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Environmental sustainability: the attitudes and experiences of UK students in the oral health care profession

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Key points

A comprehensive multi-centre survey of students in UK oral health professions, including Bachelor of Dental Surgery and dental hygiene and therapy students, was undertaken to provide insight into the current level of environmental sustainability in dentistry education provided to undergraduate students in the UK.

Barriers and drivers are identified by students for their engagement with environmental sustainability in dentistry.

There is a need for further discussions regarding the impact that oral health care provision has on the environment and provides suggestions on how further information about environmental sustainability in dentistry could be shared with students/professionals alike.

Abstract

Objective This study aims to provide insight into the attitudes and perspectives of undergraduate dental students from UK dental schools regarding environmental sustainability in dentistry (ESD) and the manner and extent in which ESD is included in the current undergraduate oral health care curricula.

Methods This study is a multi-centre, nationally representative study involving a cross-sectional online survey of undergraduate Bachelor of Dental Surgery and dental hygiene and therapy students in UK-based dental schools. Data analysis was conducted through descriptive statistics and thematic analysis.

Results In total, 263 students from 13 UK schools completed the survey, resulting in a national school response rate of 68.4%. Key findings are: 97.3% of students believe that the dental profession should be more actively engaged in environmental sustainability but students currently have very little exposure to ESD at an undergraduate level; and 76.8% of students expressed that they are concerned about the impact that oral health care provision has on the environment, but only 23% of students have independently researched ESD.

Conclusions Students identify that oral health care professionals should become more engaged in efforts to mitigate the negative impacts from our activities on the environment, principally via education at all levels. The data from this study provide insight into the current level of awareness and concerns for the environmental impacts of oral health care provision, and are a powerful driver for the inclusion of ESD into the undergraduate curriculum in UK based dental schools.

Introduction

Sustainability in oral health care

The recently published COP26 special report on climate change and health, highlights the impact of health care on the environment,¹ with evidence of how 'health professionals worldwide are already responding to the health harms caused by this unfolding crisis'.² Health care systems are responsible for around 5% of global greenhouse gas

emissions, of which oral health is an important contributor.^{3,4} The delivery of general health care is currently not environmentally, socially or financially sustainable due to high amounts of CO₂e (carbon dioxide equivalent) and waste generated.^{3,4,5,6}

To date, advancements made by the oral health care community have been largely focused on the end goal of preventing and managing oral diseases. We now have an appreciation that these laudable intentions and efforts are having the unintentional consequence of contributing to the global net rise in CO₂e emissions and pollution.⁷

The oral health care profession has a responsibility and vital role in climate change mitigation efforts through comprehensive engagement in sustainable practices. Sustainable oral health care could result in

substantial CO₂e reductions, reduced plastic usage and waste generation, leading to enhanced patient care, staff satisfaction, cost savings and improved quality of life.^{8,9,10}

Sustainability awareness through education

Education is considered as the fundamental component of any remediation strategy, with a focus on increasing awareness and identifying remediation solutions for each sector and for the supply chain as a whole.^{11,12} Effective education programmes should include communication, dissemination and participation at all levels.^{13,14}

There is an increasing understanding of the structure and content of 'sustainability' knowledge required at an undergraduate level.^{5,7,11,12,15,16,17} Essentially, the focus of

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environmental sustainability in oral health care is on the delivery of a good oral health care strategy that considers the four domains: effective preventive care regimes; good operative care; integrated patient care; and professional ownership of care. These domains apply to all aspects of the management of systemic diseases and by targeting them jointly it benefits the patient and society with low environmental impacts.^{18,19} Educational messages should focus on disease-prevention regimes with sustainable oral hygiene practices at home. The Association for Dental Education in Europe (ADEE) has been a key driver to embed environmental sustainability in oral health professional (OHP) curricula at a European level. Two consensus documents have been published from special-interest group meetings at the annual ADEE conference. The first was an initial scoping document to identify a need to embed environmental sustainability and consider key messages to begin teaching this concept.¹⁵ The second is a publication of consensus-agreed specific learning outcomes and recommendations for teaching, learning and assessment for environmental sustainability.²⁰ In addition, the O-Health-Edu vision for OHP education in Europe, published after sector-wide consultation, incorporates environmental sustainability as a key element.²⁰ With educational bodies such as ADEE increasingly publicising its positive views towards the inclusion of environmental sustainability in dentistry (ESD) into the curriculum, there is hope that universities and other governing bodies will follow suit in recognising the impact that dentistry has on the environment and how education is a key strategy to a more sustainable future.²¹ In the formative years of the oral health care undergraduate curriculum, there is an invaluable opportunity to increase awareness and remediation actions through carefully channelled educational programmes.⁷

