Received: 4 May 2021 | Revised: 20 October 2021 | Accepted: 21 October 2021

DOI: 10.1002/ppp3.10250

RESEARCH ARTICLE

Plants People Planet PPP Open Access

Investing in the future of science: Assessing UK environmental science engagement with school-aged children

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Funding information
Natural Environmental Research Council (NERC)

Societal Impact Statement

Currently, there is no national overview of environmental science engagement in the United Kingdom. Children are key stakeholders in the future of science more generally and environmental science specifically. Appraising the situation immediately before the United Kingdom first entered lockdown due to the COVID-19 pandemic allows both assessment of the achievements of the UK environmental science engagement field before the impacts of the changes resulting from the pandemic, and an up-to-date baseline by which to assess those impacts and identify existing gaps to be addressed post-pandemic. Results indicate that support is needed to increase reach and recognition of the importance of engagement, particularly in rural areas and outside Southeast England.

Summary

- Scoping research was carried out as the first step towards addressing knowledge gaps around engagement of school-aged children with environmental science in the United Kingdom. Key objectives were identifying which institutions carry out this engagement, its scope and where further engagement is needed, and assessing visibility of projects. Examples of good practice were also highlighted to inform the wider community. This was carried out via systematic online searches and an online survey of UK-based environmental science engagement professionals, February to March 2020.
- Most projects were operating locally with a smaller proportion also operating nationally or internationally. Remote engagement comprised a low proportion of delivery, with most projects engaging children in school during school time, using practical sessions. Universities, charities, trusts and societies comprised the majority of hosting institutions. Visiting a low number of schools, a low number of times per year was common, although some projects reached thousands of children in many schools. There was a focus on reaching children aged 7–14 years, relatively evenly split between primary and secondary phases. All major environmental science themes were well represented.
- Most evaluation and reporting was simple and descriptive, and while key areas for expansion included widening reach in terms of numbers and geography, funding was highlighted as a barrier to achieving this.

- Results give a snapshot of the state of play before the United Kingdom entered lockdown during the COVID-19 pandemic, also providing a baseline by which to assess impacts post-pandemic.

KEYWORDS
communication, engagement, environmental science, outreach, participation

1 | INTRODUCTION

Children are key stakeholders in the future of science. During education, they need to develop skills and knowledge that facilitate 'scientific literacy'—understanding scientific and technological aspects of the world (Harlen, 2018)—which benefit both individuals in everyday life and society as a whole (e.g., Czerski, 2016; Davison et al., 2008; Harlen, 2018; Science and Technology Committee, 2017). Children comprise the next generation of the workforce (Dewey, 2017), including future scientists. However, it is known that school science does not engage children as well as some other subjects (e.g., Archer et al., 2012, and references therein), with interest decreasing with age and a need to make science more personally relevant (Kantar, 2020; Murphy & Beggs, 2005). Cultural perceptions can also cause people to feel that science is not 'for them' outside of formal education settings (e.g., Archer et al., 2013; Kantar, 2020; Science and Technology Committee, 2017). This is particularly pertinent to plant sciences where there is a serious skills shortage (Pitt, 2021; Royal Horticultural Society, 2014).

Children are recognised as environmental stakeholders (Barratt Hacking et al., 2007) and critical agents of change in securing a global sustainable future (United Nations, 2015). Science outreach activities can empower and appeal to children through relevant and contextual approaches (e.g., Hobbs, Stevens, Hartley, Ashby, Jackson, et al., 2019; McCauley et al., 2018; Steinke et al., 2017) and make learning fun, which has long been known to have the potential to increase learning, retention and subsequent subject interest when students see work as play (Lepper & Cordova, 1992). They have value in facilitating engagement and positive associations with science and complementing formal science education, which is vital in increasing science capital in society—science-related knowledge, experiences, attitudes and resources (Archer et al., 2012; Science and Technology Committee, 2017). Therefore, environmental science outreach activities are important in both increasing scientific capital and literacy and facilitating children's ability to engage with the environment. However, currently, there is no national overview of environmental science-based outreach and engagement with children in the United Kingdom.

This scoping research aimed to address knowledge gaps around engagement of school-aged children with environmental science in the United Kingdom, in early 2020. Environmental science was defined in broad terms; covering many topics relevant to plants such as plant ecology and food security. While environmental science is a global topic, this initial exercise focused on establishing the situation in the United Kingdom, so that all projects were situated within the remit of the funder, the Natural Environment Research Council (NERC). For clarity, data collection focused on schools-based engagement; this is where most science enrichment and enhancement activity takes place in the United Kingdom (Morgan et al., 2016), and data collection in other settings is more challenging to isolate from other audiences, particularly due to needs to keep evaluation methods non-intrusive at public events (e.g., Hobbs, Stevens, Hartley, Ashby, Lea, et al., 2019; Skinner, 2020). Key objectives were to

- identify which institutions were carrying out public engagement with environmental science with schoolchildren in the United Kingdom and the scope of this engagement, via systematic online searches and an online survey; and
- assess online visibility of UK-based environmental science engagement projects.

