Received: 4 April 2023 | Revised: 13 November 2024 | Accepted: 27 November 2024

DOI: 10.1002/ppp3.10636

Plants People Planet PPF Open Access

OPINION

The Botanical University Challenge: Bridging isolation and empowering plant-aware students

Hannah Hall[1] | Sebastian Stroud[2] | Alastair Culham[1] | Colin Clubbe[3] | Sven Batke[4] | Susan Medcalf[5] | Meriel G. Jones[6] | Lauren Baker[7] | Susannah Lydon[8] | Erica McGale[9] | Carmen Acedo[10] | Jonathan Charmley[11] | John M. Warren[12] | Jonathan Mitchley[1]

[1]Herbarium, School of Biological Sciences, Health and Life Sciences Building, University of Reading, Whiteknights, Reading, UK

[2]School of Biology, Faculty of Biological Sciences, University of Leeds, Leeds, UK

[3]Royal Botanic Gardens Kew, Richmond, Surrey, UK

[4]Department of Biology, Edge Hill University, Ormskirk, UK

[5]Natural England, Seacole Building, London, UK

[6]Department of Biochemistry, Institute of Systems, Molecular and Integrative Biology, University of Liverpool, Liverpool, UK

[7]University of Oxford Botanic Garden and Arboretum, Oxford, UK

[8]School of Biosciences, University of Nottingham, Loughborough, UK

[9]Department of Ecology and Evolution, University of Lausanne, Lausanne, Switzerland

[10]Department of Biodiversity and Environment Management, Universidad de León, León, Spain

[11]Department of Archaeology, School of Archaeology, Geography and Environmental Sciences, University of Reading, Reading, UK

[12]UK Field Studies Council, Preston Montford, Shrewsbury, UK

Correspondence
Jonathan Mitchley, Herbarium, School of Biological Sciences, Health and Life Sciences Building, University of Reading, Whiteknights, Reading RG6 6EX, UK.
Email: j.mitchley@reading.ac.uk

Societal Impact Statement

In some indigenous languages, plants are referred to as 'those who care for us', reflecting their essential role in tackling global challenges. Yet, urbanisation and other factors have reduced engagement with plants and botany, decreasing awareness, especially among students. To combat this, three botanists launched the Botanical University Challenge (BUC) to inspire plant-aware students in the United Kingdom and Ireland. We show how, through competition, BUC fosters a community of budding botanists, equips students with skills to tackle environmental issues and bridges fragmented interest in plants. Its success has sparked similar contests internationally, showcasing BUC's broad appeal and potential to elevate botany globally.

Summary

The Botanical University Challenge (BUC) competition was first devised by three academic botanists in 2015 to champion plants and plant-aware students and to help connect disparate and disconnected student botanists across the United Kingdom and Ireland. Since then, BUC has grown in popularity to become the largest annual botanical contest in Europe (and possibly the world) with teams competing from a total of 33 higher education institutions from the United Kingdom and the Republic of Ireland answering questions on the full breadth of the botanical sciences. Through running the competition and (since 2023) an associated Student Botany Festival, the BUC Planning Team has had the opportunity to engage with a diverse cohort of plant-aware students, from undergraduate to doctoral level, enabling them to share their values, passions and concerns for the future. We discuss the development of BUC and our ambitions concerning the future growth and impact of the BUC competition and the ways in which BUC has supported plant-aware students, such as skills training and career pathway development. We also present two international case studies where the BUC format has been used to facilitate student education and engagement in other countries. We envision BUC as a vehicle to enable connections

Hannah Hall and Sebastian Stroud are the co-first authors for this study.

Funding information
Gatsby Charitable Foundation, Grant/Award Number: GAT3732 - Botanical University Challenge (BUC) 2; Other funders are listed in the supplementary material

between plant-aware students, not only nationally within the United Kingdom but internationally, by encouraging and supporting other communities in similar endeavours.

KEYWORDS
botanical education, botany, capacity building, field skills, pedagogy, plant awareness disparity, public engagement, skills gap

1 | INTRODUCTION

1.1 | Botany in the era of environmental crisis

The Anthropocene is an era marked by substantial challenges for human society, from the pressing and immediate impacts of climate change, and growing social inequality, to unprecedented destruction of natural ecosystems (Corlett, 2023). 'In some native languages, the term for plants translates into *those who take care of us*' (Kimmerer, 2013). As such, botanists, plant scientists, ethnobotanists and plant ecologists are urgently needed to address these key global challenges that are defining the Anthropocene (Amprazis & Papadopoulou, 2020; Queiroz et al., 2021; Wyse Jackson & Kennedy, 2009).

In the United Kingdom, these issues present at a time when there is growing awareness of a continued decline in the number of botany and plant science degrees and more general plant content in bioscience degrees available from United Kingdom higher education institutes and professional bodies (Stagg et al., 2009), some authors have warned of the long-term consequences of the neglect of the discipline (Stroud et al., 2022).

The UK student botany and plant science environment is fragmented, and there is an ever greater need to engage those students interested in plants, to connect like-minded students and their institutions to foster a strong sense of botanical community. Building resilience in our education systems should mirror the needs of our conservation organisations and industry (Clubbe, 2013). The low number of plant science students and the loss of plant science programmes across universities has hampered communication, knowledge exchange and innovation between next-generation plant scientists (Stagg et al., 2009; Walsh et al., 2023). Simply stated, a strong botanical education enables students to read the history of landscapes, understand plants processes and patterns at play, and to develop plant awareness across disciplines (Jose et al., 2019; Magntorn & Helldén, 2005). Dissolving these barriers through education is key to helping society overcome some current societal and environmental challenges that define the Anthropocene (Amprazis & Papadopoulou, 2020; Hirst & Lazarus, 2020).

There are not only challenges in the UK higher education landscape but also globally (Sanders, 2019). Studies have documented disparities between the inclusion of plant versus animal content in education textbooks across the globe. Abrie (2016) noted that plant content in South African educational texts was likely not sufficient to provide a strong knowledge or skills foundation in plant biology and might subsequently hinder development of positive values toward these sciences, a finding, which has similarly been reported from the United States (Brownlee et al., 2023; Hershey, 1996; Queiroz et al., 2021; Schussler et al., 2013; Woodland, 2007), Turkey (Ahi et al., 2018), Portugal and Brazil (Guimarães & Santos, 2009) and Greece (Paraskevopoulos et al., 1998).

More recently, governments and interest groups have raised the alert of the potential ticking time bomb of botanical skills debt (Sundberg et al., 2011). In the United States, there has been a recognised decline in botany content across biology degrees at universities and a disparity in the number of plant science graduates nationally, resulting in a dearth of botanical specialists in industry (Sidoti et al., 2023) and academia (Walsh et al., 2023). Internationally, many of the bodies responsible for the custodianship of some of the world's rarest plants are underfunded, isolated and struggling to find qualified botanical experts (Clubbe, 2013; Kramer, 2010). In the United Kingdom, the Scottish government has acknowledged that the skilled workforce needed to implement nature-based solutions, skills directly related to plant systems and processes, is currently insufficient (Hirst & Lazarus, 2020). In Singapore, a 2030 objective to realise an additional 200 ha of nature parks to the nation has been hampered by a lack of local botanical experts. Positively, in response, the National University of Singapore and National Parks Board have introduced an undergraduate botany minor (Begum, 2023).

