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Environmental Sustainability in Oral Health Professional Education: Approaches, Challenges, and Drivers—ADEE Special-Interest Group Report

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ABSTRACT

Introduction: This paper reports on the scholarship activity of the 'Sustainability in Dentistry' Special-interest Group (SiG), which met at the Association for Dental Education in Europe (ADEE) annual conference in Liverpool on 25 August 2023. The aim of this study was to (i) identify current teaching practices and approaches to embedding Environmental Sustainability (ES) in the curriculum in ADEE attendee schools and (ii) explore existing barriers/challenges to incorporating ES in dental education and consider potential solutions.

Methodology: A mixed-methods approach was used to fulfil the aims of this study. A pre-workshop questionnaire was used to explore current teaching practices, challenges and drivers of embedding ES in the curriculum. An interactive workshop at the in-person meeting in Liverpool was used to propose key strategies to overcome the most frequent challenges to embedding ES in the curriculum.

Results: The majority of respondents (56%) reported that their institutions do not currently teach ES. Traditional didactic forms of teaching were mostly reported to teach ES in non-clinical environments, and a transition to more environmentally sustainable materials and instruments was the most popular response for clinical teaching. Key barriers to embedding ES in the curriculum were identified, including time constraints and the overloaded curriculum, a lack of expertise/knowledge to teach and lack of practical guidance to support educators, limited learning resources for staff and students and resistance from colleagues regarding the relevance of ES in dentistry. The special-interest group participants proposed strategies to overcome these challenges that centred around 14 themes.

Conclusion: This paper reports recent scholarship activity by ADEE's 'Sustainability in Dentistry' SiG. Key strategies for overcoming the most common challenges to embedding ES in the curriculum are also discussed.

1 | Introduction

Delivering oral healthcare currently results in numerous significant environmental impacts, including carbon emissions, pollution, waste generation and biodiversity loss [1–4]. Research has demonstrated that patient travel and staff commuting are the most important contributors to environmental impacts, as oral healthcare is typically delivered over numerous appointments in small clinics in dispersed locations [5]. In addition, procurement of clinical items, energy and water consumption, and waste generation all contribute significantly to the environmental impact of dentistry [6–8].

There is a significant drive across healthcare to deliver more environmentally sustainable services. Multiple organisations have set goals to mitigate environmental impacts, including national healthcare systems and the universally adopted United Nations Sustainable Development Goals [9, 10]. Numerous stakeholder groups, including the FDI World Dental Federation, are engaged in discussions to deliver environmentally sustainable change in the sector [11–13]. Education has been identified as a critical strategy to achieve these goals, and therefore, Oral Health Professional (OHP) programmes must incorporate Environmental Sustainability (ES) within their curriculum [14–16].

The Association for Dental Education in Europe (ADEE) is leading the drive to embed ES in OHP education through the 'Sustainability in Dentistry' Special-interest Group (SiG). The group met for the first time at the ADEE annual conference in Berlin in 2019, and collaborative activities have led to the publication of two consensus reports [15, 16]. These papers identified a need to embed ES in the curriculum and reported consensus-agreed learning outcomes and teaching and assessment methods for ES. The Graduating European Dentist (GED) task force reviewed these learning outcomes, and they have now been adopted into the web-based curriculum framework (https://adee.org/graduating-european-dentist/graduating-european-dentist-curriculum). The General Dental Council, the national regulator in the United Kingdom, have adopted some of these learning outcomes in their recent Safe Practitioner Framework, meaning that registered OHP schools must teach and assess ES from 2025 [17].

There is limited evidence to suggest OHP schools are currently teaching ES, with the recent O-Health-Edu pan-European survey reporting that over 30% of responding schools do not currently teach this topic at any level [18]. This work did not explore *when* and *how* ES is taught, but it provides important preliminary data. Additionally, other surveys have reported very little experience with ES in OHP school curricula [19–23]. Positively, these surveys reported significant student and educator support for embedding this topic in the curriculum.