Data were collected immediately before the United Kingdom entered lockdown due to the COVID-19 pandemic in March 2020—instigating rapid and unforeseen restrictions on and changes to engagement and interaction, particularly with regard to sharing physical space, availability of staff and access through schools—thus characterising UK outreach and engagement for environmental science with schoolchildren at that time. This provides a snapshot of the situation before the changes to engagement resulting from the COVID-19 pandemic, and a baseline enabling comparison with the subsequent provision landscape and assessment of the impact of these changes. A metric to systematically assess projects, quantifying reach, approach and evaluation was also developed, with examples of good practice highlighted to inform the wider community (Supporting Information).

2 | MATERIALS AND METHODS

2.1 | Systematic online searching

Specific search terms (Figure 1a) were entered into Google, limited to UK results. As the majority of internet users will view only the first page of search engine results, with few visiting any beyond the third (Krrabaj et al., 2017), the first three pages of results ($n = 30$) were reviewed for each term. The process for including results followed the PRISMA system for systematic reviews (Moher et al., 2009) (Figure 1b).

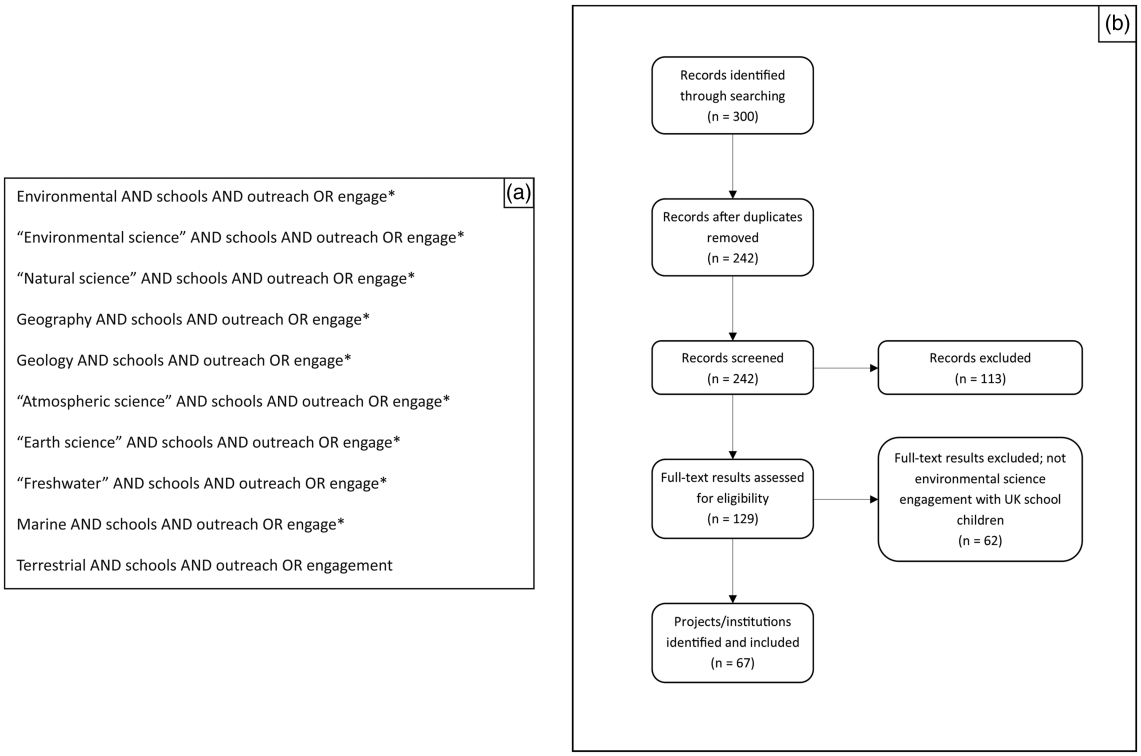


FIGURE 1 (a) Search terms using in systematic online searching. (b) Systematic online search process for identifying projects and institutions undertaking environmental science engagement with UK schoolchildren, adapted from the PRISMA process (Moher et al., 2009)

2.2 | Online survey

The survey was disseminated through relevant UK mailing lists, on UWE Bristol Science Communication Unit social media channels and directly to relevant identified contacts at the 50 institutions receiving the highest total amount of NERC funding as listed in January 2020 (NERC, 2020b) and was open between February 17 and March 15, 2020. The names of the projects reporting and the institutions they were based at, as well as project website links if relevant, were requested. Locations of institutions, combined with those identified as hosting environmental science engagement projects by systematic online searching, were mapped by institution type.

Respondents were also asked to identify which areas of environmental science research were communicated through their projects. The five scientific areas defined by NERC (Atmospheric, Earth, Freshwater, Marine and Terrestrial; NERC, 2020a) were presented as named categories, along with an 'Other' option and free text box for manual entry of other research areas. Although plants were not specified as a discipline, a number of aspects would be covered by the topics above, particularly by the 'Terrestrial' option. Distribution between themes was analysed using a one-sample chi-square (χ^2) test.