1.2 | Botanical University Challenge (BUC) and the next generation of botanists

Through their own experiences of working in UK academic institutions, in the 2010s, three plant-obsessed academics (authors JM and JW and Paul Ashton of Edge Hill University) became increasingly concerned at the limited opportunities and initiatives for plant-aware students to network together and the consequent feelings of student isolation in the botanical community (Box 1). So, to champion these students and help bring them together, they developed the first BUC at the Royal Botanic Garden, Kew, in 2016.

Despite the longstanding use of competition and engagement events, their use within the higher education field remains poorly explored and reported, mostly focusing on the design of student contests and contestant motivations (Tseng et al., 2022). In providing students with a space to connect across institutions, communities and disciplines (Scherff et al., 2013), we as facilitators and participants

BOX 1 The perspective of a student participant on feelings of botanical isolation within higher education

'I know students studying plant science at my uni and others and have contacts with a few lecturers. However, beyond the university bubble, I am not very aware of the botanical community nor have much connection or opportunity to engage with it'.

encourage collaboration and innovation and importantly raise the profile of emerging botanists. In this paper, we discuss the context and history of BUC and reflect on the multiple dimensions of value the contest has provided not only to its participants but the broader botanical community.

In brief, BUC is a friendly interuniversity (and related institution) competition showcasing botanical knowledge from teams of four students, undergraduate to postgraduate, in the United Kingdom and the Republic of Ireland. There is a live and online audience for the event. BUC is organised by the BUC Planning Team of volunteer academics, including a local organiser for in-person events, with annual assistance from a variety of BUC alumni students. The Planning Team encourages an open and inclusive environment that allows enthusiastic botanists, plant scientists and horticulturalists to get involved, for example, through engagement and involvement with the BUC student-led newsletter called 'The Thymes' (botanicaluniversitychallenge.co.uk).

The current and longer term goals of BUC are to as follows:

- Run an annual quiz, as an inclusive, friendly and free activity.
- Create a mutually supportive community of student botanists to inform and advance their career options.
- Address the skills gap and highlight botanical career pathways.
- Organise events alongside BUC to encourage and support early-career botanists.
- Help link BUC alumni with other botanical communities to help counter fragmentation and isolation.
- Reach out to the international botanical community to support BUC and develop similar activities in their communities.

1.3 | The structure of BUC

BUC started as a 1-day, in-person event in 2016 at the Royal Botanic Gardens Kew, and subsequent events followed at the University of Reading (2019) and the University of Liverpool (2020) (Figure 1). As team numbers increased and COVID-19 posed challenges, the BUC planning team had to adapt the format and by 2021, the pandemic shifted BUC to a fully virtual format. Consequently, team involvement increased dramatically, and BUC 2021 drew in 15 teams from the United Kingdom and Ireland.

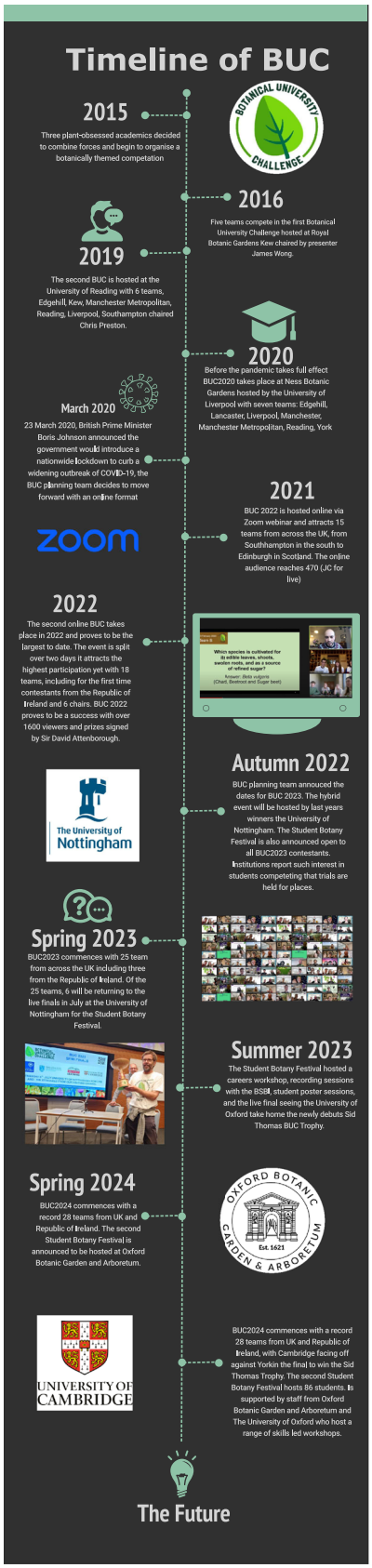
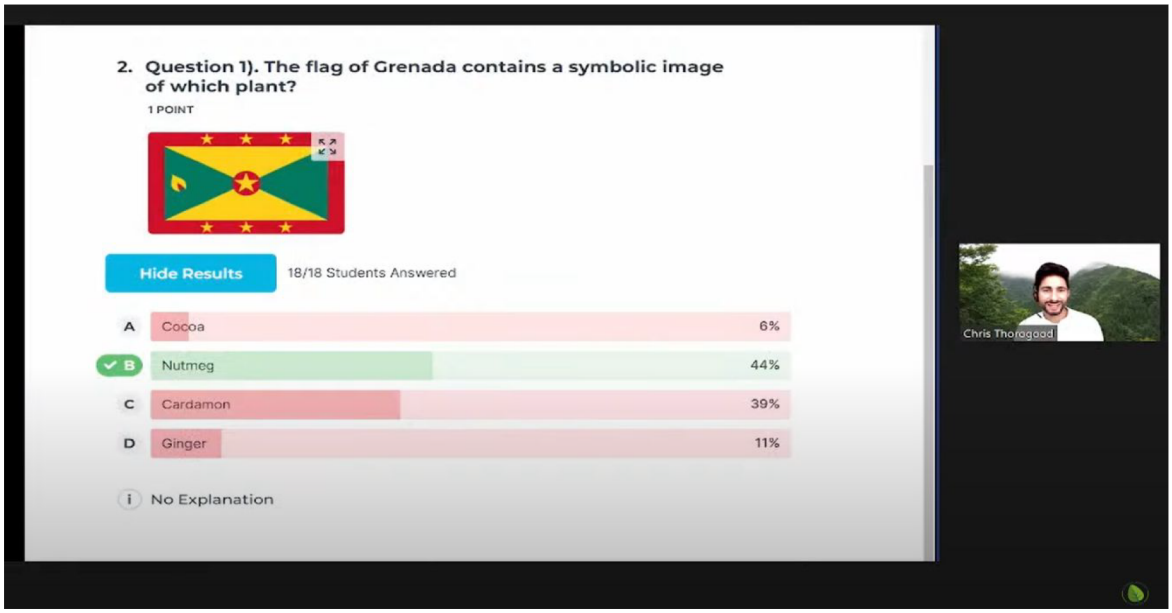


FIGURE 1 Timeline of the Botanical University Challenge from inception to the present, including significant events, developments and opportunities. https://infogram.com/timeline-of-buc-1h0r6rpmpeezw2e?live