Embedding ES in the curriculum presents numerous challenges, and some schools may feel unsure of how to proceed. Some barriers reported in the literature include a lack of time, expertise and resources, although this has not been fully explored [19, 21, 23]. Additionally, previous surveys reported low response rates and received responses from limited geographical areas and institutions.

It is important to understand current practices and challenges across multiple geopolitical areas. ADEE often brings together OHP educators from numerous countries with different regulatory processes [18, 24–26]. The SiG activities to date have focused on needs assessment and developing resources for educators. However, there is a need to identify existing practices, explore current challenges and uncover potential solutions.

This paper reports on the scholarship activity of the 'Sustainability in Dentistry' SiG, which met at the ADEE annual conference in Liverpool on 25 August 2023. The aim of this study was to (i) identify current teaching practices and approaches to embedding ES in the OHP curriculum in ADEE attendee schools and (ii) explore existing barriers/challenges that complicate incorporating ES in dental education and consider potential solutions.

2 | Methodology

This study received ethical approval from the Dentistry Ethics Committee at the University of Sheffield (application number 056060).

A mixed-methods approach was used to achieve the aims of this study. A pre-workshop questionnaire was distributed to all registered attendees of the SiG session in Liverpool to identify baseline data regarding current educational practices, challenges and drivers for embedding ES in the curriculum. The results of this survey informed an interactive workshop at the in-person meeting to explore potential strategies to overcome the most common challenges to embedding ES in the curriculum.

2.1 | Pre-Workshop Questionnaire: Current Teaching Practices, Challenges and Drivers for ES in OHP Education

An 8-item questionnaire was developed de novo due to an absence of relevant published literature in this area. Google Forms was used to write and share the questionnaire. A range of answer options were used depending on the question type, including open- and closed-ended questions. The questions were separated into four sections:

- Respondent's home institution country (1 question).
- Current teaching approaches for ES in non-clinical and clinical environments (4 questions).
- Existing challenges to embedding ES in the curriculum (2 questions).
- Existing drivers that support embedding ES in the curriculum (1 question).

The questionnaire was piloted with five academics from different European countries to ensure face and content validity. The survey link was shared with the working group, and responses were gathered via email. Minor amendments were made to improve the clarity of language and ease of understanding.

The questionnaire was distributed to all attendees who pre-registered for the SiG via the ADEE annual conference app. All potential respondents were emailed twice, the first 2 weeks before and again 3 days before the in-person meeting. Attendees to the SiG were also invited to complete the survey at the start of the session; this was necessary as not all attendees pre-registered for the event. No personal data was collected, as all responses were anonymous. Informed consent was gained at the start of the questionnaire, and a participant information statement was provided.

Descriptive statistics were used to analyse all close-ended questions, and the data was presented in tables and charts. Content analysis was used to analyse the free-text responses. This method codes and groups all responses according to frequency. Three trained researchers discussed and agreed upon the analysis and data presentation.

2.2 | Interactive Workshop: Exploring Existing Challenges and Proposing Solutions

All attendees at the SiG meeting in Liverpool participated in the workshop discussion. To provide context for discussion, the results of the pre-workshop questionnaire were presented at the start of the meeting. The aim of this session was to discuss existing challenges to embedding ES in the curriculum and propose potential solutions. Therefore, the first part of the workshop focused on reviewing the responses to the 'Existing challenges that make embedding ES in the curriculum complex' questions. The most reported barriers from the pre-workshop questionnaire (those with over 40% frequency) were used in the workshop and participants were asked to propose strategies to overcome these challenges.

Participants were invited to submit their thoughts via the interactive electronic platform WooClap (https://www.wooclap.com) to gather individual responses. For each barrier, participants were asked to respond to the question '*What strategies may help to overcome the barrier?*' in free-text format. The responses were visible to all attendees and were used to inform further group discussion. One researcher transcribed the key themes identified in the discussions to add context to the individual responses provided via WooClap. The individual responses and group discussion notes were analysed via thematic analysis, as described by Braun and Clarke [27]. This methodology extracts and organises data into themes that are based on the importance in the dialogues rather than a purely frequency-based approach.

