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An Example of the Views of Educators on Incorporating the Sustainable Development Goals into Engineering and Environmental School Engagement Activities Using Minecraft

Laura Hobbs * and Sarah Behenna

School of Applied Sciences, University of the West of England, Coldharbour Lane, Bristol BS16 1QY, UK; sarah.behenna@uwe.ac.uk
* Correspondence: sciencehunters@uwe.ac.uk

Abstract: The United Nations adopted the Sustainable Development Goals in 2015 as a call to "end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity". The UK-based Science Hunters programme uses Minecraft to engage children with Science, Technology, Engineering, and Maths. Its Engineering for Sustainable Societies project engaged children from under-represented backgrounds with engineering and the Sustainable Development Goals. We conducted mixed-methods interviews with eleven teachers, with objectives of exploring their needs and views with regard to this opportunity to use Minecraft and engineering to engage their students with the Sustainable Development Goals. Inductive thematic analysis of the qualitative data indicated that teachers were interested in the appeal and creativity of Minecraft, opportunities to creatively learn about and explore engineering at various ages, and real-world relevancy. Access barriers and the unlimited nature of the game were concerns. They felt that students would gain greater understanding of sustainability and what they can do, and deep exploration of the topic at their own level. Overall, it was felt that engineering and the Sustainable Development Goals, explored in Minecraft, could give children the opportunity to think about the future of the world they live in.

Keywords: sustainability; engineering; environment; Minecraft; engagement

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1. Introduction

The 17 Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 as a call to "end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity" [1]. It is widely acknowledged that innovative and effective education is needed to enable children to deal with issues arising from the actions of previous generations [2,3]. Children and young people are recognised as having the right to participate in society [4] and should be seen and empowered as citizens of the world [5,6]. Here we describe an approach to engaging children with the SDGs through the lens of engineering, using the computer game Minecraft. Our objectives were to (1) gather information to inform our delivery of Minecraft-based sessions exploring engineering and the SDGs, and (2) analyse this information in greater depth to explore the views of UK teachers on incorporating the SDGs into school engagement activities in this way. We conducted mixed-methods interviews with eleven school staff in the UK about their views and needs regarding engaging children with the Sustainable Development Goals and engineering using Minecraft. We focus on the qualitative outcomes of those interviews to explore these teachers' views within the case of this project. Thematic analysis identified three key themes: immediate benefits, immediate concerns, and future hopes, giving insight into the current needs and experiences of UK educators in relation to the SDGs, engineering engagement and using Minecraft for education.

Context

Minecraft is a hugely popular game, widely used in educational settings and effective for engaging children with the environment, engineering, and places [7–9]. Open-ended and with myriad opportunities for building, experimentation, and making and resolving mistakes, it has been described as an example of Papert’s [10] ‘object-to-think-with’ [11] and one of the most important games of the current generation [12]; it is currently the best-selling video game globally [8]. Studies have shown that Minecraft can be effectively deployed to support students with special educational needs to socialise and develop skills [7,13–16] and the game has been noted across various contexts and educational topics as providing opportunities for active knowledge construction, collaboration, and problem solving [7,12,17–19].

Science Hunters was established in 2014 and is a UK-based programme of projects that use Minecraft to engage children, particularly those facing potential barriers to accessing educational opportunities, with Science, Technology, Engineering and Maths (STEM). Topics are briefly introduced via hands-on, interactive discussion, promoting dialogic talk [20]. Participants then undertake topic-related building tasks or challenges in Minecraft and are supported to determine their own approach to this. They construct understanding and meaning within the context of the game, through their own ideas and efforts alongside collaboration with others, facilitating inquiry-based learning [21,22]. Thus, utilising a learner-centred constructivist approach [23,24], anchored instruction [25] and constructionism [26] are applied by contextualising the themed building challenge in a real-world situation and building upon existing knowledge to explore the topic and advance understanding.

The accessibility of Minecraft and its capability to support transformational play [27] by allowing interaction with and modification of the virtual environment and creation of almost any structure using blocks [7,28] facilitate this approach. Students are encouraged and supported to direct their own learning and solve problems through Minecraft, with strong emphasis on constructing understanding and meaning from the information given and their own existing knowledge [20]. This ensures that children can find and maintain interest in and understanding of scientific topics and feel a sense of ownership and that these fields are ‘for them’, whilst consolidating their learning. Previous research demonstrates that this approach can engage children who do not show a strong interest in science, and that taking part in sessions in schools significantly improves knowledge and understanding of the topic covered [29,30].

While the relationship between video games generally, and socio-emotional development is noted as complex, promotion of skills development, self-efficacy, and exploration in a safe virtual environment is itself in line with Sustainable Development Goals 3 (Good Health and Well-being) and 4 (Quality Education) [31]. Minecraft has been effectively used to support learning about sustainability and the SDGs. For example, Minecraft Education’s top 10 Minecraft moments of 2021 included items about their ‘sustainability worlds’, Climate and Sustainability Subject Kit, and UNESCO partnership inspired by the SDGs [32], and in June 2024 they announced a new UNESCO partnership to create and globally distribute educational content on sustainability and climate change [33]. In Ireland, a 2021 national competition offered a creative, collaborative, and engaging opportunity to design a sustainable version of their local area in Minecraft [34]. Likewise, links between engineering and Minecraft have been recognised since the game’s release [12,35,36]. As of July 2024, the Minecraft Education site provides seven engineering resources and challenges. In the 2023–2024 academic year, engineering has been explored in Minecraft through initiatives such as children designing streets in the game with the support of engineers [37], and the Welsh digital learning platform Hwb releasing three projects that allowed learners to immerse themselves in engineering in Minecraft and support the SDGs [38].

