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SPECIAL SECTION: COVID-19 FORCED RAPID CHANGES IN EDUCATION, BUT WHICH CHANGES SHOULD WE KEEP?

Adapting for remote delivery during COVID-19: Insights from a science engagement project

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Abstract

Science Hunters is an established outreach program using the computer game Minecraft to engage children in science. Before the pandemic, Science Hunters regularly delivered sessions in schools but ceased delivering face-to-face sessions during the COVID-19 pandemic. Online remote delivery was trialed in eight schools, with 201 children of age 9–11 years and 21 school teachers and classroom assistants. This paper aims to evaluate the success of making the change from face-to-face to remote delivery. Children's feedback indicated they were as positive about online sessions of Science Hunters as about those previously delivered in-person. Teachers rated the session organization, delivery, and student benefit on a scale of 1 (lowest)–5 (highest); mean scores of 4.47–4.76 were returned and 100% would repeat the session. The study found that pre-session discussions with teachers covering expectations, training, and technical setup were key to running session successfully. Using activities to run alongside Minecraft sections made the session more immersive and videos at the start of the activity were particularly successful and were carried forward to face-to-face sessions.

1 | INTRODUCTION

Science Hunters is an established United Kingdom science outreach program that uses the computer game Minecraft, a popular open world computer game, to engage children in science learning (Hobbs, Stevens, Hartley, & Hartley, 2019). With an estimated 126 million people now playing it monthly (Chiang, 2020), Minecraft can be played across five gaming platforms. In utilizing its popularity and its creative free play element, Science Hunters has developed imaginative and fun ways for its integration into science learning (Hobbs et al., 2018).

Science Hunters sessions have traditionally involved visits to settings, such as schools, community provision, and public events, by team members to work with small groups of children. They involve a hands-on introduction to a science topic, such as plant biology, animal adaptations, volcanology, coral reefs, minibeasts, and the circulatory system, followed by pupils building relevant creations or exploring a pre-made world in Minecraft.

During the 2019–20 academic year, all visits ceased during March 2020 due to the global COVID-19 pandemic. In August, Science Hunters received a Natural Environment Research Council funded Public Engagement COVID-19 grant to create an online session and remotely deliver it to groups of children, aged 9–11, in 10 schools (as these settings

Abbreviations: LSA, learning support assistant.

remained operational while others were unable to bring children together in person at their locations) between September 2020 and February 2021. Here, we discuss the challenges, successes, and practice insights, applicable across a range of schools and educational settings, of the process of moving outreach sessions to an online delivery format to groups of children who all sat together in a classroom.

Core Ideas

- Adapting physical outreach sessions for remote delivery was challenging.
- Accessible, engaging, and successful sessions were delivered.
- Scheduling training and pre-session discussions with teachers was key to running sessions successfully.
- Using activities to run alongside Minecraft sections made the sessions more immersive.
- Videos at the start of the activity were successful and were carried forward to face-to-face sessions.

2 | CHALLENGES AND DELIVERY

Given the widening education gap caused by the COVID-19 pandemic (EEF, 2021), the first challenge our study faced was whether schools would want or be able to take part in the study. Furthermore, how should the crucial practical Minecraft element be delivered remotely, particularly regarding access to Minecraft and overcoming teachers' general lack of experience and confidence with the game (Nebel et al., 2016)?

When asked about their early reservations in committing to a session, various reasons were given by schools: lost learning, extra time required by teachers, uncertainties in forward planning, and apprehension around technical aspects, in particular using Minecraft.

2.1 | Outreach session development

A timeline for session development and delivery is given in Table 1. For the study, the target audience, subject matter, session structure, and practicalities of delivery were all considered in the early phases. A school educating children of age 9–11 years with existing close connections to Science Hunters was involved in initial development and trial delivery of the session (henceforth, called the "trial school"). This ensured that the session topic was relevant and tailored to the audience, and any initial issues were rectified before sessions were delivered to further schools.