3 | Results

3.1 | Pre-Workshop Questionnaire: Current Teaching Practices, Challenges and Drivers for ES in OHP Education

Thirty-two responses were received for the questionnaire. The responders were based in 26 different higher education institutions and 18 countries worldwide (Table 1). One response was received from an additional stakeholder (professional body).

Over 56% of responding institutions do not currently teach ES (Figure 1). Within this group, 33% of responses stated that they have plans to teach ES soon. Of the respondents that teach ES, 12.5% currently have specific learning outcomes for ES, while 31.3% teach ES without dedicated learning outcomes.

Regarding the most appropriate strategy to embed ES in the undergraduate curriculum, 50% of respondents selected '*ES forms a part of our teaching in all years of our programme*' (Figure 2). Additionally, a significant number of respondents (40%) stated that ES is delivered as a single or group of lectures, and two respondents (10%) deliver a standalone course for ES.

TABLE 1 | Responding countries to the pre-workshop questionnaire.

Responding country	Number of responses
United Kingdom	6
Portugal	4
Netherlands	3
Spain	3
Georgia	2
Australia	1
Belgium	1
Cambodia	1
Denmark	1
Estonia	1
Germany	1
Israel	1
Italy	1
Malta	1
Mexico	1
Oman	1
Romania	1
Sweden	1
Not stated	1
Total	32

Lectures, seminars, workshops and student-led projects ($n = 5$) were the most reported teaching methods used in non-clinical environments (Table 2). Raising awareness in clinical spaces ($n = 5$) and using more sustainable materials, instruments or other clinical items ($n = 3$) were the most reported approaches to teaching ES in clinical spaces (Table 3). Six responses were removed from Table 3 due to the responses falling into non-clinical teaching methods.

Time constraints and the overloaded curriculum were major challenges reported by almost 70% of respondents (Figure 3). A lack of knowledge/expertise to teach ES (59%), a lack of practical guidance to support educators (47%), limited learning resources for educators or students (44%) and resistance from colleagues regarding the relevance of ES in dentistry (44%) were other commonly reported barriers. Additional barriers from the free-text responses included cost/finances ($n = 3$) and technology in prosthodontics ($n = 1$).

Support and policy from local universities ($n = 7$) were the most reported drivers to embed ES in the curriculum (Table 4). Alignment with worldwide trends and societal expectations ($n = 6$) and no reported drivers or 'unsure' ($n = 5$) were other common responses, in addition to staff engagement and support ($n = 4$), ADEE SiG activities ($n = 4$), and activities by other professional bodies for ES ($n = 4$).