For any educational approach to be successful, it is essential to obtain and consider the attitudes of students as the recipients and co-managers of their education. Two recently published studies consider this in a UK and USA setting.^{22,23} Both studies had similar aims with regards to assessing the current level of ESD being taught to pre-doctorate/undergraduate students and assessing the students' level of interest and desire for a change in their curriculum.

Joury *et al.* (2021) gathered opinions from both students and educators across two dental schools in the UK and in the USA.²² The study

demonstrated a positive attitude towards the inclusion of ESD into the curriculum, more specifically from students rather than educators. It highlighted the importance of having a 'bottom-up' approach, where end-users help guide policy that is complemented by a 'top-down' approach (paternalistic guidance from key governing organisations), from either the General Dental Council (GDC) or US equivalent, to create a legitimacy to the cause. The study by Gershberg *et al.* (2021) focused on dental students in US-based dental schools only.²³ They found that despite other health professional courses already embedding environmental sustainability in their respective curricula, dental schools have not yet followed suit. Gershberg *et al.* found that students have expressed their concern about the impact that the provision of oral health care has on the environment and found a baseline eagerness for ESD to be included in the curriculum.

Both these studies have provided the foundation to push the ESD agenda into the curriculum in US-based dental schools, by showing that there is a drive from students to have more ESD-based content throughout the course. Nevertheless, further research into the levels of ESD within the dental curriculum is needed to better understand the particular requirements of the students. Students are a key stakeholder of OHP education and as such, the student voice is essential in any intervention to improve education or to integrate new concepts.

This study aims to provide further clarity and focused detail into the students' attitudes and behaviours towards ESD in the provision of oral health care. Also, the manner and extent to which ESD is included (currently and in the future) into the undergraduate oral health care professional curricula. This study focuses on the perspective of undergraduate dental students (Bachelor of Dental Surgery [BDS]) and dental hygiene and therapy students (DH&DT) from UK dental schools, as a national representative case study.

Materials and methods

A multi-centre, cross-sectional online survey of undergraduate BDS and DH&DT students was carried out using an online questionnaire that was distributed to all UK-based dental schools. Ethical approval was obtained from the University of Sheffield's Research Ethics Committee (Application 044529). Consent was gained through a 'participation statement' that prospective participants had

to read and approve before continuing onto the survey questions. Support for this study was obtained from the UK Dental Schools Council.²⁴ Participation requests were sent to the Heads of School of 19 UK dental schools for onward internal distribution among all the undergraduate BDS and DH&DT student cohorts of each respective school. The validity of the questionnaire was tested through two focus groups of students at the authors' institution. The survey consisted of 13 questions that included closed and open questions – Likert scale as well as multiple-choice questions. Likert scales allowed for a wider range of answers to be collected to improve the clarity of the questions and allow for quantification of the data. Multiple-choice questions were used to focus responses into key categories and a free-text section was included to identify barriers that they personally face that hinder them from increasing their understanding of ESD and their ability to apply this knowledge in a clinical environment.

All close-ended questions were analysed through descriptive statistics and the data were presented as graphs or charts using Google Forms auto-generated software. Thematic analysis was used for the single open-ended question as per Braun and Clarke's (2006) six-phase approach and resulted in the development and refinement of themes.²⁵