2.1.1 | Target audience

Children from Upper Key Stage 2 (age 9–11 in England) were targeted for incorporation into this study. An estimated 68% of children aged 9–12 actively play Minecraft (Mavoa & Carter, 2018). The children targeted in the study are within the typical age range interested in the game, are attending Science Hunters public events through choice (Hobbs, Stevens, Hartley, Ashby, Lea et al., 2019), and are around the age which interests in science begin to decline (Murphy & Beggs, 2005).

This age group was also selected to make classroom management easier for physically present teaching staff. They are more likely both to have experience of Minecraft than younger children (53% of children aged 6–8 actively play; Mavoa & Carter, 2018), especially if the program had visited the school previously, and be more adept in their fine motor skills and ability to learn the game controls (Ohio State University, 2011).

2.1.2 | Subject matter

During the COVID-19 pandemic, all schools in England closed to the majority of pupils in March 2020 and switched to home learning; this period is commonly called Lockdown 1. Upon reopening in September 2020, many were implementing educational catch-up programs (Department for Education, 2020) and facing potential further disruption due to further localized or national COVID-19 restrictions. Therefore, a topic from the Key Stage 2 National Science Curriculum (Department for Education, 2013) was selected, rather than one which would introduce substantial amounts of unfamiliar content. After discussions with the trial school, a session on the topic of "Classification of living things" was created for remote delivery to schools, with an option for home learning delivery in the event of future closures.

2.1.3 | Session structure and delivery

Prior to the pandemic, the Science Hunters program would run small group sessions for children in schools with sessions and associated activities run by our own staff. Presenting sessions during the pandemic required significant changes with external visitors not being allowed into schools. Devising a successful remote delivery approach posed a significant challenge. Previously, face-to-face sessions were entirely led by Science Hunters staff, with support from setting staff where appropriate. During virtual sessions, some components could

TABLE 1 Timeline of session development and delivery.

Date	Steps taken
July 2020	• Schools that could take part were identified and invited to engage in a session from September 2020 onwards. • Working with the trial school, suitable topics were identified.
August 2020	• Session development.
September 2020	• Session outline, topic video and worksheets sent to trial school for feedback. • Training resources delivered to trial school and online training meeting with school staff.
October 2020	• Online session with the trial school delivered followed by meeting with class teacher for verbal feedback and discussion of feedback. • Sessions and materials adapted to account for feedback.
October–December 2020	• Sessions delivered in eight schools.
January 2021	• Two planned sessions were cancelled due to COVID-related school closures

still be delivered by a Science Hunters team member over a live video feed; the scientific introduction, instructions, and discussions with a scientist. However, other activities, for example, hands-on elements using Minecraft, had to be led by adults physically present, now supervised by an online team member. It was therefore imperative that the adults involved—in this case the teachers—felt well supported and confident to co-operatively deliver the session. To enable this, a clear session plan, plus straightforward staff information sheets, and training videos, worksheets and classroom-based activities were created. Each session was also preceded by a virtually held meeting for discussion, training, and familiarization with the resources. Science Hunters provided all equipment, resources, and training needed to mitigate for economic hardship as a barrier to participation.

Pre-pandemic, a Science Hunters team member would work with small groups of participating children, in rotation if necessary, giving them a hands-on introduction to the science topic ahead of their creative Minecraft session on project laptops. Usual setting activities, for example, teaching the rest of the class in schools, would continue concurrently as appropriate. As this was no longer feasible, an introduction to the science topic was presented to the whole class before it was split into two groups. Since the teacher was required to deliver the Minecraft element, supporting topic-related educational worksheets and activities were created to run concurrently so that while half the class were completing the Minecraft activity, the other half were engaged with these resources. The use of these resources was a new development to the outreach delivery, specifically created to enhance remote delivery, increasing engagement as well as helping with the practicalities of the session structure and delivery.