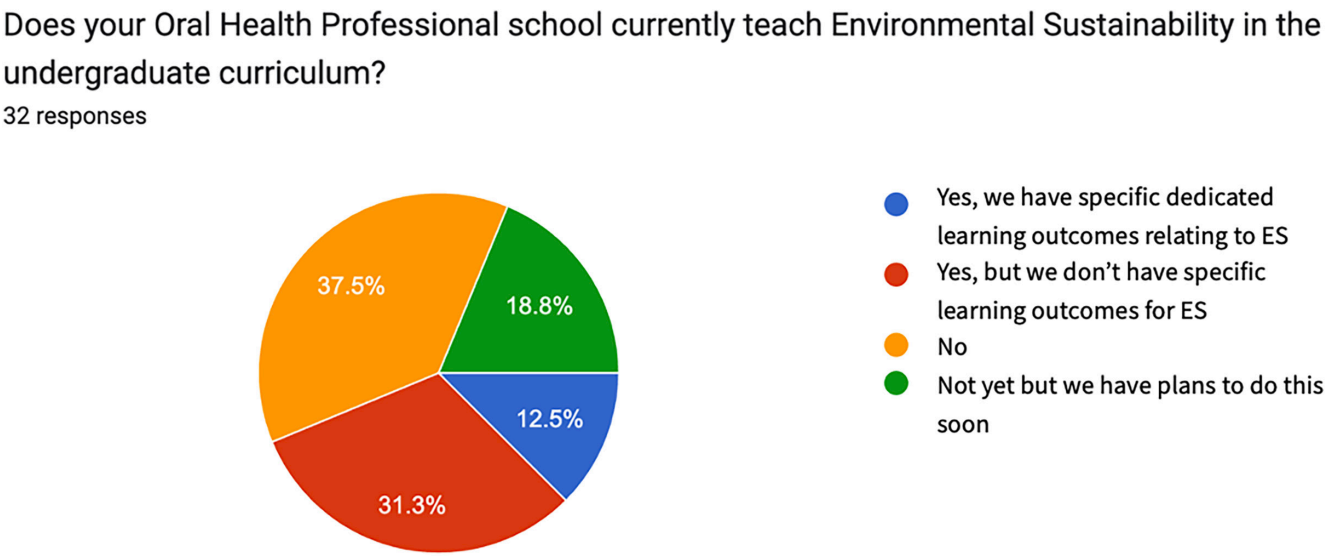

FIGURE 1 | A pie chart demonstrating current teaching practices for environmental sustainability in the undergraduate curriculum.

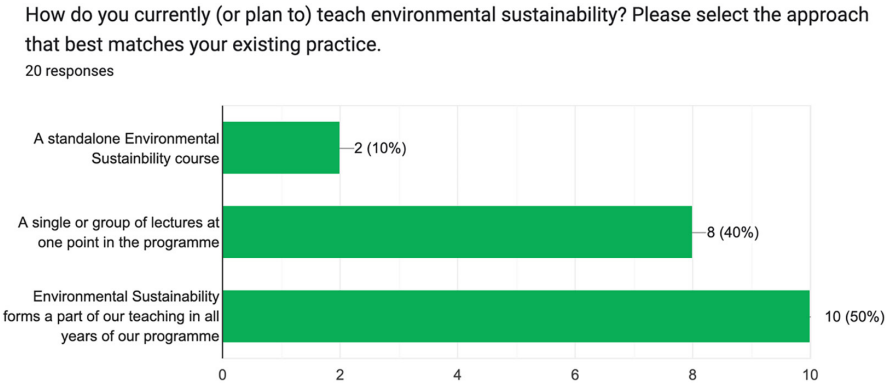

FIGURE 2 | A bar chart demonstrating current or planned approaches to embedding environmental sustainability in the undergraduate curriculum.

3.2 | Interactive Workshop: Exploring Existing Challenges and Proposing Solutions

Thirty-seven participants contributed to the interactive workshop. The participants were based in similar countries to those who completed the pre-workshop questionnaire (Table 1), although there are some differences between the two groups. Participants in the interactive workshop also came from institutions based in France, New Zealand, Saudi Arabia, Switzerland and the United States of America. Respondents to the pre-workshop questionnaire from Cambodia, Georgia, Italy and Sweden did not participate in the interactive workshop.

The discussion in the workshop centred around the five most reported barriers in the pre-workshop questionnaire:

- Time constraints and the overloaded curriculum:
- A lack of expertise/knowledge to teach ES.
- A lack of practical guidance to support educators.
- Limited learning resources for staff and students.
- Resistance from colleagues regarding the relevance of ES in dentistry.

Thematic analysis of the responses and discussions in the workshop identified 14 themes across the five barriers. The themes for each barrier are presented in Table 5.

4 | Discussion

The scholarship activity provided in this update of SiG activity provides essential information for policymakers, educational organisations, local curriculum committees and individual educators. The mixed methods approach described in this paper has enabled an overview of current educational practices, barriers and drivers and explored key strategies to overcome core challenges in embedding ES in the curriculum.

4.1 | Current Teaching Practices and Approaches for ES

A significant proportion (56%) of respondents reported that they are not currently teaching ES, which highlights the need to overcome the identified challenges that OHP schools face. The results largely align with previous surveys, which also report little experience of ES. However, previous student-led surveys

TABLE 2 | Free-text responses to current or planned learning and teaching methods for environmental sustainability (ES) in non-clinical environments.