Results

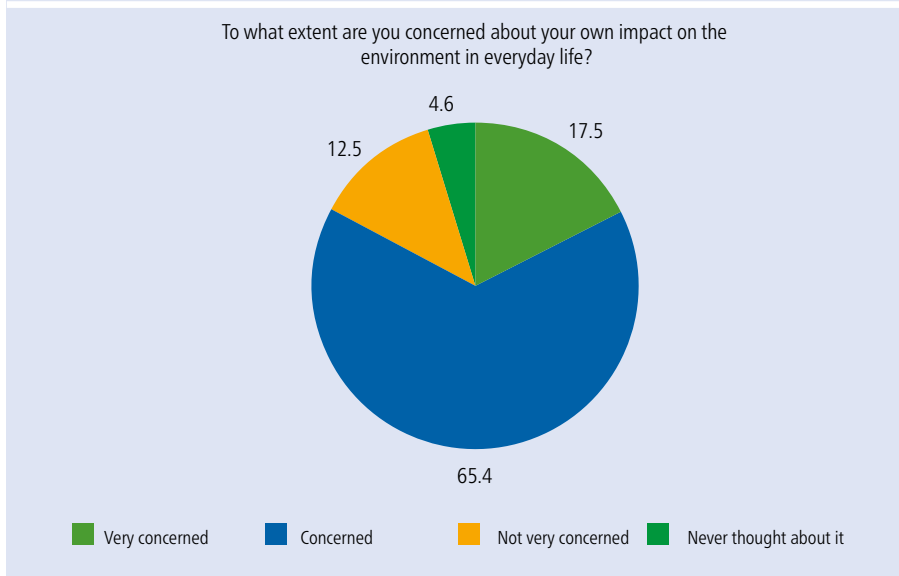
Students from 13 schools completed the survey, resulting in a school response rate of 68.4%, showing a strong representation of this student population across the UK. Six schools did not respond or wish to participate, identifying student survey fatigue and academic burden as a concern.

The student response rate (as a function of the total number of registered undergraduate students) was 24.5%, with a total of 263 students taking part in the survey from across 13 UK-based dental schools.

From the written responses, it is clear that the students had varying degrees of clinical experience dependent on individual levels of progression in their respective courses, with the following key findings as depicted in Figure 1 and Table 1:

- There was no difference in opinions of students at different stages of progression within their own dental school curriculum, all showing equal interest in their profession's environmental impact

Fig. 1 Responses demonstrate the level of concern students express towards environmental sustainability in everyday life



- The level of concern for their own personal environmental impact identified that 77.9% of respondents were concerned, of which 17.5% were very concerned (Fig. 1)
- Despite this apparent level of baseline concern, only 27% of respondents 'always try' to reduce their personal impact on a day-to-day basis, compared to 54% sometimes trying
- A total of 16% of respondents stated that 'I would like to do more but don't know how' (Fig. 2)
- In total, 90% of students have considered the impact that the provision of oral health care has on the environment, with 85.6% believing that it is our responsibility as oral health care workers to provide care in an environmentally sustainable manner
- And 46.4% believe that 'the provision of oral health care is my priority as a clinician and this has unavoidable environmental consequences that we need accept' (Table 2). One student responded that 'environmentally friendly solutions always seem to contradict infection control and therefore cannot be done for patient safety'. Cross-infection control and being in a hospital setting were identified by students as barriers to them engaging with impactful solutions at an undergraduate level.

Regarding students' own level of concern for the effect that the provision of oral health care has on the environment, 76.8% expressed that they are concerned. This was conveyed in the free-answer question, with many students identifying cross-infection control policies and procedures, specifically the use of single-use plastics and personal protective equipment (PPE), as a barrier to them engaging with impactful solutions to make the provision of oral health care more sustainable. A common view among many dental students on this topic was clearly expressed by one particular statement: 'as dental professionals we use a lot of plastic single-use items due to cross infection, but this is very concerning to me and wish there was another way to be more sustainable'.

A further common finding was their perceived lack of power within the hierarchy of a hospital setting and that their 'student voice' lacked any form of influence. This sentiment is captured by the comment 'as a student we just follow the protocols and guidelines set out by staff or the hospital or the trust the hospital is a