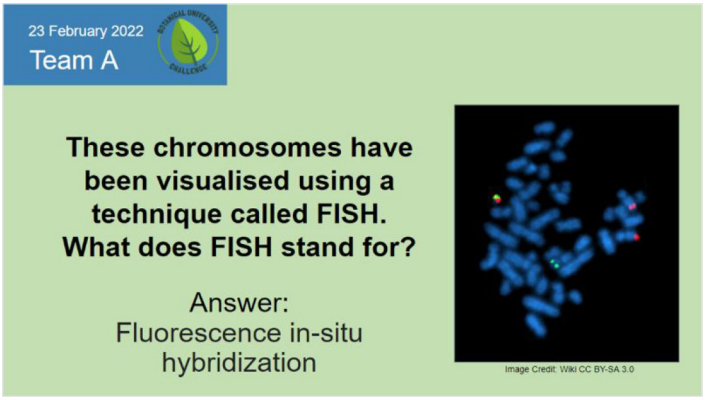
BOX 2 Question topics and examples for Botanical University Challenge

Field botany and identification (vascular and non-vascular plants), botanical terms and definitions, ecology and conservation, plant taxonomy, evolution and palaeobotany, crops, foods and ethnobotany, plant morphology and physiology, plant biochemistry, fungi and plant health, plant genetics and molecular biology, plant breeding systems and pollination, horticulture and forestry, world plants, plants in popular culture, botanists and the history of botany.

Example of Day 1 online question format for Botanical University Challenge. In this example, the question 'The flag of Grenada contains a symbolic image of which plant?' is given by the chair Dr Chris Thorogood and lists the options: cocoa, nutmeg (the highlighted correct answer), cardamom and ginger. The spread of answers are also displayed.

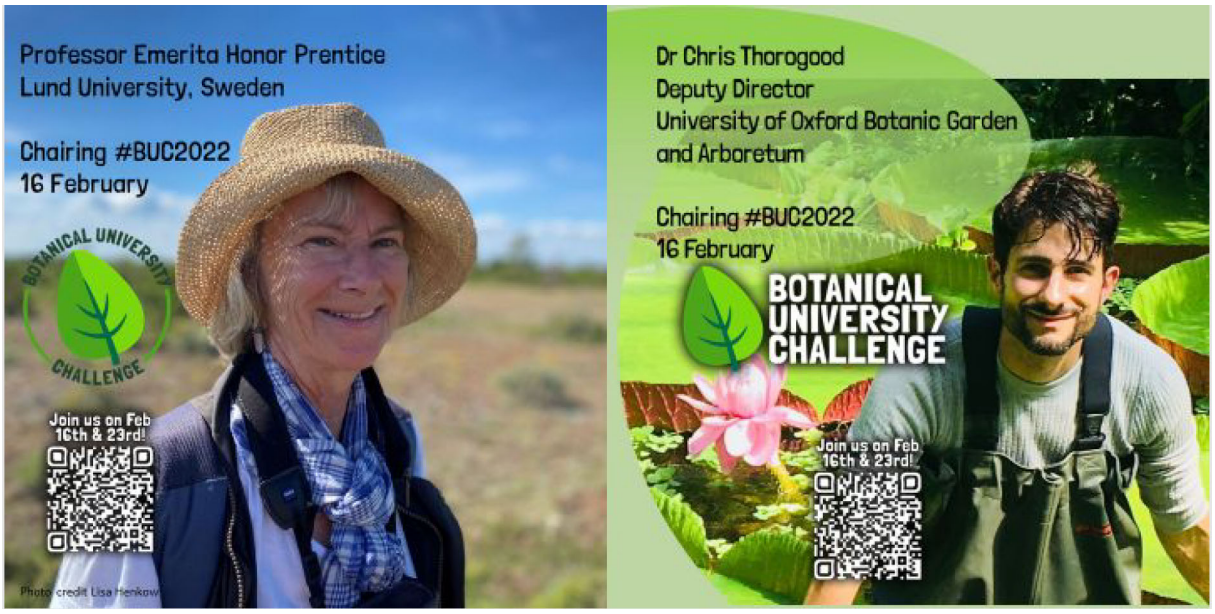


Example of directed question from the head-to-head rounds from BUC2022.



In 2022, numbers grew again to 18 teams and was split into two afternoons: knockout-style questions on Day one and finals for top-scoring teams on a second afternoon. In 2023, growth continued with 25 teams registered, prompting a hybrid contest with knockouts and quarterfinals online, leading to live semi-finals and finals in July 2023 at the University of Nottingham after COVID-19 restrictions were lifted. BUC2024 followed a similar format to 2023, with the semi-finals and finals hosted by the previous year's winners at the University of Oxford Botanic Gardens and Arboretum. In general, the earlier, online rounds are multiple choice questions presented at

BOX 3 **The 2022 chairs of Botanical University Challenge and their respective affiliations and research interests. Images are of engagement materials produced featuring two of the BUC2022 chairs, Professor Emerita Honor Prentice and Dr Chris Thorogood.**



For BUC 2022, our chairs were Professor Emerita Honor Prentice from the University of Lund, Sweden; Dr Chris Thorogood, Deputy Director and Head of Science at the Oxford Botanic Garden and Arboretum; Dr Raj Whitlock, Senior Lecturer University of Liverpool; Professor Lena Struwe, Director of the Chrysler Herbarium at Rutgers University and Dr Sandy Knapp, Merit Researcher at the Natural History Museum, London.

FIGURE 2 Signed Green Planet books with Botanical University Challenge Planning Team members Dr Alastair Culham (left) and Dr Jonathan Mitchley (right) with Sir David Attenborough (middle).

the same time for all teams. In later rounds, including the quarters, semis and final, the questions are directed and different but balanced for content, for each team (further examples can be found below in Box 2.). All online events, rounds and questions are available at the BUC YouTube channel: www.youtube.com/@BotanicalUniversityChallenge.

FIGURE 3 John Warren from the Botanical University Challenge Planning Team presenting the Sid Thomas trophy for the first time at the live finals in 2023.

The questions for BUC are set by a small group of subject specialists from the Planning Team to cover the great diversity of botanical topics (Box 2). The Planning Team works to maintain question quality and accuracy. The diversity of the questions reflects the diversity of the BUC teams that include undergraduate (Level 4–6) and postgraduate students (MSc/MRes and PhD).

Botanical experts are invited to chair the BUC quiz events, and they are a focal point of the competition. The chairs introduce the teams, ask the questions and reveal the answers. Their knowledge and expertise bring a professional gravitas and another dimension to the competition, allowing students to engage and communicate with established professionals in their field (Box 3).

Prizes started as a simple trophy for the winning team in 2016, and since 2022, all teams now receive a variety of plant identification aids, donated by the Field Studies Council. The overall winners and runners-up of BUC 2022 won book tokens and copies of the BBC 'Green Planet' book signed by British broadcaster, biologist, natural historian and author Sir David Attenborough (Figure 2).

In 2023, a new BUC 'Sid Thomas' trophy was introduced (Figure 3). The trophy is named in memory of the plant scientist Sid (Howard) Thomas, a strong supporter of BUC from the start. Sid was a true polymath, and whilst his research focused on plant cell death and senescence, he was also a highly accomplished jazz musician. Sid would not describe himself as a botanist but was passionate about public engagement work covering many topics surrounding botany. His wife Helen has carried on his work and still writes questions for the competition. The BUC trophy has a strong botanical and ecological basis. It represents Oak woodland in the United Kingdom and Ireland, and the choice of timber used reflects the most common tree species you might expect to find and their relative abundances. The position in the trophy roughly equates to the height of the trees. At the base is Silver Birch, followed by Downy Birch and capped by Beech; the inlay with the logo is Lime wood. Up the stem is Yew, Alder, then Lime, and the bowl is made from Oak.