Learning and teaching method (non-clinical)	Number of responses
Lectures	5
Seminars/workshops	5
Self-directed learning/student-led projects/groupwork	5
Embedded into all teaching events where appropriate	3
Central university department delivers teaching on ES	2
Online module/training package	1
Culture change (e.g., promoting home-based positive ES attitudes)	1
Teaching hospital delivers teaching on ES	1
Case studies, reflective discussions	1
Elective course	1
Unsure	1

TABLE 3 | Free-text responses to current or planned learning and teaching methods for environmental sustainability (ES) in clinical environments.

Learning and teaching method (clinical)	Number of responses
Raising awareness in clinical spaces (e.g., facilitating recycling, planning sessions to reduce travel)	5
Using sustainable materials/instruments on clinic	3
Incorporate into clinical grading/marking criteria	2
Still finalising delivery method/unsure/in discussion	2
Case-based discussion and treatment planning	2
Clinical audits	1
Reflective log that incorporates ES	1
Focus on high-quality preventive oral healthcare delivery	1
Clinical skills laboratory teaching	1

reported little, if any, exposure to ES in the curriculum, and this survey identifies that 44% of respondents teach ES in some capacity. This suggests that change may be starting to occur, although slowly.

The majority of respondents plan to teach ES longitudinally across all years of OHP programmes, and this aligns with the recommendations proposed by the SiG and associated published literature [15, 16, 28]. This approach should reduce concerns regarding adding new events into an already overloaded curriculum and allow for frequent reinforcement of this challenging construct. A significant, albeit lesser proportion, of responses proposed teaching ES as a single or group of lectures at one point in the programme. While this may be suitable in some contexts, it is unclear if this approach will support learners in developing an understanding that ES is a core component of all aspects of oral healthcare delivery.

The teaching methods explored in the pre-workshop questionnaire demonstrated that traditional forms of didactic teaching, such as lectures and small group sessions, were popular options for teaching ES in non-clinical environments. Some responses referred to incorporating ES into *existing* learning events as opposed to adding new lectures that focus exclusively on ES. This aligns with recent work by Dixon et al. that developed evidence-based and subject-specific content statements for ES, with the idea that these can be directly incorporated into local contexts, perhaps in the form of a slide deck [28]. Some responses suggest that other methods of teaching are employed to teach ES, including student-led learning, culture change initiatives and reflective projects. It is promising that all responses correspond with the methods proposed in the SiG's consensus report by Field et al. [16].

Current teaching in clinical environments is less clear, with significantly fewer applicable responses provided for this question. Responses largely centred around making changes to adopt more environmentally sustainable materials and instruments or facilitating recycling of non-contaminated single-use plastics. Interestingly, there was less focus on teaching the benefits of good quality preventive and operative oral healthcare and treatment planning, even though these points have been a key focus of recent publications and have been demonstrated to provide significant environmental benefits [13, 28, 29].

4.2 | Barriers to Embedding ES in the Curriculum and Potential Solutions

Multiple challenges to embedding ES in the curriculum have been identified. These will be considered individually alongside the proposed solutions by the workshop participants.

4.2.1 | Time Constraints and the Overloaded Curriculum

Educators feel that the most significant challenge to embedding ES in the curriculum is time constraints and the overloaded curriculum. The solutions proposed by the SiG were to embed ES into the existing curriculum across all years of study, refine the existing curriculum to create space and reduce repetition and start with small steps across all years of study. The benefits of embedding ES longitudinally across all years of programmes, both in terms of curriculum time and educational rationale, have been discussed previously in this manuscript and in associated publications [16, 28]. The approach proposed