Another new addition to the session delivery was the creation of a pre-made topic introduction video. This was used rather than a live online presentation from Science Hunters, so that sessions were less reliant on internet connectivity, and the adults physically present could become more actively involved. The video presentation was made interactive by including opportunities for the teacher to pause it and engage the class using accompanying hands-on resources and prompted discussion. This was sandwiched between a live introduction and an explanation of how to play Minecraft, from a Science Hunters team member projected onto the classroom whiteboard. Pre-recorded videos of these live parts were made available in case of connectivity difficulties.

Within the COVID-19 school year group/class "bubble" system, children in a bubble were able to share equipment and work in pairs at a laptop. In our experience, this makes classroom management easier and encourages peer-to-peer collaboration (Hobbs, Stevens, Hartley, & Hartley, 2019), while Minecraft itself offers opportunities to collaborate and engage in playful and interactive social learning (Kervin et al., 2015; Nebel et al., 2016). Teachers were also encouraged to offer "assistant" roles to any class members that were highly experienced in Minecraft, as would be the case during face-to-face sessions, giving these students an opportunity to use their knowledge and gain a sense of expertise (Hobbs, Stevens, Hartley, & Hartley, 2019).

2.2 | Delivery of the virtual session

2.2.1 | Preliminary arrangements

To orient the teachers enrolled in the project, a preparation meeting was held via Microsoft Teams, one week prior to the session. A sanitized laptop loaded with Minecraft along with worksheets, feedback forms, and resources were delivered to the school beforehand for familiarization. This was accompanied by a detailed email about the session including attachments such as consent forms, a risk assessment, and a session plan outline with links to the videos for pre-watching by staff.

During the meeting, the session plan (tailored to that school's requirements; Table 2) was discussed and adapted if

TABLE 2 Example of a lesson plan for a typical session.

Time	Activity	Led by
5 min	Introduction to Science Hunters over live video feed into classroom (pre-recorded back up video also available).	Science Hunters
20 min	Topic introduction by pre-recorded video played to whole class (*web link* provided). Use resources provided for the sorting activities.	Science Hunters and teacher
10 min	Explain Minecraft controls over live video feed into classroom (pre-recorded back up video also available).	Science Hunters
5 min	Split class into two groups.	Teacher
40–50 min	Group 1 using Minecraft on laptops–working in pairs. Group 2 carry out parallel activities.	Teacher with Science Hunters support
10–15 min	BREAK Clean laptops/wash hands.	
40–50 min	Group 2 using Minecraft on laptops–working in pairs. Group 1 carry out parallel activities.	Teacher with Science Hunters support
15 min	Round up of the session: Q&A over live video feed. Goodbyes. Children fill in feedback slips. Clean laptops/wash hands.	Science Hunters Teacher

needed. Minecraft training was provided and the teacher could practice on the laptop by following detailed written instructions and game play video footage. The technical set up for the session's live video feed into the classroom was also checked.

The day before the classroom session, a set of sanitized laptop equipment and borrowed resources were delivered to the school in a COVID-19 secure method, along with personal protective equipment and cleaning products. Between schools, the equipment was thoroughly sanitized and quarantined for at least 72 h.

2.2.2 | On the day

The teacher connected to a Science Hunters team member via Microsoft Teams. For safeguarding purposes, online sessions were secure, school staff had to remain in the classroom and teachers had full control of their audio and video settings.

The session started with a short introduction from Science Hunters (Figure 1). The teacher then led the pre-recorded science topic video presentation before handing back to Science Hunters to explain the Minecraft task and the game controls.

The teacher then led the classroom activities with the Science Hunters member online in the "background" to supervise proceedings and provide assistance and classroom interaction.

One half of the class did the Minecraft task on the laptops, working in pairs and taking turns to create/build (Figure 2). The other half engaged in related activities on classification keys using pre-made worksheets and investigating resources (Figure 3). The two groups then swapped over. Modifications to this plan were made if required, to accommodate individual school needs. The session ended with a final live video

FIGURE 1 The video feed as seen by pupils in the classroom, with a virtual Minecraft background (photograph courtesy of Amy Garnett).