Information was collected on the

- number of schools and schoolchildren reached per year;
- number of visits per school;
- type and length of engagement;
- age ranges covered;
- flexibility of delivery mode;
- use of pedagogical methods;
- evaluation methods; and
- modes of dissemination.

As survey responses comprised self-reported data, outreach and engagement activity manually identified through separate online searching was not included in this analysis.

In total, 58 full and 17 partial (where respondents did not have or did not provide all requested information) responses to the online survey were recorded. Following review, 45 full and 9 partial ($n = 54$) responses were analysed to explore the characteristics of projects undertaking environmental engagement with schoolchildren in the United Kingdom. Excluded responses were duplicates, reported ineligible activity (e.g., individual activity within a project, non UK-based projects and commercial activity), recorded insufficient information for analysis or recorded data from two or more projects in one response. Where responses identified the activity and institution only or named multiple projects, these were included in identified project counts and visibility analysis.

Projects that had been active for more than 1 year were asked to report figures for the last full year of data collection. Project status, start and end years, duration, settings used, age ranges engaged, reach to schools and children, session duration and evaluation and dissemination methods used were assessed using descriptive statistics. A one-sample χ^2 test was used to analyse distribution of delivery across

age ranges. Qualitative comments relating to evaluation, dissemination and limitations on projects were manually analysed for content.

2.3 | Online visibility of projects

Visibility of projects was assessed by

- quantifying the proportion of projects, which were both named in the survey responses and identified via online searching; and
- comparing the number of projects identified by online searching and harvested via survey responses.

3 | RESULTS

3.1 | Identification and distribution of projects and institutions

Sixty-eight unique projects were reported, at 53 institutions. One project was disregarded as being outside the United Kingdom. Sixty-seven were identified via systematic searching, at 56 institutions. After removal of duplicates, 129 projects undertaking environmental science outreach and engagement with UK schoolchildren, at 94 institutions, were identified in total. Table 1a,b shows distribution of institutions involved, by UK nation and institution type. While more information is needed about where institutions focus outreach activities geographically (Bridge Group, 2017), previous research indicates that universities conduct most work 'locally' (Universities UK, 2017) and that collaborations with businesses are stronger within a zone of approximately 50 km (30 miles) around institutions (Tijssen et al., 2019). Excluding UK-wide providers, Table 1c lists institution types by regional locations, visualised geographically in Figure 2. Table 1d shows the total number of these institutions in each region.

3.2 | Online visibility of projects

Sixty-seven projects were identified by systematic searching of 300 Google results, compared with 68 identified through the survey. However, of the projects found via online searching, only six were also identified in the online survey; 62 (92%) projects reported in the survey were not found through online searching. Of the 54 responses analysed for specific projects, 59% had a website, whereas 41% did not.

3.3 | Characteristics of projects

All 54 analysed projects delivered engagement in the United Kingdom. Of the 47 reporting their geographical reach, 79% operated locally to their institution, 40% nationally and 19% internationally with 57% working locally only. Those that did not report operating locally were (inter)national providers and/or delivered online

TABLE 1 (a) Geographical distribution of 94 identified institutions hosting environmental science engagement projects within the United Kingdom; (b) types of identified institution hosting environmental science engagement projects in the United Kingdom; (c) institutions types by regional location, excluding UK-wide providers ($n = 24$) and one web-based project for which a physical location could not be ascertained (Wales); and (d) number of located institutions in each region

(a) Geographical distribution

Institution location (percentage of UK population; ONS, 2020)	Number	Percentage of nation-based institutions ($n = 70$)
England (84)	56	80
UK wide (—)	24	-
Scotland (8.2)	7	10
Wales (4.7)	6	8.6
Northern Ireland (2.8)	1	1.4

(b) Institution type

Institution type	Number	Percentage
University	38	40
Trust, charity or society	28	30
Research centre	9	10
Community organisation	7	7
Commercial enterprise	5	5
Government	3	3
Museum	2	2
School	2	2

(c) Nation-based institution types by region

Type	Nation	Region	Number of institutions
Commercial enterprise	England	East Midlands	1
Commercial enterprise	England	London and Southeast England	1
Commercial enterprise	England	Northwest England	1
Community organisation	England	London and Southeast England	2
Government	England	Northeast England	1
Government	England	Southwest England	1
Museum	England	London and Southeast England	1
Museum	Wales	South Wales	1
Research centre	Scotland	Highlands of Scotland	2
School	England	London and Southeast England	2

(Continues)

TABLE 1 (Continued)

(c) Nation-based institution types by region

Type	Nation	Region	Number of institutions
Trust, charity or society	England	London and Southeast England	8
Trust, charity or society	England	Southwest England	4
Trust, charity or society	England	West Midlands	2
Trust, charity or society	Scotland	Central Scotland	1
Trust, charity or society	England	East of England	1
Trust, charity or society	England	Northeast England	1
Trust, charity or society	Scotland	Southeast Scotland	1
University	England	London and Southeast England	11
University	England	Southwest England	5
University	England	Northwest England	4
University	Scotland	Central Scotland	3
University	England	East of England	3
University	England	North of England	3
University	England	Northeast England	2
University	England	East Midlands	1
University	Wales	Mid Wales	1
University	Northern Ireland	Northern Ireland	1
University	Wales	South Wales	3
University	England	West Midlands	1