1.4 | Student Botany Festival and engagement

Funding from several organisations (including the New Phytologist Foundation, the Gatsby Foundation and the British Ecological Society) enabled us to organise the first Student Botany Festival. This was open to all BUC 2023 participants and followed the live finals at the University of Nottingham in July 2023, further details can be found in Figure 4. More than 60 students participated in the Student Botany Festival, which was student-centred, maximising networking opportunities with professional and vertical networking between different groups of students. The 2-day event included a student poster session, a careers workshop, visits to lab facilities, outdoor botanical activities, coupled with networking and social events (Figure 4).

In 2024, 85 students attended the finals and Student Botany Festival in Oxford, hosted by the Oxford Botanic Garden and Arboretum.

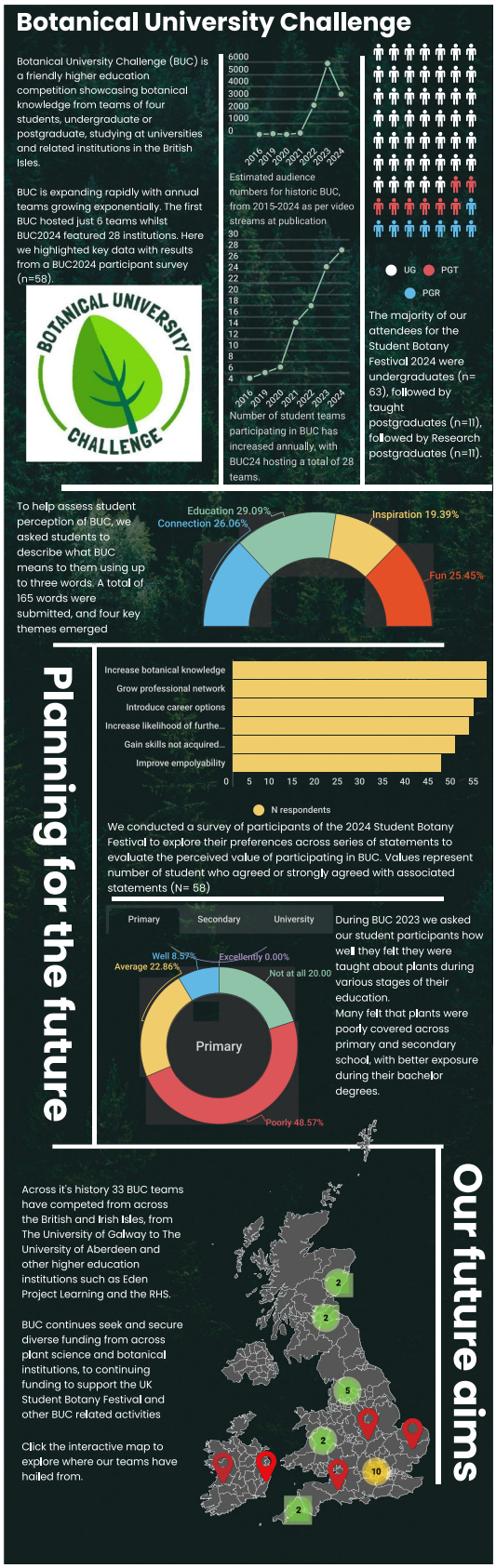


FIGURE 4 The BUC infographic detailing elements of both participant and audience feedback surveys from BUC 2022, 2023 and 2024 and the distribution of the total number of BUC teams. https://infogram.com/buc-2022-1h7g6k0731pwo2o?live

Highlights of the programme included academics and industry experts delivering talks in four diverse sessions on careers inside and outside academia, as well as a plant science research showcase. Professor Alex Antonelli, Director of Science at Kew, opened the festival with a keynote discussing botanical conservation and biodiversity dark spots (Ondo et al., 2024). Other activities included an early-career panel on the realities of postgraduate study and early-career research. Careers showcase from botanical and environmental organisations was also held, offering students networking opportunities and career advice. Finally, a range of skills workshops were held on topics such as botanical illustration, conifer identification, ethnobotany, conservation and science communication.

The aim of the Student Botany Festival is to bring together BUC student participants with professional botanists and related organisations such as the Botanical Society of Britain and Ireland, the Chartered Institute of Ecology and Environmental Management, the British Ecological Society, independent ecological consultancies and other related industry sectors.

Beyond the Student Botany Festival, BUC has facilitated other ways to connect students with influential botanists and BUC alumni. The BUC YouTube channel showcases interviews with influential botanists such as Dr Sandy Knapp and Professor Lindsay Turnbull and interviews with BUC alumni demonstrates the career pathways open to students.

1.5 | The BUC audience—Location and geographical reach

BUC has wide appeal amongst the plant-loving public, and the BUC audience is an important element of the contest. Initial BUC audiences were relatively small due to the logistics of the contest's location. However, with BUC taking place online, the audience has grown both in number and geographical reach, culminating in BUC 2023 with a global online audience viewing the live stream and the subsequent YouTube video. Audience feedback has demonstrated high levels of appreciation for the quiz highlighting the broader interest and awareness that BUC brings to the wider botanical community (Table 1).

1.6 | Student participants

Up to and including BUC 2024, a total of 33 different institutions have taken part in BUC from England, Wales, Scotland and the Republic of Ireland (Figure 4). Teams were formed of a diverse range of participants, from first year biosciences to postgraduate research students. Student participant feedback has shown high levels of enjoyment and enthusiasm for the contest. There is a danger however that some students might feel excluded or stressed through participation in the contest. Previous work has identified that quiz formats can elicit greater levels of stress than other forms of learning exercises (Yang et al., 2023). Beyond just

TABLE 1 Summary statistics of winners, funders and other relative details of Botanical University Challenge from inception to present. Audience numbers are estimates from venue capacity for live events and from our YouTube livestream stats for the online events. ~ approximate number. Further details can be found in Table S1.