"Q & A" section with Science Hunters before goodbyes were said and feedback slips were completed by the children.

2.3 | Delivery and reach

Ten online sessions were delivered to eight schools between September and December 2020; seven in Lancaster and

FIGURE 2 Children building topic related creations in Minecraft. In this case, they are building an arthropod insect to include its key features (photograph courtesy of Amy Garnett).

FIGURE 3 Some of the resources used in the session, provided by Science Hunters (photograph courtesy of Amy Garnett).

Morecambe and one in Cumbria. Two further schools could not participate due to the uncertainty of Lockdown 3 (January–March 2021). Although most sessions were delivered to Year 5 and 6 children, two were adapted and delivered to other year groups (a mixed Year 3/4 group and a Year 8 group during an extracurricular Minecraft Club).

Of the 201 children (103 boys and 98 girls) participating, the majority were in Year 6 (155), with 13 in Year 3, four in Year 4, 13 in Year 5, and 16 in Year 8. Twenty-one members of teaching staff were involved.

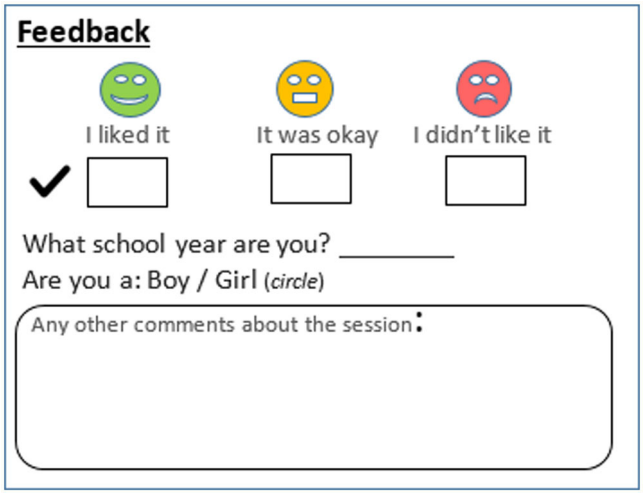

FIGURE 4 Children's feedback card.

3 | EVALUATIONS

As the sessions were tailored to individual schools so delivered slightly differently in each, evaluation is of the project delivery on the selected topic as a whole, rather than attempting to separate out feedback into smaller samples for each specifically delivered session.

3.1 | Children's feedback

Feedback cards containing a choice of three faces/statements to give feedback on the session, with space to add written comment if they wished, were given to children (Figure 4). It was communicated via the teacher that completion was entirely voluntary. Pictorial scales, including "smileys", are commonly used to enable children to communicate responses; they can help those at lower reading levels to answer and can be more enjoyable (Toepoel et al., 2019 and references therein).

4 | RESULTS

Of the 189 feedback cards returned, 89% ($n = 168$) were positive (I liked it), 10% ($n = 19$) were neutral (It was okay), and 1% ($n = 2$) were negative (I didn't like it). The mean score, on a scale of 1–3 (1 = negative, 2 = neutral, 3 = positive), was 2.83 ± 0.03.

One session was delivered to a younger class of Year 3 and 4 children; measures were taken to make classroom

TABLE 3 Mean "smiley face" ratings on a scale of 1–3 for children with various characteristics.

Characteristic	*n*	Rating range (1–3)	Mean rating (1–3)	Standard error
Female	87	1—3	2.89	0.04
Male	95	1—3	2.78	0.06
Primary school	173	1—3	2.84	0.03
Secondary school	16	1—3	2.69	0.18
Lower Key Stage 2	15	1—3	2.53	0.17
Upper Key Stage 2	158	1—3	2.87	0.03
Learning support assistant present	164	1—3	2.84	0.04
Learning support assistant not present	25	2—3	2.76	0.09

Note: Primary school visits targeted Years 3−6, whereas secondary school targeted Years 7 and 8. Lower Key Stage 2 refers to Years 3 and 4; Upper Key Stage 2 refers to Years 5 and 6.

management easier, such as making the Minecraft task more prescribed and pairing children with a Year 5/6 buddy to assist (Badley et al., 2018). Although no children reported that they "didn't like" the session, it appeared more challenging for the teacher during the practical section with many children needing and waiting for assistance. This was reflected in children's feedback, with only 64% being positive ("I liked it") compared to 89% across all sessions (91% with this session excluded from analysis), and the remainder (36%) selecting "It was okay".