(d) Number of located institutions in each region

Region	Number	Percentage of total institutions located ($n = 69$)
London and Southeast England	25	36%
Southwest England	10	15%
Northwest England	5	7.2%
Central Scotland	4	5.8%
East of England	4	5.8%
Northeast England	4	5.8%
South Wales	4	5.8%
North of England	3	4.3%
West Midlands	3	4.3%
East Midlands	2	2.9%
Highlands of Scotland	2	2.9%
Mid Wales	1	1.4%

TABLE 1 (Continued)

(d) Number of located institutions in each region

Region	Number	Percentage of total institutions located ($n = 69$)
Northern Ireland	1	1.4%
Southeast Scotland	1	1.4%

engagement or resources accessible from anywhere. Forty-one were 'current projects' and 13 'past projects'. Of 40 current projects with reported start years, the majority (60%) had become active since 2015. A further 23% began during the period 2010–2014, whereas the remainder (18%) began before 2010. Start and end years were reported for 11 past projects. Ten had durations of five or fewer years; the other lasted for 25 years. All had ended since the start of 2018.

Forty-nine responses detailed settings used for engagement. The most commonly used setting was engaging children in schools, during school time (81%), followed by public events outside of school time (52%), public events during school time (48%) and on-site visits (e.g., at the project's home institution) during school hours (44%). All other settings were used by 26% or fewer of projects (Figure 3a).

Individual projects used 1–10 settings; most (85%) engaged in more than one setting. Of the eight projects that reported engaging in only one setting, three hosted children on-site during school hours, three worked with children in schools during school time, one hosted children on-site outside of school hours and one produced materials for schools to use ('Other').

Practical sessions (23%), field-based classes (14%) and assemblies (11%) were the most commonly reported forms of delivery, as was use of videos alongside in-person delivery (14%). Remote delivery comprised 4% of responses regarding delivery mode.

Reach was relatively evenly distributed between primary (47%) and secondary (53%) schools ($n = 47$). All school age groups were covered by projects reporting the range worked with, with two projects covering all six phases. However, focus was significantly ($\chi^2 = 33.8$, df $= 5$, $p < .001$) more concentrated on Key Stages 2 (7–11 years) and 3 (11–14 years) or equivalent than other phases, with 87% and 74%, respectively, working with these age groups (Figure 3b).

Most projects reached either ≤250 (30%) or ≥3000 (28%) children in schools each year; 4% were unable to report the number of children they reached per year (Figure 4a). Almost half (48%) worked with ≤10 schools per year, with 19% reaching over 100 (Figure 4b). Working with a lower number of schools generally correlated with reaching lower numbers of children, although in some cases projects worked with low numbers of schools but higher numbers of children, suggesting that they reached all or most children in schools that were visited. Overall, 59% projects visited each school ≤3 times on average per year; 2% visited 4–6 times, 28% visited 7–10 times, 6% visited ≥10 times and 6% did not know. Of those ($n = 14$) reaching both the lowest numbers of children (≤250) and schools (≤10), 28% visited

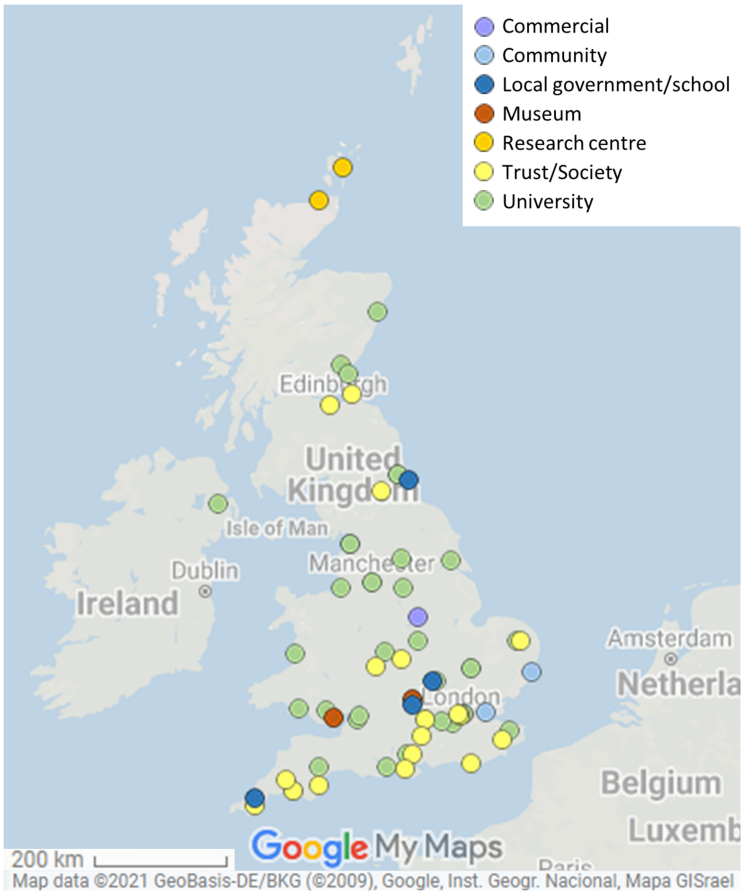


FIGURE 2 UK institutions with identified environmental science engagement projects mapped by type, excluding UK-wide providers ($n = 24$) and one web-based project for which a physical location could not be ascertained (Wales)