Year	Venue	Duration	Teams	Estimated audience	Funders
2016	Live, Royal Botanic Gardens Kew	One afternoon (3 h)	5: Aberystwyth, Edgehill, Kew, Reading, Southampton	~110	Self-funding, University of Reading
2019	Live, University of Reading	One afternoon (3 h)	6: Edgehill, Kew, Manchester Metropolitan, Reading, Liverpool, Southampton	~165	University of Reading 50th anniversary of masters botany fundraising
2020	Live, Ness Gardens, University of Liverpool	One afternoon (3 h)	7: Edgehill, Lancaster, Liverpool, Manchester, Manchester Metropolitan, Reading, York	~100	Self-funding, University of Liverpool
2021	Online Zoom Webinar	One afternoon (6 h)	15: Aberdeen, Cambridge, Eden Project, Edge Hill, Edinburgh, Imperial College, Liverpool, Manchester Metropolitan, Nottingham, Open University, Oxford, Reading, Kew, Southampton, York	220†	Self-funding, University of Reading
2022	Online Zoom Webinar	2 afternoons (3 h 15 min and 5 h)	18: Aberdeen, Cambridge, Durham, Eden Project, Edge Hill, Edinburgh, NUI Galway, Lancaster, Liverpool, Manchester, Manchester Metropolitan, Nottingham Sutton Bonington, Open University, Plymouth, Reading, RHS, Warwick, York	2526†	New Phytologist Foundation
2023	Online Zoom Webinar, live finals University of Nottingham	2 afternoons (3 h 30 min and 4 h 30 in) plus 1 afternoon live (July 2023)	25: Aberdeen, Aberystwyth, Bristol, Cambridge, Dundee, Durham, Eden Project, Edge Hill, Exeter, Galway, Imperial College, Kew, Lancaster, Liverpool, Manchester, Manchester Metropolitan, Nottingham, Oxford, Portsmouth, Reading, Southampton, Trinity College Dublin, UEA, University College Dublin, Warwick	6,028† and ~80 live in auditorium	New Phytologist Foundation, Gatsby Foundation, British Ecological Society
2024	Online Zoom Webinar, live finals at Oxford Botanic Garden and Arboretum	3 afternoons (3 h) plus 1 afternoon live (August 2024)	28: University of Galway, University College Dublin Edge Hill University, Royal Horticultural Society, University of Plymouth, University of Reading, Aberystwyth University, University of Manchester, University of Cambridge, Oxford Brookes University, University of Bristol, Eden Project University Centre, Trinity College Dublin, University of Portsmouth, Imperial College London, University of Aberdeen, Durham University, University of Oxford, Royal Botanic Gardens Kew, Royal Botanic Garden Edinburgh University of York, Harper Adams University, University of Edinburgh, Anglia Ruskin University, University of Dundee, University of Southampton, Lancaster University, University of Nottingham	3336[a] and ~110 live in auditorium	New Phytologist Foundation, Gatsby Foundation, BGCI, RSK BioCensus, FPCR, Countryside Jobs Service, The Botanist Foundation, Edgehill University, University of Reading, University of Cambridge, University of Plymouth, University of Portsmouth, University of Lancaster, University of Durham, University of Edinburgh, Eden Project, University Centre, University of Bristol, University College Dublin, University of Oxford, St John's College, Friends of Oxford Botanic Garden and Arboretum, Torrey Botanical Society (USA)

[a]Online analytics based on total views across all events per contest at time of publication (13/11/2024).

the contest, students are invited to participate in the wider BUC community through volunteering opportunities and the Student Botany Festival.

Feedback from BUC 2023, BUC 2024 and their respective Student Botany Festivals illustrates the value of these events (Box 4), further details of feedback can also be found in Report S1.

BOX 4 Selected quotes from the student feedback from BUC 2023 and 2024

'Good energy—you could tell that everyone involved was really enjoying themselves, as well as those watching online', and 'Engaging with professionals in their field, listening to them talk about what inspires them to work with plants'.

'I have spent a lot of time feeling like I'm the only person in my age group that finds this stuff super interesting which can be isolating and discouraging'.

'Thanks to BUC, I've been able to forge these connections, which have subsequently paved the way for valuable opportunities such as internships and placements for postgraduate degrees for some of our competitors'.

'It has highlighted that I can also use horticulture in my ecology/conservation career, which I had not considered before. It has made me want to undertake further study at Masters or Ph.D. level'.

1.7 | BUC alumni reflections on their experiences

To help the BUC Planning Team defines the most appropriate strategy to connect students as a botanical community, we asked some of our BUC student alumni to reflect on their experiences in an online workshop held in May 2022. Quotes are provided in Box 5 with full text provided in Box S1. These reflections showed great appreciation and enjoyment from the quiz itself but also on the value of BUC in facilitating and connecting the community of plant-aware students across our institutions.

1.8 | The role of BUC: Connecting plant-aware students, skills development and building a resilient community

The previous Covid-19 restrictions have undoubtedly compounded the feelings of isolation of students and the lack of face-to-face activity hampered any real connection between students and their mentors/tutors. From our student workshop, interviews and questionnaire responses, some participants wondered if people who study plants are a bit more reclusive or less active online. Others stated that they had no connections to the community outside their university and that beyond the 'university bubble' they are not very aware of the botanical community, nor have much connection or opportunity to engage with it. Another said, they had made some connections through LinkedIn but felt a lack of genuine connections. Some said that their only link is through BUC, as well as a few social media accounts and fellow students at their university (Box 5).

BOX 5 Selection of quotes from participants of the BUC workshops (2022) Participants were asked questions on the botanical community, skills gaps and the value of BUC.

'Very quickly, through taking part, I realised that there is a huge network of botanists both here in the UK and internationally. Getting to speak with and hear from experts in the field during the BUC is an invaluable experience that is hard to come by in botany and incredibly helpful to someone just starting their career. … Following from the BUC I have decided to pursue botany and will soon begin my master's degree in plant and fungal taxonomy, diversity and conservation. Participating in the BUC showed me that a career in botany is possible and that is primarily thanks to the creators, guests, and everyone who partook'.

'The opportunity that BUC provided for us to engage with a much larger botanical student community in the UK was invaluable. … I recently wore [my BUC T-shirt] to [a] Conference in Stockholm. Multiple attendees at this conference approached me to enquire about the details of the BUC and the t-shirt served as a great icebreaker when meeting new researchers. Without the help of the BUC t-shirt, it is unlikely that I would have met and talked to as many researchers at the conference as I did'.

Throughout BUC and the SBF, the planning team has also organised various events and workshops to deliver skills training development. Some of these focus on practical field and lab skills (conifer identification, botanical illustration and floral formula), whilst others focus on academic skills such as workshops on scientific writing (delivered by the Annals of Botany) as well as careers in and outside academia (a panel of academics and industry professionals). Feedback from student participants of BUC2024 events has been overwhelmingly positive, with many students highlighting that BUC has improved various elements of their botanical knowledge and skill sets (Figure 5). A summary of BUC facts and figures is shown in the infographic (Figure 4) and further details of feedback can be found in Report S1..

1.9 | BUC International scope and potential

We have witnessed a growing international audience for BUC, including enquiries for teams from further afield to participate in the contest. The BUC format can be applied to most higher education settings worldwide, with each institution or organisational team developing questions and content that meet their local regional context and

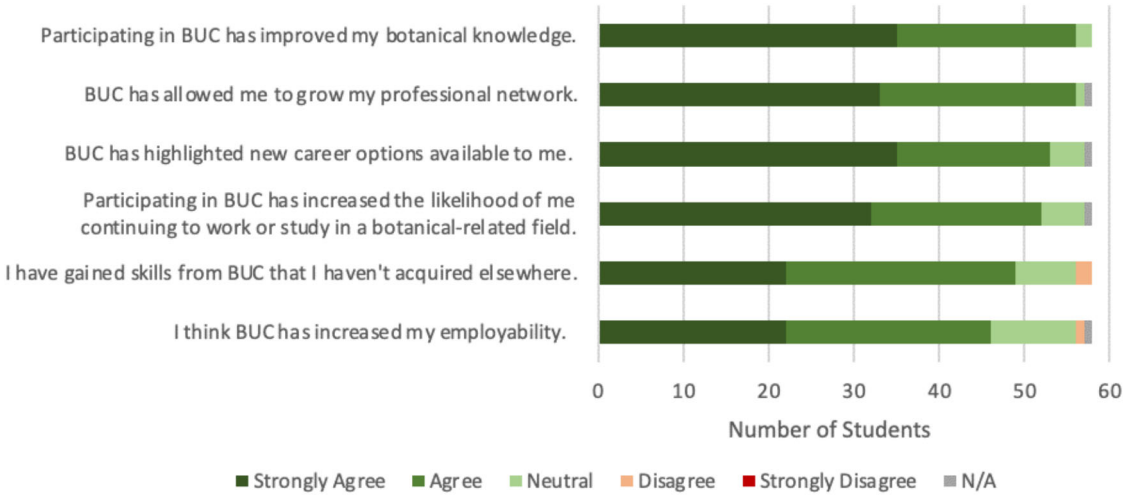


FIGURE 5 Student participant responses regarding skills and knowledge development from the Botanical University Challenge 2024 Student Botany Festival ($n = 58$).