Table 1 Understand students' level of concern about the environment

To what extent are you concerned about your own impact on the environment in everyday life?	
Very concerned	46 (17.5%)
Concerned	172 (65.4%)
Not very concerned	33 (12.5%)
Never thought about it	12 (4.6%)
To what extent do you try to reduce the environmental impact of your daily activities?	
I always try	71 (27%)
I sometimes try	142 (54%)
I would like to do more but don't know how	42 (16%)
I don't really try	7 (2.7%)
Not my problem, it is the responsibility of the authorities and government	1 (0.4%)
Have you considered if the provision of oral health care has an impact on the environment?	
Yes	237 (90.1%)
No	26 (9.9%)
With regards to the last question, please read the following carefully and tick all that apply:	
The environmental impact is negligible and can be ignored	3 (1.1%)
Society has bigger environmental problems to worry about that should focus or attention	38 (14.4%)
The provision of oral health care is my priority as a clinician and this has unavoidable environmental consequences that we need accept	122 (46.4%)
As clinical oral health care workers we have enough to worry about; our job is hard enough and sustainability concerns are not part of our job	16 (6.1%)
It is our responsibility, as oral health care workers, to provide care in an environmentally sustainable manner	225 (85.6%)
How concerned are you about the effect of oral health care on the environment?	
Unconcerned	4 (1.5%)
Neither	57 (21.7%)
Concerned	202 (76.8%)

part of. It doesn't feel like we can do anything to change any of it'. A suggestion captured in the responses is to create a mechanism that allows students to have a greater voice with regards to ESD within dental schools. For example, the introduction of sustainability action groups that allows like-minded students and staff to convene and discuss local strategies and action plans to that will make a difference. Sheffield Dental School introduced the Sheffield Oral Sustainability group in 2022; this group has allowed students to partake in local campaigns to promote ESD. Students have expressed that after 'joining a sustainability group, I feel more positive about this and feel like my voice is more heard'.

In total, 23.2% of undergraduate students were neither concerned or unconcerned about the effect of oral health care on the environment. Another barrier identified by students was a lack of care and/or a lack of time. Many students have the view that 'it's hard enough to do the whole course without having the extra worries, I think it should become more of a concern once you are a practising clinician rather than as a student'.

Currently, there is very limited exposure to undergraduate students about the effect that oral health care provision has on the environment, with 51% saying it's only been mentioned briefly through staff members or informal conversations with peers (53.2%) (Table 3). Only 9% of students believe that they have been taught ESD through more formal means such as lectures. However, despite this lack of current emphasis in the curriculum, 97.3% of students believe that the dental profession should be more actively engaged in ESD (Fig. 3).

Current level of student engagement in ESD

Despite a desire for greater education in ESD, students are unlikely to proactively seek information about it, as only 23% of respondents independently researched ESD outside of the undergraduate curriculum, either part of a group or independently (Table 3), with 76.4% admitting to not doing any additional research on the topic. This implies students will only engage with ESD if it is part of the curriculum and not optional or extra-curricular, as students feel they lack the time to research ESD independently, typified by the comment 'the effect we have on the environment is not taught to us and not much time is available to research this'.

Fig. 2 Results identify students' current level of proactivity regarding reducing their personal impact on the environment

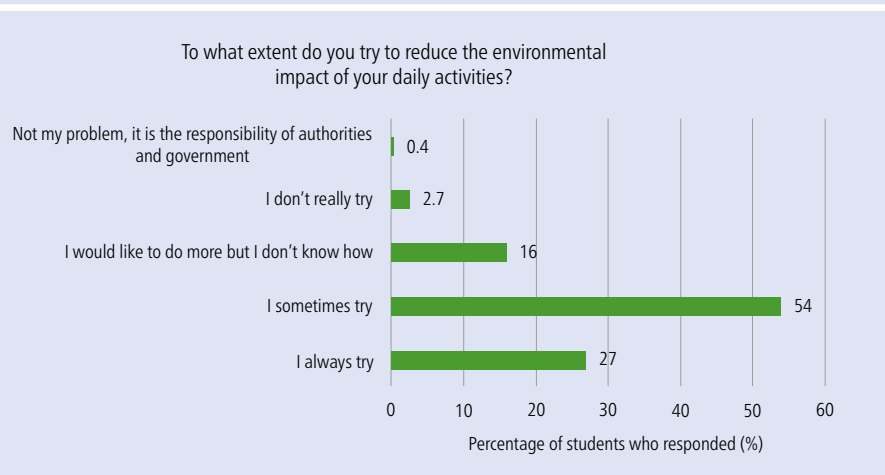


Table 2 Understand students' level of awareness of the impact that oral health care provision has on the environment