those schools ≥7 times per year, indicating repeated engagement with those children. However, the remaining 72% visited ≤10 schools ≤3 times per year.

The majority (52%) of projects delivered engagement sessions lasting over 1 h, on average. A further 28% provided sessions lasting 31–60 min; sessions lasting 1–9 and 10–30 min were delivered by 6% each (4% did not deliver in-person engagement and 6% did not know).

Most projects offered some flexibility in their provision; 70% indicated that delivery was adapted to requirements of participants (15% did not know). Use of pedagogical approaches varied; 34% used a defined pedagogy, 34% did not and 31% did not know. Where a defined approach was used, learner-centred, constructivist, experiential pedagogies were indicated in expanded responses ($n = 7$). Such approaches can encourage child-led development based on children's own ideas, facilitating positive impacts on learning (McCauley et al., 2018; Rosen & Salomon, 2007), and can be easier for outreach and engagement practitioners to implement than teachers, due to the lack of constraints of formal education requirements (McCauley et al., 2018).

Reaching more children, schools and geographical areas were key areas for expansion. Access to funding, particularly to cover staff time, was repeatedly highlighted as the limitation on achieving this, for example, 'capacity is limited by funding … need more staff and time available', 'huge potential to expand … but would need dedicated staff', '… would be happy to do more but we need staff time and funds …', 'within current funding there is no scope for expansion' and 'training more people … this is limited by funding'.

3.4 | Representation of environmental science research areas

All five NERC scientific areas (Atmospheric, Earth, Freshwater, Marine and Terrestrial science) were represented. Although there were 13 'Other' responses, these could be manually categorised into the above themes based on information given in the accompanying open text responses, suggesting that key themes were not always recognised by respondents. With only themes directly identified by respondents used for analysis of distribution between themes, Terrestrial (50%) and Marine (50%) received the highest number of responses. Atmospheric, Earth and Freshwater were represented by 37%, 44% and 37%, respectively. After classification of 'Other' responses, Terrestrial was represented by the greatest proportion of projects (59%), followed by Marine (52%), Earth (44%), Atmospheric (39%) and Freshwater (39%). There was no significant difference in distribution between research areas for those only identified by respondents ($\chi^2 = 2.1$, df = 4, $p = .720$) or with 'Other' responses reclassified ($\chi^2 = 3.6$, df = 4, $p = .462$).

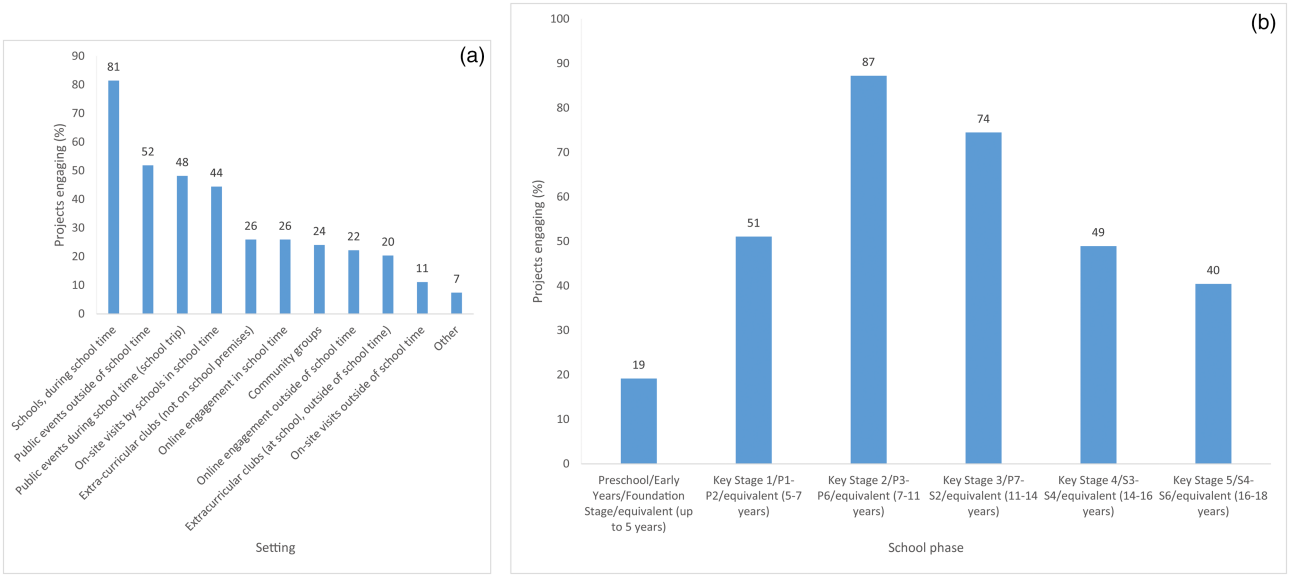
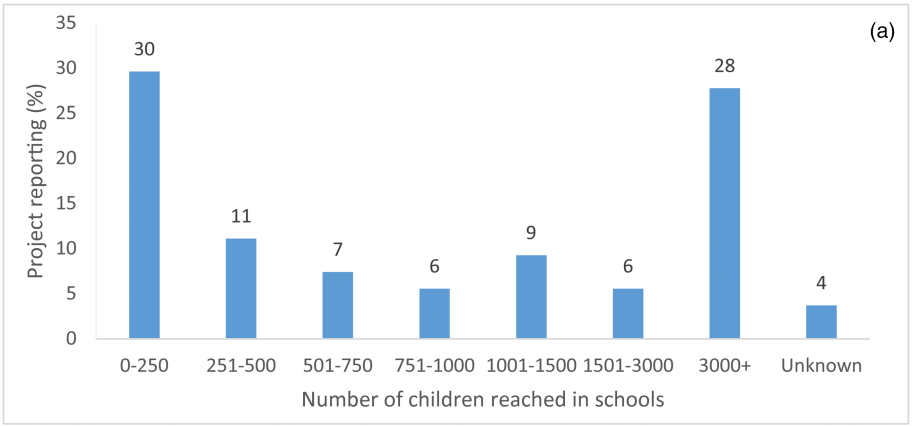