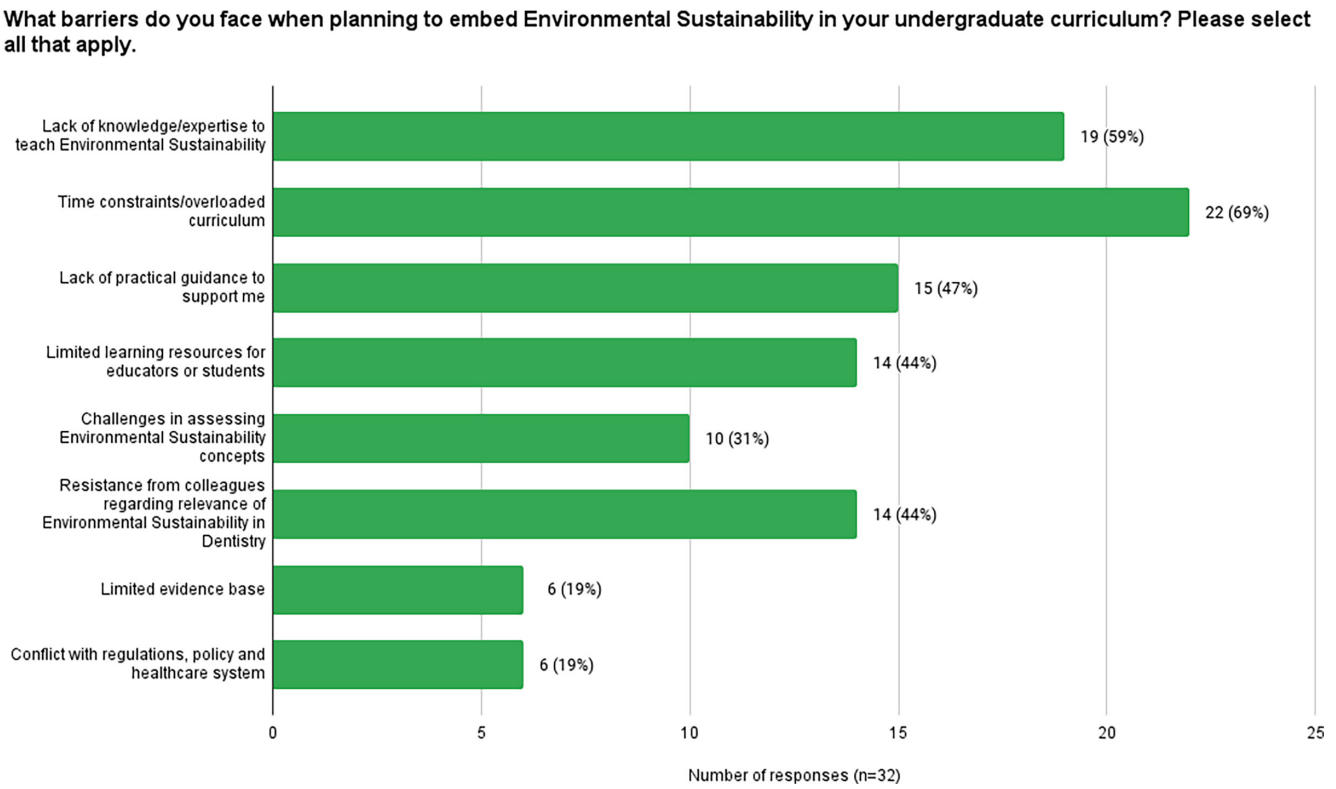

FIGURE 3 | A bar chart demonstrating responses to the most common challenges to embedding environmental sustainability in the undergraduate curriculum.

TABLE 4 | Content analysis of the free-text responses for drivers to embedding environmental sustainability (ES) in the undergraduate curriculum.

Driver/facilitator	Number of responses
University policy	7
Worldwide trend/societal expectations	6
No drivers reported or unsure	5
Staff engagement and support	4
ADEE 'Sustainability in Dentistry' SiG activities	4
Activities by other professional bodies for ES	4
Student engagement and support	3
Local staff as leaders/champions of ES	3
Emerging topic at conferences	2
Published learning outcomes for ES	1
Audit results	1
Emergence of digital workflows	1

by Dixon et al. [28] should allow for minimal disruption as the content statements can be directly incorporated into existing teaching events in the form of single or multiple statements or '*take-home messages*' for ES.