Have you considered if the provision of oral health care has an impact on the environment?	
Yes	237 (90.1%)
No	26 (9.9%)
With regards to the last question, please read the following carefully and tick all that apply:	
The environmental impact is negligible and can be ignored	3 (1.1%)
Society has bigger environmental problems to worry about that should focus or attention	38 (14.4%)
The provision of oral health care is my priority as a clinician and this has unavoidable environmental consequences that we need accept	122 (46.4%)
As clinical oral health care workers we have enough to worry about; our job is hard enough and sustainability concerns are not part of our job	16 (6.1%)
It is our responsibility, as oral health care workers, to provide care in an environmentally sustainable manner	225 (85.6%)
How concerned are you about the effect of oral health care on the environment?	
Unconcerned	4 (1.5%)
Neither	57 (21.7%)
Concerned	202 (76.8%)

It is important for us to acknowledge that eco-anxiety is recognised as a true emotional response to the predicted impact of climate change and is defined as 'a chronic fear of environmental doom'.^{26,27,28} One student authenticated this fear leading to an avoidance of the topic by saying 'the environmental impacts of dentistry etc can feel very overwhelming. This is not a feeling which results in productive action'.

Methods for improving engagement with students

Students identified social media (66.4%), professional talks (74.9%) and tutor-led discussions (58.9%) as the best way to increase awareness of the impact that oral

health provision has on the environment (Fig. 4). This, combined with opinions such as 'I think a compulsory attendance tutorial with no extra work could be a good way of delivery the teaching', suggest that students have a preference for information on ESD to be delivered from credible sources, in a manner that does not significantly increase their workload. However, despite expressing interest in attending professional seminars relating to ESD, students face a significant barrier in that the majority of these events are aimed at qualified clinicians and therefore require a UK GDC number to register, something students do not possess.

In total, 97.7% of respondents have said that being taught ESD at an undergraduate

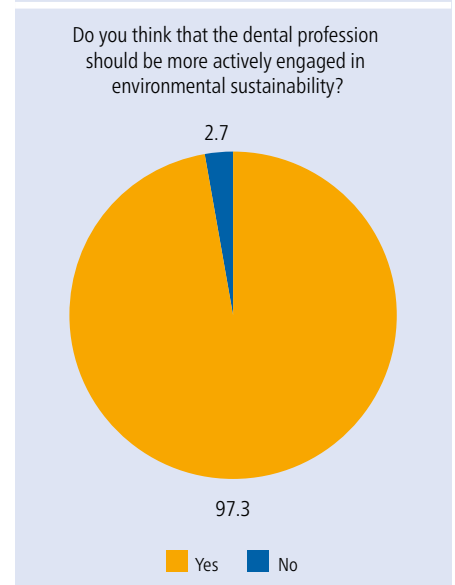
Table 3 Identify if student environmental concern are a driver for inclusion of environmental sustainability in the undergraduate curriculum

Do you think that the dental profession should be more actively engaged in environmental sustainability?	
Yes	256 (97.3%)
No	7 (2.7%)
During your undergraduate degree, have you been exposed to the concept of environmental sustainability? Please tick all that apply:	
Never exposed	62 (23.6%)
Formal lectures	24 (9.1%)
Briefly mentioned by staff members	134 (51%)
Students society talks/activities	46 (17.5%)
Informal conversations between peers/friends	140 (53.2%)
Would you like your undergraduate dental course to include a greater emphasis on environmental sustainability?	
Yes	223 (84.8%)
No	40 (15.2%)
Have you personally or as part of a group, ever taken a pro-active approach to learning about oral health care and its environmental impact?	
Yes	62 (23.6%)
No	201 (76.4%)
How do you think that we can increase awareness of the impact that oral health care provision on the environment within the undergraduate curriculum?	
Through social media	174 (66.2%)
Professional talks	197 (74.9%)
Student led societies	121 (46%)
British Dental Students Association	139 (52.9%)
Tutor facilitated group tutorials	155 (58.9%)
Do you think that increasing our knowledge of environmental sustainability in oral health care will have an impact on our future profession and the environment?	
Huge positive impact	84 (31.9%)
Some positive impact	173 (65.8%)
No impact	6 (2.3%)
Negative impact	0 (0%)

level would have a positive effect on the future impact that dentistry as a profession has on the environment. No participants said that it would have a negative impact and only 2.3% believe that there will be no impact by as a result of the change (Table 3). These results show an overwhelming support for increasing awareness and education surrounding the environmental impact of dentistry, suggesting a very positive student response to the inclusion of ESD into the curriculum.