FIGURE 3 (a) Settings used by analysed projects ($n = 54$) to engage UK school-aged children with environmental science. (b) School levels (and ages of children) engaged by analysed projects ($n = 54$)



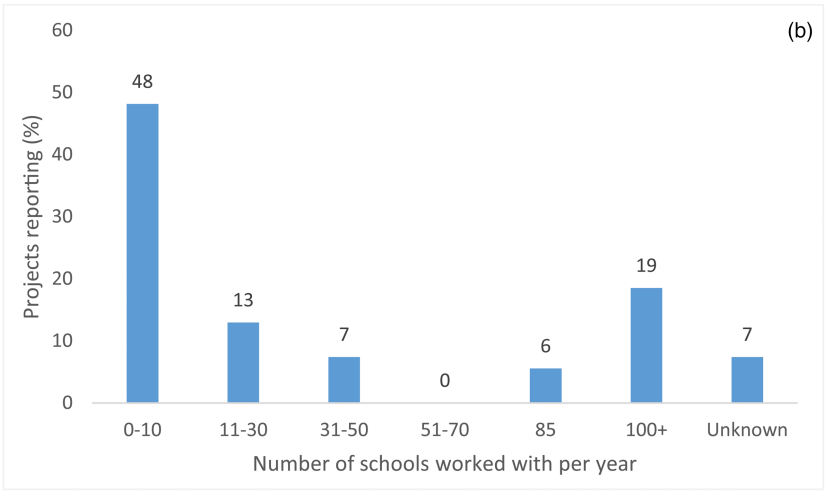


FIGURE 4 Number of (a) children in schools and (b) schools reached annually

Discounting 'Other' responses, leaving 50 projects with directly reported research areas, the majority (34%) represented a single research area. Four and all five areas were represented by 10% and 8.0% of projects, respectively; 82% represented three areas or fewer. This was a statistically significant difference ($\chi^2 = 12.6$, df = 4, $p = .013$).

Of the 44 projects that could be assessed either via their websites or the description given in the survey response, 11 had direct links to plants, with a further 11 having peripheral links where plants were embedded in a wider topic or offering. All five themes were represented by projects directly linking to plants, with nine projects covering multiple themes. Terrestrial was the most common theme for projects linked to plants, represented by nine projects, followed by Earth ($n = 6$), Atmospheric ($n = 5$), Marine ($n = 5$) and Freshwater ($n = 4$). This was based on assessment of the themes as given by respondents; review of the project content indicated that the Terrestrial theme could also be applied to the other two projects with direct plant links.

3.5 | Evaluation and dissemination of projects

Forty-five projects reported evaluation and dissemination methods; after recategorising two 'Other' responses based on expanded answers, simple counts and qualitative evaluation were both used by 80%. Quantitative (51%), descriptive (33%) and inferential (16%) analysis were used by fewer projects. As a proportion of reported evaluation methods ($n = 117$), counts comprised 31%; qualitative, quantitative and descriptive analysis encompassed 31%, 20% and 13%, respectively; and inferential analysis accounted for 6%. Five (11%) projects reported using only one of five potential methods: three using counts (e.g., attendance) and two qualitative feedback. Most used two (44%) or three (27%) methods, with 11% using four and 7% (three projects) reporting use of all five. Expanded responses indicated that some projects designed specific evaluation tools, conducted evaluation for funding-related purposes or did not see evaluation as an embedded element of outreach projects or qualitative feedback as formal evaluation.