A curriculum development cycle should allow for regular review of teaching across the length of OHP programmes. This is essential to ensure that curricula are fit for purpose in meeting the demands of a changing profession and are 'sustainable' through effective use of resources. Curriculum development should allow for refinement of content, ensuring all essential components are covered but avoiding unnecessary repetition of components. The outcomes of this process may provide opportunities or 'space' to embed ES in the existing curriculum.

Due to the challenges identified in this and previous studies, it may be necessary for OHP schools to start with small steps and build on these foundations over time. There may be '*easy wins*' where ES can be embedded into current events, and there may be potential to do this quickly and with minimal disruption. Other learning events may be too complex to complete in a short time frame and can be incorporated later after reflecting on what has been learned in these early steps. Sharing of these practices among institutions will allow for a collaborative solution to overcome core issues in embedding some elements of ES in OHP education.

4.2.2 | A Lack of Expertise/Knowledge to Teach ES

Concerns from educators regarding a lack of expertise or knowledge to teach ES have been widely reported in the healthcare literature [19, 21, 30–34]. It is acknowledged that the subject of ES is foreign to many, and teaching this across the length of the programme may be intimidating for some educators. It is anticipated that a significant proportion of ES teaching can be delivered by non-experts who "learn alongside the learners" to improve awareness and knowledge of this critical issue [35, 36].

TABLE 5 | Themes identified to overcome the most common barriers to embedding environmental sustainability (ES) in the undergraduate curriculum.

Barriers	Identified 'Themes' as key strategies
Time constraints and the overloaded curriculum	Embed ES into the existing curriculum across all years of study
	Refine the existing curriculum to create space and reduce repetition
	Start with small steps across all years of study
A lack of expertise/ knowledge to teach ES	Develop and deliver effective faculty/ staff development sessions for ES
	Collaborate with colleagues and educational bodies external to the university
	Student collaboration and co-creation
A lack of practical guidance to support educators	External collaboration, sharing of practice
	Publish examples of practice and guidance
Limited learning resources for staff and students	Develop and share resources among institutions
	Centralised collection of resources (e.g., ADEE webpage)
	Student co-creation of resources
Resistance from colleagues regarding the relevance of ES in dentistry	Facilitate and support further education
	Incorporate ES into mandatory training
	Set good examples—senior staff and ES champions

Developing effective staff development sessions with easy-to-use and accessible resources will improve awareness and knowledge. It is important for educators to be aware that relatively small changes to our education processes and clinical care can mitigate environmental impacts significantly, and actually, good quality oral healthcare is good for the patient, the profession and the environment [13, 28]. Staff development should consider fundamental concepts, such as climate change, the impact of climate change on health, how healthcare contributes to climate change, more environmentally sustainable strategies for care delivery and educational strategies to embed ES in the curriculum [37, 38].

The SiG participants proposed co-creating resources between staff and students, which is particularly relevant for this emerging topic and was also proposed in the previous consensus report [16]. ES is a transdisciplinary issue, and sharing resources among similar programmes or institutions may significantly reduce workload, avoid duplication and improve the quality of teaching [31, 35, 39].

4.2.3 | A Lack of Practical Guidance to Support Educators

Participants reported a lack of guidance to support educators in embedding a topic like ES in the curriculum. Although ES has emerged as an important component of OHP education and it is already incorporated into some curriculum frameworks, there is limited guidance to demonstrate how (strategies) it should be done and what (content) should be taught. The recent publication by Dixon et al. utilised a mixed methods approach of focus groups and extensive stakeholder consultation to provide guidance on this [28]. However, this was published after the data was collected from the SiG. A real-world example of embedding ES within the constraints of an OHP curriculum is yet to be published.

The key themes proposed by the SiG members include external collaboration, sharing good practices and publishing these in a peer-reviewed journal or making them available online in a central resource hub.