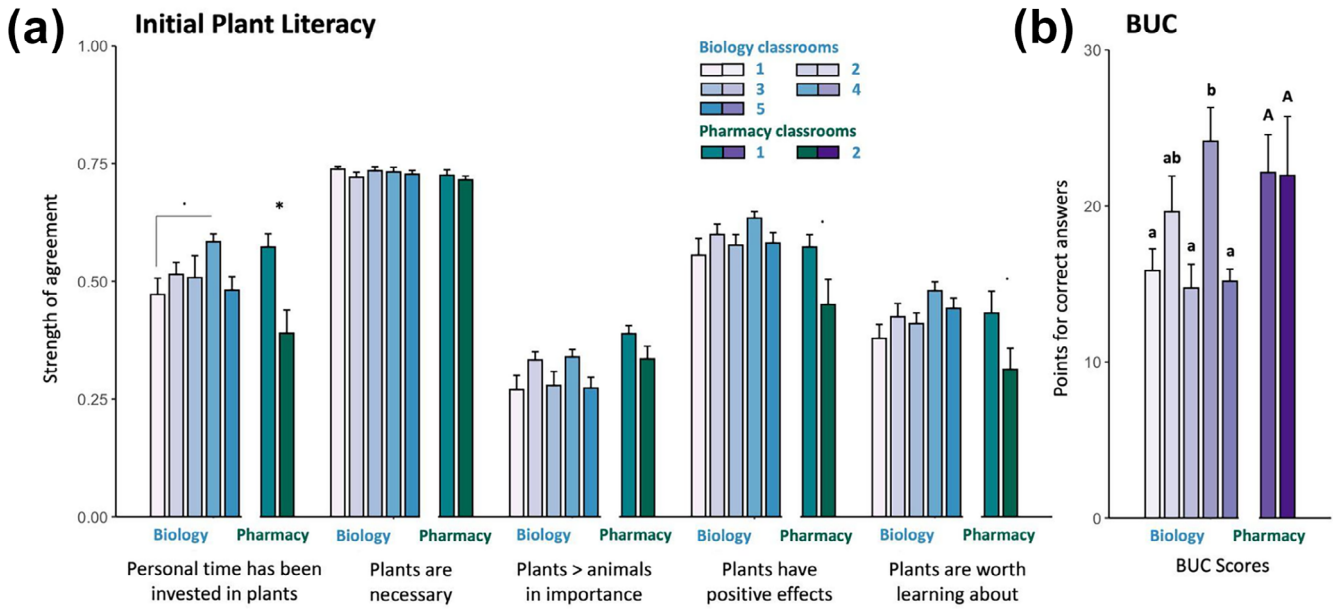


FIGURE 6 (a) Plant literacy of student participants before engagement with a Botanical University Challenge-style event and (b) related scores in BUC event. Multiple comparisons (*emmeans* package) with Sidak post hoc extracted within student groups from different faculties after significant effect among classrooms detected with ANOVA: p-value <0.05 = * or represented by non-overlapping letter codes, <0.1 = ·.

research specialties. It would be valuable for such local organisers to consider integrating and highlighting indigenous botanical knowledge where appropriate. Examples have already been seen in Spain (delivered in Spanish) and Switzerland (delivered in Swiss French and English) (Box 6), whilst at Harvard University, USA, Dr Min Ya sought the advice of the BUC planning team to introduce the Botanic Trivia quiz at #Botany2021, the annual meeting of the Botanical Society of America.

These case studies demonstrate clear potential for an international dimension of BUC. Critically, BUC is enabling international colleagues to utilise the BUC format to develop engaging plant education methods and galvanising students in the fascination and importance of plants.

1.10 | The future of BUC

The BUC Planning Team has identified three key themes to build on current successes and to further connect plant-aware students.

BOX 6 Case studies of BUC inspired events. These have been modified for clarity and length.

Dr Carmen Acedo, University of León, Spain

LBULE—La Liga Botánica de la Universidad de León, Spain, plays a significant role in engaging our students. LBULE is a local, friendly contest involving teams of undergraduate students from various degrees at the University of León. Until now, we have only organised three editions, from the spring of 2021 to 2023. To have a greater impact, we scheduled the LBULE sessions in May, around the Fascination of Plants Day. The contest's origin, inspired by BUC, aims to stimulate students, interest in plants, fungi and algae whilst drawing attention to their importance in our Faculty. We strive to combat plant blindness and enhance botanical skills because currently, students are exposed to limited plant content, and essential identification skills are not adequately emphasised.

To engage students in our small botanical community at the University of León, one of my team's goals is to pay attention to students and stimulate their interest in botanical skills. According to a survey regarding their opinions and feedback about LBULE, 98.5% expressed great interest in this formative tool. We suggested highlighting specific aspects of LBULE, and they found the contest to be amazing, expressing their happiness in participating. Additionally, several students thanked the LBULE team for organising the contest.

A future possible connection among international and interdisciplinary participants will be essential to adopting a virtual version of the contest, facilitating the participation of teams from different countries. This will help showcase botany to society and engage students with the amazing world of botany.

Dr Erica McGale, University of Lausanne, Switzerland

The importance of investing time to interact with plants, as well as for gaining knowledge on plants, is clear, but opportunities to interact with formalized information on plants (e.g., botanical concepts, ecological theory, chemical and physiological analyses) become fewer at the university stage.

The University of Lausanne (UNIL), Switzerland, requires first-year students in the Biology and Pharmacy faculties to pass a tripartite course named the 'Diversity of the Living'. This comprises a Zoology, Botany and Microbiology section, each with a lecture series in tandem to attendance to practical sessions (i.e., 'lab' periods). From the plant side, this course aims to strengthen students' ability to understand plants from the molecular functions in their cells, to the roles of their tissues and their influence as individuals in communities. In addition, the practical focuses on providing students with tools to maintain interest in, manage and interpret future plant information.

However, for the botany portions, engagement in the practical is a yearly problem. Having heard of the BUC from a conference, and with consultation from the BUC organisers, a BUC-like quiz competition was implemented as part of the 2023 Diversity of the Living: Botany practical sessions. As this first-year course has over 200 students, they were divided among seven practical classrooms. Over 2 days near the end of the semester, teams within each classroom competed against those of other classrooms.

We evaluated plant literacy per a published Plant Awareness Disparity paradigm (Parsley et al., 2022) at the beginning of the practicals and compared this with the scores, per classroom, of BUC competing teams (2 months later), to determine if success in the BUC could be decoupled to initial plant literacy of the students, therefore suggesting its role as a tool for unbiased engagement in botanical knowledge.