The GDC recently distributed their Safe Practitioners domains for consideration and commentary, which included two learning outcomes relating to environmental

sustainability, inspired by the ADEE's 2022 conference that specifically discussed sustainability in dental education.²¹ The learning outcomes include: describing the main principles of sustainable oral health care; any challenges or barriers to implementing ESD; and understanding the environmental impact of common treatments. If agreed upon and included, this is a positive first step into the implementation of ESD learning objectives into the UK undergraduate dental curriculum. This also highlights that sustainability is a topic that is going to be a common theme in the provision of oral health care in coming years and something that will impact all practitioners.

Fig. 3 Shows that 97.3% of students believe that the dental profession should be more actively engaged with environmental sustainability

Barriers to engagement – identified by the student community

Seven key themes were identified by students as barriers to engagement in solutions for managing the effects of oral health care on the environment. These are (listed in the order of incidence of responses):

- Hierarchy of a hospital setting (27% of responses)
- Lack of knowledge (23.2%)
- Cross-infection control policy, especially with regard to COVID-19 pandemic (16.4%)
- Lack of time (8.2%)
- Eco-anxiety (6.1%)
- Lack of care (3.7%)
- Limited knowledge base within academic tutors (3.7%).

It should be noted that 2% of respondents did not believe there were any barriers in place and 9.2% did not respond to the question.

The barriers identified confirmed the findings raised throughout the survey. Students identified that their main barrier to becoming more sustainable while at dental school was the hierarchy present within hospital settings and the standard operating procedures and policies put in place by management. This was summarised by one student: 'as students, we do not have as much impact/authority to help create a change...following correct procedure for PPE is a main thing that prevents us from reducing waste'.

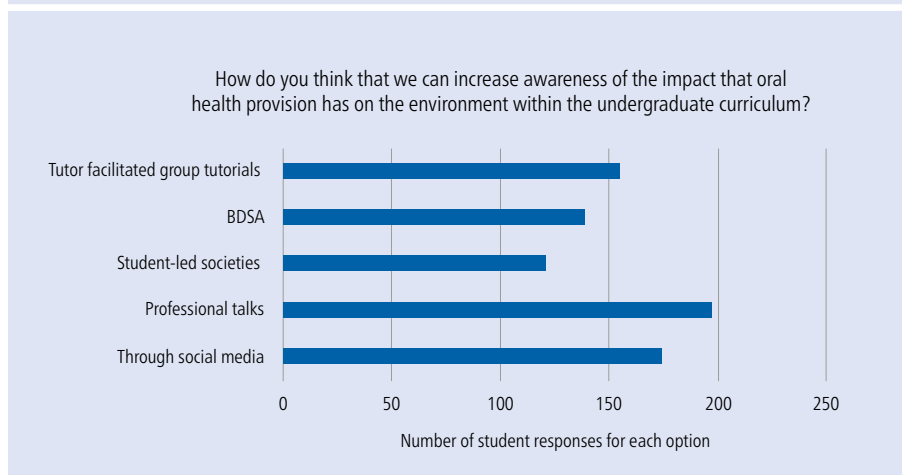
Discussion

This study sought to determine the attitudes and opinions from undergraduate BDS and DH&DT students for the inclusion of ESD into their curricula. The strong student response rate, with a 68% representation from a total of 13 UK dental schools, indicates that this topic is of significant interest and concern to the undergraduate population. As a cohort, current undergraduates have a strong baseline level of concern (65%) with regards to the environment. The 90% of students who considered the impact on the environment that arises from the provision of oral health care is reassuring and shows a wide level of awareness across the cohort, as identified in other sectors^{29,30}. However, this finding is worryingly diluted by the fact that nearly half of the respondents (46.4%) identify that the environmental impact from oral health care provision 'is an unavoidable consequence that we need to accept'.