Another session was delivered to a Year 8 lunchtime Minecraft club over four shorter, 20 min sessions. Although this had to be delivered solely by the teacher using videos rather than a live feed due to the room setup, participating students reported similar levels of positive responses (87%) to the overall feedback (89%).

Mean ratings from specific groups of children, where characteristics were reported, are shown in Table 3.

After testing for normality, Mann–Whitney *U* tests were used, in SPSS 26, to test for statistical significance of differences between: female and male students, primary and secondary school students, lower and upper Key Stage 2 students, and students who did and did not have a learning support assistant (LSA) present in their sessions. For this study, a *p*-value of <.05 was accepted as statistically significant.

There were no statistically significant differences between female and male students ($U = 3888$, $p = .241$), primary and secondary students ($U = 1286$, $p = .426$), or whether a LSA was present ($U = 1817$, $p = .119$), although there are order of magnitude disparities in sample size for comparisons of school type and presence of an LSA.

There was a statistically significant difference ($U = 835$, $p = .001$) in mean rating between children in Lower Key Stage 2 (school years 3 and 4, age 7–9 years) and Upper Key Stage 2 (school years 5 and 6, age 9–11 years), with the older children giving a higher mean rating than the younger group, although it should be noted that the size of the older cohort was 10 times greater than that of the younger.

Of the 189 feedback cards, 129 included comments, the content of which was analyzed to ascertain which elements were most common in the written feedback (Figure 5). Since one written comment could cover more than one category, each comment could be allocated to more than one category group, for example, "it was fun to learn about science" would be assigned to both "Fun/enjoy/amazing" and "Education/learning element", returning 212 items of categorized content.

The majority of the comments revolve around fun/enjoyment (46.7%), followed by the science topic itself (17.92%). Most of the negative comments were around initially finding it difficult to use the game controls.

4.1 | Teaching staff feedback

Teachers said initial doubts about running these sessions were outweighed by the opportunity for this experience, especially in these restricted times. A couple said that they thought it would be beneficial as a new experience, such as our sessions acting as a trigger to a child's retention of learning (previous school sessions have been shown to improve subject knowledge; for example, Hobbs, Stevens, Hartley, Ashby, Jackson et al., 2019). Teachers and LSAs were given a feedback questionnaire. This was completed by 17 members (81%) of the teaching staff involved: nine teachers and eight LSAs. They were asked to grade, on a scale of 1–5, the organization and running of the session and the extent of benefit to students. They could also give written feedback about each part. Each question, its mean score and range, and a selection of written feedback is shown in Table 4.

Of 55 individual written comments, only seven were negative or neutral. Four made suggestions for improvements to the resources, such as using more realistic or a wider range of animal models and providing additional information about the invertebrates in the resin blocks. The other three were related to the practicalities of using Minecraft, such as initial

