)	31.9 (37)	15.5 (18)	Gender	0.034	Male–Female / Male–Other	0.046 / 0.035
	Gender neutral language should be used during anatomy classes	12.7 (15)	20.3 (24)	33.9 (40)	16.9 (20)	16.1 (19)	Sexuality / Gender	0.047 / 0.002	Heterosexual–LGBTQIA+ / Male–Female / Male–Other / Female–Other	0.047 / 0.034 / 0.001 / 0.015
	Transgender anatomy/surgeries should be taught in anatomy classes	5.1 (6)	11.0 (13)	25.4 (30)	37.3 (44)	21.2 (25)	Sexuality	<0.001	Heterosexual–LGBTQIA+	<0.001
Sex	The term sex should be defined in anatomy classes	4.2 (5)	10.8 (13)	26.7 (32)	38.3 (46)	20.0 (24)	Gender	0.05	Female–Other / Male–Other	0.015 / 0.027
	Sex should be described as binary (i.e., male/female)	9.2 (11)	10.9 (13)	38.7 (46)	30.3 (36)	10.9 (13)	n.s.	n.s.	n.s.	n.s.
	Sex should be described as beyond the male/female boundary (i.e., intersex)	7.5 (9)	7.5 (9)	44.2 (53)	25.0 (30)	15.8 (19)	Gender	0.009	Female–Other / Male–other	0.011 / 0.003
	The anatomy of intersex/difference in sexual development should be taught in anatomy classes	1.7 (2)	5.9 (7)	26.9 (32)	34.5 (41)	31.1 (37)	n.s.	n.s.	n.s.	n.s.

Abbreviation: n.s., not significant.

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