There is no doubt that students are concerned (77.9% concerned and 17.5% very concerned) about the manner in which their personal activities impact on the environment but this is worryingly dampened by a lack of translation of environmental attitudes to actual behaviour change, identified by a 54% of respondents that identify as 'sometimes try to reduce their personal impact on the environment on a daily basis'. The majority of students appear to have an understanding of how to be more environmentally friendly but do not always see this as significant when it comes to their everyday life. It is therefore important when introducing ESD into the curriculum to impress on students the importance of being environmentally sustainable as often as possible, both personally and professionally. It has been identified that clinicians often find it difficult to transfer their home-based behaviours into a clinical setting due to a shift in mindset from environmental citizenship to professional clinical duties. In order to overcome this issue, it is important for members of the dental team to be open to conversations and education on the topic. Once ESD has become a common topic, steps can be taken to implement real actions into the workplace.¹⁸

Nearly one-quarter of the cohort (23.2%) showed ambivalence towards the effect of oral health care on the environment, identifying that this was a distraction from their studies, creating an additional time and content burden. The majority of students (76.4%)

Fig. 4 Students identified social media, professional talks and tutor-led discussions as the best way to increase awareness of the impact that oral health provision has on the environment



did not engage in any further formative, self-directed learning in ESD outside their curriculum. Students identified a number of reasons for this, highlighting a lack of time, lack of resources, not knowing where to find the correct resources and eco-anxiety. Providing students with the guidance and baseline knowledge of environmental sustainability, with an emphasis on oral health care provision, would empower students to do further research on the topic without feeling lost or overwhelmed. Interestingly and despite their reticence or difficulties to engage as undergraduate students, there was overwhelming support (97.3%) for greater engagement of the (qualified/practising) dental profession in ESD. Despite the overall guarded responses to the inclusion of sustainability in the curricula, students overwhelmingly (97.7%) accepted that such a move would have a positive effect on the future impact that dentistry as a profession has on the environment.

These results highlight the importance of creating clinical guidelines and protocols in dental hospitals with environmental sustainability in mind, as this would provide students with first-hand experience in providing more sustainable oral health care while in education and as a practising professional.

In terms of delivery modalities, a blend of different formats was considered and advocated, with representation from social media, tutor-led discussions and professional guest presentations/webinars. Social media is a powerful tool that can be utilised to disseminate awareness and information relating to ESD in a manageable and effective manner. It has

the potential to make sustainability a more achievable and understandable goal for dental professionals. The FDI World Dental Federation does this through the use of social media (#SustainabilityinDentistry), alongside promoting engagement in their sustainability challenges, which helps to promote more sustainable practice within dental practices.³¹

Overall, the results from this study provide a useful insight into current perspectives from undergraduate BDS and DH&DT students with regards to the topic of ESD in their curricula. Students are concerned about the impact of their (current and future) professional activities on the environment. It is very clear that in order to gain maximum engagement from students, ESD should be integrated into the curriculum. This would increase enthusiasm and engagement, as the inclusion of ESD within the undergraduate curriculum is viewed in a positive light by all students surveyed.

Conclusions

There is a clear recognition that ESD is not consistently taught in the undergraduate curriculum in dental schools across the UK. All respondent students identified the inclusion of ESD within the undergraduate curriculum as a positive development. They also identified that ESD should be included in the student curricula in a seamless and fully integrated manner and in a manner that it does not create a further burden to learning and teaching. Through education on the environmental impact of dentistry, students, as emerging oral health care professionals, will be better informed to practise dentistry in

a more environmentally sustainable manner, for the benefit of their patients and the planet.

Ethics declaration

The authors declare that they have no conflict of interest.

Ethical approval was obtained from the University of Sheffield's Research Ethics Committee (Application 044529). Consent was gained through a 'participation statement' that prospective participants had to read and approve before continuing onto the survey questions.

Data availability

Data supporting this publication can be freely downloaded from the University of Sheffield Research Data Repository at <https://doi.org/10.15131/shef.data.24657627>, under the terms of the Creative Commons Attribution (CC BY) licence.

Author contributions

Conceptualisation: Steven Mulligan and Nicolas Martin. Project design: Steven Mulligan, Nicolas Martin, Olivia Durnall and Jonathan Dixon. Project execution: Olivia Durnall, Steven Mulligan, Jonathan Dixon and Nicolas Martin. Initial writing: Olivia Durnall and Steven Mulligan. Results and interpretation of data: Steven Mulligan, Nicolas Martin, Olivia Durnall and Jonathan Dixon. Final writing and editing: Nicolas Martin, Olivia Durnall and Jonathan Dixon.

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