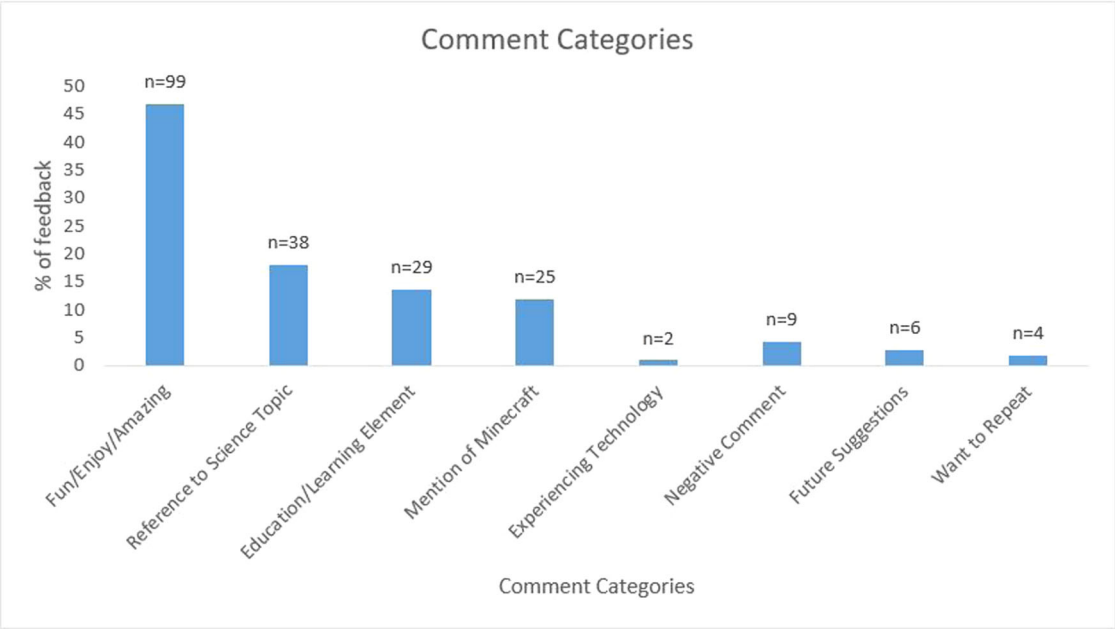

FIGURE 5 Distribution of content of written comments across identified feedback categories.

difficulty with the controls or deciding what they needed to build. Feedback collected, particularly from the early sessions, was used for continuous development.

No teaching staff felt that the session did not meet their expectations; 64.7% said it exceeded and 35.3% said it met expectations. Some commented that this was only because they already had high expectations after experiencing previous sessions with Science Hunters; "I only selected met expectations as I already knew it would be an extremely enjoyable session for the children due to previous experience of it (still of great quality even delivered remotely)."

There was no significant difference (Mann–Whitney U tests; $p > .05$) between responses from teachers and LSAs on any measure. There was also no significant overall correlation (Spearman's correlation test) between the level of benefit to children of taking part that staff perceived, and other measures, except a moderate positive correlation ($r_s = .639$, $p = 0.006$) between ease of organization and perceived benefit to children of taking part. When considered by staff role, a strong positive correlation between ease of organization and perceived benefit was found for LSAs ($r_s = .800$, $p = 0.006$; $n = 8$), but not for teachers ($r_s = .478$, $p = 0.193$; $n = 9$). There were no other significant correlations between perceived benefit to children and other measures for either teachers or LSAs.

Responses of staff working with different age groups were not compared as only three worked with children outside of Year 6, with two of those working with mixed groups including children in Year 6. The results suggest that schools were highly satisfied with all areas of the session.

Finally, when asked if given the chance they would do it again, 100% said they would, and 100% also said they would recommend the experience to other schools.

5 | DISCUSSION

Selecting schools that Science Hunters had previously worked with provided two key benefits: (1) teachers were more confident in our ability to train them and deliver a successful session, and (2) classroom management was easier since the children already had experience of a Minecraft-based session with Science Hunters. Although more preparation work was needed by the school than usual and many staff were outside of their comfort zone with the Minecraft element, they rose admirably to the challenge. Feedback from the teaching staff was positive with schools being highly satisfied with all parts of the session. Further analysis showed a strong positive correlation between ratings for session organization and benefit of the session to the students for LSA's feedback, but not for teacher's feedback. Support staff often have less time than the teacher/project lead to comprehend the task they are assisting with. For these sessions, LSAs were less involved in the pre-session planning than the teachers; therefore, their perceived benefit of the session to the students may be more strongly correlated with its organization's result. Clear instructions and organization of resources is of particular importance for support staff to ably assist student learning on the day; this would also apply in non-school settings. All schools said they would repeat the opportunity should it be available and many of these

TABLE 4 Feedback from teaching staff.