4.2.4 | Limited Learning Resources for Staff and Students

The presence of learning resources for educators and students about ES in dentistry and oral healthcare is steadily increasing, although it is acknowledged that further work is needed. Recent works, including the publication of the FDI World Dental Federation's MOOC (massive open online course) on Sustainability in Dentistry, the previously mentioned work based on ES curriculum content and strategies, a textbook and previous SiG consensus reports, are major developments in this area. Table 6 provides easy-to-access links to these resources.

The themes proposed by the SiG members to overcome this challenge were to develop and share resources among institutions, create a centralised collection of resources and student co-creation of resources. These points have all been covered earlier in the discussion.

4.2.5 | Resistance From Colleagues Regarding the Relevance of ES in Dentistry

Resistance from colleagues regarding the relevance of ES in the curriculum has been sparsely reported in other publications [31, 32]. However, the results from SiG members suggest that this is a common concern for many educators. It is acknowledged that climate change can be a polarising topic; however, airing open discussions with colleagues regarding the benefits of an environmentally sustainable approach to oral healthcare should extend beyond climate change; there are significant benefits for patients, the profession and the environment. Holding regular staff development updates on ES may help increase staff knowledge of ES and reduce scepticism.

Previous publications have demonstrated that active staff members, whether through research or teaching, are key drivers of change [19, 20]. Environmentally sustainable change will not be a quick process, but setting good examples and embedding ES in

TABLE 6 | Recent resources to support staff and student learning of environmental sustainability (ES) in dentistry and oral healthcare.

Resources for ES in dentistry and oral healthcare	Link
FDI World Dental Federation's MOOC (open access)	bit.ly/FDI-ES-MOOC
ADEE Consensus report on learning outcomes and methods of teaching and assessment for environmental sustainability (open access)	bit.ly/ADEE-ES-LO
Evidence-based, subject-specific content statements for environmental sustainability (open access)	bit.ly/ES-CONTENT
Sustainable dentistry—making a difference	https://link.springer.com/book/10.1007/978-3-031-07999-3
Consensus on Environmentally sustainable oral healthcare: A joint stakeholder statement (open access)	https://universitypress.whiterose.ac.uk/site/books/filter/3328/

education, clinical practice and research will hopefully increase cooperation among all staff members.

4.3 | Drivers to Embedding ES in the Curriculum

Positively, numerous drivers have been identified that support embedding ES in the curriculum. University policy and support are proving to be a major driving force behind the push to embed ES in OHP curricula. The impact of wider societal expectations on driving curriculum change is notable, in addition to staff and student engagement and the activities of professional bodies including the Sustainability in Dentistry SiG.

4.4 | Future Activities

The Sustainability in Dentistry SiG has developed several key resources throughout its term, including establishing a need, proposing specific learning outcomes and teaching and assessment methods for ES, and now identifying current practices, challenges and drivers to embedding ES in the OHP curriculum. It has also proposed key strategies to overcome the frequently reported challenges.

The SiG members have identified a clear need for future activities, perhaps in a community of practice through ADEE. Almost 80% of members proposed developing a series of examples of good practice for teaching and assessing ES, and over 60% supported developing a curriculum development model to demonstrate how to embed ES longitudinally across programmes.

5 | Conclusion

This paper reports recent scholarship activity by ADEE's 'Sustainability in Dentistry' special-interest group, which involved a mixed-methods approach to uncovering existing teaching practices, challenges and drivers to embedding ES in OHP curricula. Most respondent schools do not currently teach ES in any form, although many have plans to do this soon. Key barriers have been identified to embedding ES in the curriculum, including time constraints and the overloaded curriculum, a lack of expertise/knowledge to teach and lack of practical guidance to support educators, limited learning resources for staff and students and resistance from colleagues regarding the relevance of ES in dentistry. The special-interest group participants proposed strategies to overcome these challenges that centred around 14 themes.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data supporting this study's findings are openly available in the University of Sheffield Research Data Repository at https://doi.org/10.15131/shef.data.26502637, under the terms of the Creative Commons Attribution (CC BY-NC 4.0) licence.

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