Most notably, the two pharmacy practical classrooms began with the largest, and the only significant, disparity in a category of initial plant literacy (Figure 6a) but received equal BUC scores at means similar to the highest scoring classroom from the biology students (Figure 6b). Of all the plant literacy categories, the initial importance assigned to plants relative to animals seemed to best predict students' success in the BUC (that which we associate with investment above-and-beyond the course material), across both faculties (Figure 6b, central bars versus Figure 6b result trends).

Many questions, considerations and opportunities have been opened up by the use of the BUC as a pedagogical tool at UNIL. Plant literacy at the end of the course was also recorded and could be analysed in the context of the results observed here to determine a lasting impact of involvement and success in the BUC. Additionally, the point of whether preconceptions about plants relative to animals should be addressed more strongly at the beginning of the practical, potentially to 'unleash' investment in Botanical concepts, was reiterated and could be explored in the 2024 practical. The implementation of the BUC in the lab practical for this course resulted in a teaching award for the organiser and will without a doubt be continued as a valuable tool to understand more about the local state of botanical learning and receptivity of the students.

1.10.1 | Fostering community

This is to address the disconnect between students of botany/plant science and other disciplines. Critical to this is broadening the

institutions involved, via advertising and engaging a broad range of plant-aware students. Additionally, we aim to develop communities related to BUC, to better enable students to network and develop academic and personal relationships to bridge this isolation using emerging technologies and media platforms.

1.10.2 | Nurturing botanical knowledge

BUC aims to combat the botanical education extinction by supporting teachers across all levels, providing information and examples on career opportunities and presenting plants as interesting via media and public engagement. We also aim to share best current practices across academic and practical approaches and provide a dedicated information portal to disseminate this knowledge. Across all these elements, we aim to ensure that accessibility is our default and diversify our membership and engagement.

1.10.3 | Inspiring future botanists

We aim to provide more specific educational content and opportunities for participants. Currently, there is the roughly quarterly alumni newsletter, produced with substantial student involvement in both media production and content creation, and a botanically themed creative competition devised and run with student input. These further increase the visibility and connectivity of plant-aware students.

As BUC continues to grow in participants, the funding pressures increase. The additional support BUC offers such as the student botany festival requires considerable amounts of planning and resources to ensure that it is accessible and inclusive for all participants. Therefore, a sustainable funding model needs to be ensured to guarantee that the valuable progress made in connecting students and highlighting the role of botany in the 21st century can be continued. As such, BUC is always looking for future funding opportunities with organisations whose values align with those of BUC.

2 | CONCLUSION

Through connecting students with each other, researchers, academics and industry, BUC stimulates knowledge exchange, enabling students and botanical enthusiasts to coalesce and reinvigorate botanical and plant science studies in the United Kingdom, Ireland and in the future, globally.

BUC highlights the desire of students to engage with plant content across all levels, from cell to systems. This reinforces the need for a dynamic and diverse next-generation botanical student community to facilitate society's transition and adaptation to emerging global environmental threats and opportunities.

BUC also highlights the need for the educational landscape to prioritise the support of botanically engaged students and promote the critical importance of understanding and valuing our botanical world—not only to the wider scientific community but to the wider public and those able to drive positive change.

3 | CALL TO ACTION

BUC's longer term aims are to continue to support early-career botanists and other plant-aware students in the United Kingdom, Ireland and particularly internationally. To help us facilitate this, the BUC Planning Team welcomes enquiries from anyone interested in supporting both their and our ambitions. Please contact the corresponding authors for support or suggestions.

All the previous BUCs and botanical interviews are posted on the BUC YouTube channel @BotanicalUniversityChallenge and the student-led newspaper 'The Thymes' can be found on the BUC website botanicaluniversitychallenge.co.uk.

AUTHOR CONTRIBUTIONS

Sebastian Stroud, Jonathan Mitchley, John M Warren, Meriel G Jones, Susan Medcalf, Hannah Hall, Colin Clubbe, Sven Batke and Alastair Culham planned and designed the initial research, and all authors contributed to the performance of the research under the auspices of BUC; data analysis, collection and interpretation was by Sebastian Stroud, John M Warren, Jonathan Mitchley, Meriel G Jones, Susan Medcalf, Lauren Baker, Sven Batke and Hannah Hall; the original manuscript was led by Sebastian Stroud, John M Warren, Sven Batke and Jonathan Mitchley. For the revised manuscript, Sebastian Stroud and Hannah Hall led the major revisions supported by Meriel G Jones, Sven Batke, Jonathan Mitchley, Alastair Culham and Colin Clubbe, with all other authors equally providing further interpretation and comment on the revised finalmanuscript. Carmen Acedo and Erica McGale provided the international case studies. John M Warren and Jonathan Mitchley hosted the competition with Alastair Culham, Meriel G Jones, Sebastian Stroud, Hannah Hall, Jonathan Charmley and Susan Medcalf providing additional social media and tech support throughout the two events and Susannah Lydon providing support for the in-person Nottingham events of 2023, whilst Lauren Baker supported the in-person event at OBGA. We would also like to thank all our keynote speakers, workshop organisers and other volunteers to help to support BUC and its aims.

ACKNOWLEDGEMENTS

BUC is run by the BUC Planning Team, which is a group of academics and students who give their time on a voluntary basis because of their strong commitment to the philosophy and goals of BUC. We would also like to thank the Plants, People, Planet editor and board members for their valuable feedback on the initial manuscript.

We would like to thank all the funders who are featured within this manuscript and the supplementary data. We also wish to thank the Field Studies Council, Botanical Society of Britain and Ireland, Chartered Institute of Ecology and Environmental Management, and Sir David Attenborough for their generous support and gifts.

Finally, we would like to thank our many student participants and our global audience, without whom there would be no Botanical University Challenge. May you be ever fascinated by the natural world and push the boundaries of knowledge on the many forms of life with which we share planet Earth.

CONFLICT OF INTEREST STATEMENT

The authors state no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in the Supporting information of this article.

ORCID

Hannah Hall https://orcid.org/0000-0002-3846-5802
Sebastian Stroud https://orcid.org/0000-0002-7482-6791
Alastair Culham https://orcid.org/0000-0002-7440-0133
Colin Clubbe https://orcid.org/0000-0002-0532-1722
Sven Batke https://orcid.org/0000-0002-1938-3625
Susannah Lydon https://orcid.org/0000-0001-9516-9703
Erica McGale https://orcid.org/0000-0002-5996-4213
Carmen Acedo https://orcid.org/0000-0001-6692-6509
Jonathan Mitchley https://orcid.org/0000-0002-0558-7547

REFERENCES

Abrie, A. L. (2016). Botanical content in the South African curriculum: A barren desert or a thriving forest? *South African Journal of Science 112*, 7.