Survey question: On a scale of 1 (very difficult)–5 (very easy), how easy did you find the organization of the session taking place?	***n* = 17** **Mean: 4.76 ± 0.11** **Range: 4–5**
Selection of written feedback: • "It was brilliantly organised and easy to implement in the classroom." • "The guides and videos assisted the Teacher prior to this event thanks to the dedication of the Science Hunters." • "Wonderful communication throughout and resources all copied and ready to go made it incredibly simple—great to have a laptop to try it out on too." • "It was brilliantly organised and easy to implement in the classroom."	
Survey question: On a scale of 1 (very difficult)–5 (very easy), how easy did you find running the introductory part of the session?	***n* = 15** **Mean**: **4.73 ± 0.12** **Range**: **4–5**
Selection of written feedback: • "The videos were very clear and interesting." • "Worked well. Good that there are opportunities to pause the video intro." • "Having [*Science Hunters staff name]* on screen was really useful and the video provided the children with everything they needed to know." • "Clips effective; excellent use of live feed/YouTube clips."	
Survey question: On a scale of 1 (very difficult)–5 (very easy), how easy did you find running the Minecraft section of the session?	***n* = 15** **Mean**: **4.53 ± 0.17** **Range**: **4–5**
Selection of written feedback: • "I am rubbish at Minecraft but the tips sheet was very useful." • "Getting a laptop to play around on gave me confidence and getting all of the resources in good time was very helpful." • "All the visual instructions help those (like me) who have never used Minecraft." • *"[Science Hunters staff name]* was available to speak to the children at all times which they enjoyed."	
Survey question: On a scale of 1 (very difficult)–5 (very easy), how useful did you find the extra activities/worksheets provided?	***n* = 17** **Mean**: **4.65 ± 0.12** **Range**: **4–5**
Selection of written feedback: • "Excellent resources, children loved the wordsearch/resin blocks."	
Survey question: How much do you think your students benefited from participating? (1 not at all–5 hugely)	***n* = 17** **Mean**: **4.47 ± 0.15** **Range**: **3–5**
Selection of written feedback: • "A great interactive method of teaching the science curriculum." • "Huge engagement from the whole class with some brand-new learning included." • "Especially at this time, it was still fun whilst educating them." • "Thank you for putting this activity on, especially with the difficulties we face this year." • "Encouraged teamwork and problem-solving skills as well as providing an engaging context for the science knowledge." • "An excellent idea and this has given us the idea of introducing other science-related topics throughout the year and setting challenges to keep the activities fresh and interesting." • "Great for social skills (partner work), computing skills (and fine motor skills) and consolidating scientific knowledge. Appealed to a wide range of children and motivated/engaged some children who struggle to engage during normal lessons".	

schools are, at the time of writing, partaking in a new online session.

All schools felt that the sessions were worth the effort and feedback from the children supports this. Compared to previous feedback collected from public events (89.5% positive, 10% neutral, and 0.5% negative: Hobbs, Stevens, Hartley, Ashby, Lea et al., 2019) and school sessions delivered in-person by the same team member (89% positive, 9% neutral, and 2% negative for academic years 2018–2020), it seems that the children appear to enjoy the remote sessions (89% positive) as much as those delivered physically. Many children recognized that the session was educational, with comments such as "I loved it because you make learning fun with Minecraft" (Year 6 pupil) or "It was really fun and I learnt some new stuff about science" (Year 6 pupil). The only factor that seemed to significantly affect the child's feedback of their enjoyment during the session was age, with Upper Key Stage 2 children enjoying it more than the Lower Key Stage

2 children. This appears to support the original reasoning in the selection of Years 5 and 6 as the main target audience, although the difference in sample size should be noted.