Most reporting was descriptive, with internal/to funder descriptive reporting (69%) more than twice as common as external (29%). In-project reporting was conducted by 62%, whereas 64% used public dissemination such as blogs and media, and 44% disseminated through websites and 20% via inferential/research level internal reporting. Whereas 29% and 11% published in academic and professional publications, respectively, only 9% (four projects) used external inferential/research level reporting. Conducting more in-depth evaluation and wider dissemination were potential areas for expansion by 43% and 41% of projects ($n = 44$), respectively.

4 | DISCUSSION

Data were analysed from 54 projects conducting environmental science engagement with schoolchildren in the United Kingdom. The proportion from each UK nation was broadly consistent with population distribution within the country, with universities delivering outreach in all four nations. Although projects were most likely to represent one to three themes, with most focussing on a single area and 46% feeling they could cover more topics, outreach projects addressed all five NERC themes (Atmospheric, Earth, Freshwater, Marine and Terrestrial). The lack of significant difference in the distribution across themes suggests relatively even representation of research themes across the landscape of engagement with school-aged children in the United Kingdom. Projects related to plants, while having the potential to fall within all themes, were directly represented in a relatively low number of projects, and for a further 11 plant-related content was found only through searching of web content and resources, suggesting that more outreach and visibility may be needed to promote engagement with these areas.

At the time of data collection in February to March 2020, most current projects reported had begun within the last 5 years, with the majority of those that had ended lasting for 5 years or under. Although some projects had longer reported durations, this suggests that most tend to be relatively short term. Excluding nationwide providers, hosting institutions of projects identified via systematic online searching and the online survey were concentrated in Southeast England, with more than half of projects reporting via the survey working only in their local area. This indicates that rural areas were underserved, in all nations, in line with existing knowledge that students in more rural and coastal areas are generally less likely to have access to outreach opportunities than those in urban locations (Bridge Group, 2017; Universities UK, 2016; Wilkinson & Lane, 2010). This suggests that more focus is needed on supporting outreach to rural areas, to areas outside Southeast England (notwithstanding that even in areas with greater activity, under-represented groups may not be successfully catered for) and for longer term delivery generally, allowing more extensive work with children and longitudinal impact tracking and evaluation. While the majority of hosting institutions were universities, which may have strong links with local schools and thus design outreach for local context (Universities UK, 2017), expanding reach to other geographical areas, along with reaching more children, reaching more schools and covering new topics, was a key area for expansion highlighted by respondents.

While the concentration of hosting institutions in Southeast England may at least in part reflect population distribution density in the United Kingdom, increasing outreach to other areas could be beneficial. In England, pupils from the West Midlands are least likely to go on to study at Key Stage 5 whereas those in London are most likely, and the gains in narrowing the attainment gap seen in London are not replicated elsewhere (Sutton Trust, 2015) with coastal towns and Northern cities particularly affected (Sutton Trust, 2015). The need for more work on encouraging progression to Higher Education in rural and coastal areas, and the access difficulties faced by those in rural areas, are long known (Universities UK, 2016; Wilkinson & Lane, 2010; Wiseman et al., 2017). There is a need for future research to determine how best to target funding towards places and groups at most disadvantage.

Access to funding, staff and resources was repeatedly highlighted by respondents as the limitation on achieving project expansion. Moves to online, remote delivery as seen during and following the COVID-19 pandemic could present a solution; further research is needed to ascertain whether this is a feasible, viable and effective

long-term approach. Themes emerging on key needs for future expansion are summarised in Figure 5.

Most projects were working with schools, which suggests significant ramifications of school closures during the COVID-19 pandemic, and furthermore, the social and practical shifts caused by the pandemic suggest that online delivery will have now increased, at the expense of in-person activity; follow-up research is being conducted to assess the impact of this. Most projects were working with relatively low numbers of schools and only visiting a few times per year, again linking to lack of access to funding and resources to undertake more extensive outreach work. Previous reporting shows that schools wish outreach to be sustained and meaningful (Universities UK, 2016) and that focusing on a single school is not the most effective use of resources as it limits the number of students reached (Universities UK, 2017).

The strong focus on children aged 7–14 indicates that primary aged children are being targeted by outreach activities, engaging younger children while their interests in science are still forming (Archer et al., 2012; Murphy & Beggs, 2005, and references therein). The variable use and knowledge of pedagogical approaches is consistent with observations made previously in museums (Tran & King, 2007) and suggests scope for professional development to underpin educators' practice with theoretical pedagogical understanding, which will enable them to best support learning (Tran & King, 2009).

In order to scale up outreach activities and improve their efficacy, practitioners need to know what works; however, evidence has been limited in general and the recommendation was made in 2016 that 'Consideration should also be given to evaluating the difference that these interactions make with schools' (Universities UK, 2016). Davison et al. (2008) noted that systematic evaluation of science communication and outreach was critically important, but not often performed and merited development. Results here indicate that in-depth evaluation is not routinely conducted for environmental science engagement activities.