Ahi, B., Atasoy, V., & Balci, S. (2018). An analysis of plant blindness in Turkish textbooks used at the basic education level. *Journal of Baltic Science Education*, *17*, 277–287. https://doi.org/10.33225/jbse/18.17.277

Amprazis, A., & Papadopoulou, P. (2020). Plant blindness: a faddish research interest or a substantive impediment to achieve sustainable development goals? *Environmental Education Research*, *26*, 1065–1087. https://doi.org/10.1080/13504622.2020.1768225

Begum S. (2023). New NUS botany programme aims to increase number of plant experts here. The Staits Times. Retrieved January 04, 2024, from https://www.straitstimes.com/singapore/new-nus-botany-programme-aims-to-increase-number-of-plant-experts-here

Brownlee, K., Parsley, K. M., & Sabel, J. L. (2023). An analysis of plant awareness disparity within introductory biology textbook images. *Journal of Biological Education*, *57*, 422–431. https://doi.org/10.1080/00219266.2021.1920301

Clubbe, C. (2013). Building Capacity for the Achievement of the Global Strategy for Plant Conservation in the Caribbean Region [1]. *Annals of the Missouri Botanical Garden*, *99*, 147–152. https://doi.org/10.3417/2011122

Corlett, R. T. (2023). Achieving zero extinction for land plants. *Trends in Plant Science*, *28*, 913–923. https://doi.org/10.1016/j.tplants.2023.03.019

Guimarães, F., & Santos, F. S. 2009). Botany teaching in Portugal and Brazil: analysis of school textbooks and their application in elementary school classes (2001–2010). Madrid.

Hershey, D. R. (1996). A Historical Perspective on Problems in Botany Teaching. *The American Biology Teacher*, *58*, 340–347. https://doi.org/10.2307/4450174

Hirst, A., & Lazarus, H. (2020). Supporting a Green Recovery: an initial assessment of nature based jobs and skills. In NatureScot Research Report No. 1257. Inverness.

Jose, S. B., Wu, C., & Kamoun, S. (2019). Overcoming plant blindness in science, education, and society. *Plants, People, Planet*, *1*, 169–172. https://doi.org/10.1002/ppp3.51

Kimmerer, R. (2013). Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants. Milkweed editions.

Kramer, A. (2010). Measuring Botanic Gardens' Contributions: To Plant Conservation And Education In The United States. *BGjournal*, *7*, 24–28.

Magntorn, O., & Helldén, G. (2005). Student-teachers' ability to read nature: Reflections on their own learning in ecology. *International Journal of Science Education*, *27*, 1229–1254. https://doi.org/10.1080/09500690500102706

Ondo, I., Dhanjal-Adams, K. L., Pironon, S., Silvestro, D., Colli-Silva, M., Deklerck, V., Grace, O. M., Monro, A. K., Nicolson, N., Walker, B., & Antonelli, A. (2024). Plant diversity darkspots for global collection priorities. *New Phytologist*, *244*, 719–733. https://doi.org/10.1111/nph.20024

Paraskevopoulos, S., Padeliadu, S., & Zafiropoulos, K. (1998). Environmental Knowledge of Elementary School Students in Greece. *The Journal of Environmental Education*, *29*, 55–60. https://doi.org/10.1080/00958969809599119

Parsley, K. M., Daigle, B. J., & Sabel, J. L. (2022). Initial Development and Validation of the Plant Awareness Disparity Index. *CBE—Life Sciences Education*, *21*(4), ar64. https://doi.org/10.1187/cbe.20-12-0275

Queiroz, C., Norström, A. V., Downing, A., Harmáčková, Z. V., De Coning, C., Adams, V., Bakarr, M., Baedeker, T., Chitate, A., Gaffney, O., & Gordon, L. (2021). Investment in resilient food systems in the most vulnerable and fragile regions is critical. *Nature Food*, *2*, 546–551. https://doi.org/10.1038/s43016-021-00345-2

Sanders, D. L. (2019). Standing in the shadows of plants. *Plants, People, Planet*, *1*, 130–138. https://doi.org/10.1002/ppp3.10059

Scherff, L., Rush, L. S., & Holschuh, J. P. (2013). Opening the Conversation: Connecting across Classrooms, Communities, and Disciplines. *English Education*, *45*, 315–321. https://doi.org/10.58680/ee201323851

Schussler, E. E., Bautista, N. U., Link-Pérez, M. A., Solomon, N. G., & Steinly, B. A. (2013). Instruction Matters for Nature of Science Understanding in College Biology Laboratories. *Bioscience*, *63*, 380–389. https://doi.org/10.1525/bio.2013.63.5.11

Sidoti, B. J., Walsh, L. L., Parsley, K. M., Callis-Duehl, K., Hove, A. A., Liu, H., Uzcategui, M., Ospina, D., Bruce-Opris, H., Gonzalez, R., Baraloto, C., & McCartney, M. (2023). Characterizing the landscape of plant science careers in the United States I: Government and private sector perspectives. *Plants, People, Planet*, *5*, 776–795. https://doi.org/10.1002/ppp3.10375

Stagg P, Wahlberg M, Laczik A, Huddleston P. (2009). The uptake of plant sciences in the UK. A Research Project. Retrieved October 04, 2023, from https://www.gatsby.org.uk/uploads/plant-science/reports/pdf/cei-uptake-of-plant-science-in-uk-feb-09.pdf

Stroud, S., Fennell, M., Mitchley, J., Lydon, S., Peacock, J., & Bacon, K. L. (2022). The botanical education extinction and the fall of plant awareness. *Ecology and Evolution*, *12*, e9019. https://doi.org/10.1002/ece3.9019

Sundberg, M. D., DeAngelis, P., Havens, K., Holsinger, K., Kennedy, K., Kramer, A. T., Muir, R., Olwell, P., Schierenbeck, K., Stritch, L., & Zorn-Arnold, B. (2011). Perceptions of Strengths and Deficiencies: Disconnects between Graduate Students and Prospective Employers. *Bioscience*, *61*, 133–138. https://doi.org/10.1525/bio.2011.61.2.8

Tseng, F.-M., Weng, J.-Y., Liu, F.-W., & Hsieh, M.-H. (2022). How to design contests and motivate participants to engage in crowd innovation contests. *The International Journal of Management Education*, *20*, 100722. https://doi.org/10.1016/j.ijme.2022.100722

Walsh, L. L., Parsley, K. M., Sidoti, B. J., Callis-Duehl, K., Hove, A. A., Liu, H., Bruce-Opris, H., Gonzalez, R., Ospina, D., Uzcategui, M., Baraloto, C., & McCartney, M. (2023). Characterizing the landscape of plant science careers in the United States II: Academic perspectives. *Plants, People, Planet*, *5*, 796–811. https://doi.org/10.1002/ppp3.10374

Woodland, D. W. (2007). Are botanists becoming the dinosaurs of biology in the 21st century? *South African Journal of Botany*, *73*, 343–346. https://doi.org/10.1016/j.sajb.2007.03.005

Wyse Jackson, P., & Kennedy, K. (2009). The Global Strategy for Plant Conservation: a challenge and opportunity for the international community. *Trends in Plant Science*, *14*, 578–580. https://doi.org/10.1016/j.tplants.2009.08.011

Yang, C., Li, J., Zhao, W., Luo, L., & Shanks, D. R. (2023). Do practice tests (quizzes) reduce or provoke test anxiety? A meta-analytic review. *Educational Psychology Review*, *35*(3), 87.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Hall, H., Stroud, S., Culham, A., Clubbe, C., Batke, S., Medcalf, S., Jones, M. G., Baker, L., Lydon, S., McGale, E., Acedo, C., Charmley, J., Warren, J. M., & Mitchley, J. (2025). The Botanical University Challenge: Bridging isolation and empowering plant-aware students. *Plants, People, Planet*, 1–14. https://doi.org/10.1002/ppp3.10636