Initial creation of the session and its resources required significant development and preparation, but once completed these could be easily adapted to tailor delivery for each school. Though originally aimed at Years 5/6 in classrooms, the session was also adaptable for other age groups and scenarios. It was challenging to devise a session that would deliver the same learning experience and enjoyment as a physical session, necessitating utilization of a variety of presentation formats and resources. Once everything was in place, however, it was relatively straightforward for the school staff to run. Although a remote delivery format has increased potential for technical issues to arise, measures were put in place to mitigate for this as much as possible.

Usually schools can pick from a variety of topics, sometimes having different topics for different year groups, but online delivery and the time available to adapt sessions reduced flexibility in this regard; only one topic was available to schools. Sessions were only available to one year group/class bubble as equipment could not be shared between bubbles in the timescale. Going forward, a small choice of the more popular sessions could be developed for future remote delivery. Additionally, with the training for Minecraft already completed, repeat visits would be more straightforward.

Although the schools had an option to use Minecraft on school computers, only one school had the facilities to do this. Therefore, to ensure that the session was accessible, delivery was focused on schools that were local to the university the project was based at. This enabled schools to borrow everything they needed to complete the session. However, this also meant that only one school per week could take part due to the time needed for sanitization and quarantining of equipment. A higher than usual level of equipment damage and loss was noted due to rigorous cleaning, transportation, and not having direct supervision during its use. There was also a necessary reduction in reach compared to the pre-pandemic Science Hunters offer, in which sessions were offered and delivered across much of the UK to thousands of children in multiple settings and far beyond the local reach of the hosting institution.

Two schools could not take part due to school closure during the UK's Lockdown 3, and a home learning option was made available. Given that whole school closure for lockdown was for a much longer and indefinite period, these two schools decided against the home learning option. However, during preliminary meetings with schools, many liked this idea as an option should the class or school be isolating during the booked visit date.

6 | CONCLUSION

In conclusion, during a time when settings were unable to host physical Science Hunters sessions, we created new opportunities for engagement with our science outreach program. Although for Science Hunters, physical visits have the advantage of a more personal interaction with the visiting scientist and reducing the extra work for setting staff, remote delivery can also be highly successful and confers other benefits. For example, removal of the need to travel to session locations saves time, financial costs, and environmental impacts. Going forward, as face-to-face outreach increases with reductions in COVID restrictions, there is still great value in:

- carrying forward some of the new techniques learned, in particular the use of newly developed concurrent activities to run alongside the practical Minecraft section to make it a more immersive experience. This, along with the use of a video presented at the start of the activity, was carried forward to subsequent Science Hunters projects once this project ceased. Such videos were also adapted and used for access online by a wider target audience;
- carrying out some online delivery, and moving to a blended approach, which allows a wider range of locations and audiences to be reached.

Further evaluation of Science Hunters' remote offering, including providing schools with Minecraft to use on their own hardware, both for online delivery and with project-provided resources for teachers to deliver themselves with background support, is ongoing and additional analysis will provide further insight to themes, challenges, and successes identified here. However, for other programs that wish to extend their delivery into an online format, this reflection gives some ideas of possible formats, some of the hurdles involved and how they can be overcome. The key is in the planning and preparation of the session: suitable resources, clear communication with those that have to help deliver it, a scheduled session outline so everyone knows the role they have to play to ensure continuity, easy to use audience-targeted resources, and a pre-session discussion covering expectations, training, and checking of technical setup.

AUTHOR CONTRIBUTIONS

Jackie Hartley: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; writing—original draft; writing—review and editing. **Laura Hobbs**: Data curation; formal analysis; methodology; project administration; writing—review and editing. **Carly Stevens**: Conceptualization; funding acquisition; project administration; writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Due to the sensitive nature of the research, no research subjects consented to their data being retained or shared.

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