Sharing of evaluation and best practice is also important in improving and expanding outreach activity (Davison et al., 2008; Universities UK, 2016); however, much reported dissemination was internal-facing. Expanding evaluation and dissemination was seen as a possibility by over 40% of responding projects in each case; lack of funding for staff time as noted in free comments is a limiting factor on ability to conduct this rigorously or extensively.

Furthermore, despite reporting via public websites being twice as common as dissemination via academic and professional publications, which may not be publicly available, online visibility of projects was found to be low; 41% of the projects reported in the survey did not have a website and 92% were not identified through systematic online searching.

Based on these insights, projects and practitioners should be supported to expand, particularly to underserved geographical areas, and in reaching more schools and more children, a greater number of times. Evaluation and dissemination should be resourced and seen as valuable; impacts of the pandemic on delivery modes remain to be seen, but it seems likely that the use of remote delivery will have substantially increased above the low rate found here pre-pandemic.

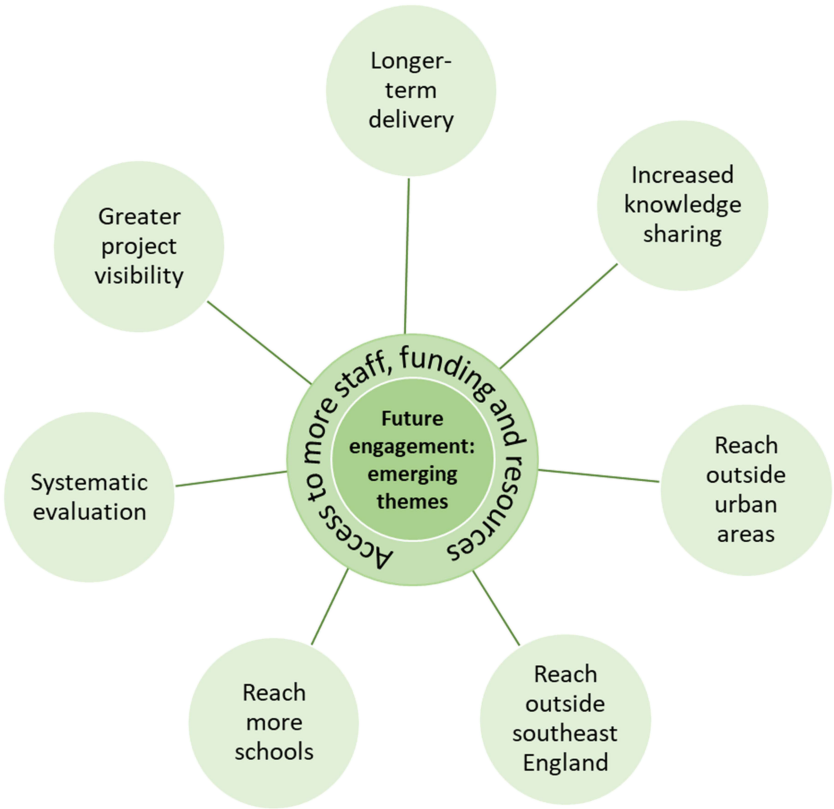


FIGURE 5 Themes emerging on key needs for future expansion, based on survey responses

These changes will not be quantifiable or learnt from without enabling project level investigation and information sharing. Although remote delivery may reduce some costs, effects on practicality and efficacy should be explored, and the need for physical and paid staff resources remains.

While this scoping research focuses on engagement with children in schools, as the main setting for such activity in the United Kingdom, it gives insight into the wider state of UK environmental science engagement for this group immediately before COVID-19 restrictions took effect. There is much scope for further exploration, including ascertaining and quantifying where else children are engaged, exploring teachers' perspectives, quantifying funding and staffing availability and how these impact practice and exploring the extent and practicalities of specific provision for children facing access barriers, as well as promoting the importance of embedded evaluation and information sharing. In light of the COVID-19 pandemic, we are now using these data as a baseline to assess impacts on projects.

ACKNOWLEDGEMENTS

This research was funded by the Natural Environmental Research Council (NERC) 'Embedding Engagement' scheme. Receipt of funding from NERC was not a criterion for inclusion in the analysis. We gratefully acknowledge the contribution of all those who disseminated and completed the survey. Particular thanks is due to case study contacts for agreeing to and reviewing their inclusion as case studies.

CONFLICT OF INTEREST

The Science Hunters outreach project, as featured in the case studies is delivered by this report's authors, and was assessed against the same criteria as other projects.

AUTHOR CONTRIBUTIONS

LH and CS designed the methodology and wrote the manuscript. LH disseminated the survey and analysed results. CS conceived the project.

DATA AVAILABILITY STATEMENT

Research data are not shared for ethical reasons.

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Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Hobbs, L., & Stevens, C. (2022). Investing in the future of science: Assessing UK environmental science engagement with school-aged children. *Plants, People, Planet*, *4*(3), 232–242. https://doi.org/10.1002/ppp3.10250