Furthermore, engineering and engineers are recognised as crucial in achieving the 17 SDGs [39,40]. The SDGs can be explicitly incorporated into engineering higher education programmes [41,42], combining sustainable engineering with the SDGs at a UK primary school was explored by UNESCO in 2023 [43], and our own previous work demonstrated links to the SDGs in Minecraft-based engineering engagement, leading to development of the current project [44].

2. Materials and Methods

After exploring links to the SDGs during 2020–2022 [44], a new project, Engineering for Sustainable Societies, was designed in 2022 and initiated in 2023 with funding from the Royal Academy of Engineering Ingenious Awards scheme, to explicitly engage children from under-represented backgrounds (with a focus on, but not limited to, girls, children with Special Educational Needs and Disabilities, children from lower socioeconomic status backgrounds, and children in care) with engineering and the Sustainable Development Goals.

The project supported engineers to develop their engagement skills by contributing to the design and delivery of a set of Minecraft-based sessions, structured as outlined above, on environment-based topics relating to engineering and the SDGs, such as active design, the circular economy, renewable energy, sustainable leisure, and ways to manage future food and flooding challenges. These sessions, and resulting legacy resource supporting materials made freely available online, were designed to be combined into a series allowing students to construct their own 'sustainable community' model over a number of sessions, but also function as standalone sessions in order to accommodate different logistical needs. Sessions were delivered in UK schools during 2024 and primarily aimed at an audience of 7–14 years, a key age range for Science Hunters activities [29]. However, activities were tailored and adapted to the needs of each participating group and, as such, could be delivered to children of various ages and settings. Delivery was provided free of charge, with all necessary resources provided by the project.

Semi-structured, mixed-methods interviews were conducted with teachers, alongside advertising of the engagement outreach project to schools, during May–June 2024. They concerned teachers' views before their participation in the project (i.e., they were not gathering feedback about completed activities), and not all respondents went on to access the project offer. The information sent to teachers included the following text about the project:

> "Engineering for Sustainable Societies is a new outreach project to engage children from under-represented groups with engineering and the Sustainable Development Goals using the popular computer game Minecraft"

and how the sessions work:

> "Science Hunters sessions are all slightly different, and are adaptable to the needs of those taking part"
>
> However, they have some core elements:

- A hands-on, interactive topic introduction. This usually involves using some physical resources and discussing them.
- For example, during the 'Coral Reef Conservation' session, some examples of coral are shown, along with images of threats to coral health such as illegal fishing vessels.
- A Minecraft building or exploration task. These are differentiated for age, ability, and experience with Minecraft and can be stepped.
- For example, in the 'Corals' session, children explore a pre-built coral reef, build their own coral reef, build a glass-bottomed observation boat, or devise their own related build.
- This building is child-led. Sessions follow a constructivist pedagogy utilising anchored instruction and constructionism to scaffold learning."

Teachers were working in primary and secondary schools in England and Wales. With respect to the busy nature of teachers' jobs, respondents were able to give their answers via email or by online call, as best suited them; all opted to respond via email. The purpose of the questions was both to gather individual information to support bespoke delivery to meet the needs of each teacher, school, and participating student group, including selection of a session topic for those that went on to access the provision, with additional deeper analysis in aggregate for this research where participants consented for their responses to be anonymously used for this purpose. 29 interview requests were sent to teachers with accompanying participant information, of which eleven responses were returned for inclusion in research analysis.

Interviews included closed questions focusing on awareness and prior and future incorporation of the SDGs into teaching and pastoral support, and how the activity would best work for the participants, as well as open-text questions allowing for elaboration on these answers, deeper exploration around challenges and benefits, and any other information respondents felt was relevant.

Responses were first used to inform activity provision where relevant, to support tailoring to the needs of individual participants, and then analysed in aggregate. For the purposes of this study, quantitative data (regarding teachers' national location within the UK, age group taught, prior awareness and use in teaching of the SDGs, cohort selection, and careers relevance) are reported to provide context, while qualitative responses to the following questions were analysed:

- What do you think your students would gain from exploring the SDGs in a specific engagement session?
- What do you think about using Minecraft and engineering to engage your students with the SDGs? What benefits or pitfalls could you foresee?
- We are specifically looking at how engineering and the SDGs can be used to support understanding and facilitation of building future sustainable communities. Which curriculum areas would you find these aspects were best linked to?
- (In relation to the closed question, "Would activities emphasising these areas (engineering and the SDGs) be useful for careers provision?"): How would they be useful? Would you use them within lessons or as part of pastoral support? Or, why would they not be useful?
- Why would you target such activities at the whole class or specific groups of students?
- Anything else you'd like to tell us about engaging students with the SDGs and engineering, either in general or using Minecraft.

With awareness of our position as both practitioners and researchers, and our underlying perspective that Minecraft is an effective engagement tool that we seek to make as efficacious as possible, data were analysed inductively to identify themes [45,46]. As such, while some of the outcomes (the codes and themes) were inevitably influenced by interview questions such as those around benefits and pitfalls, analysis was performed without a pre-existing coding framework determined by the researchers, or in line with any preconceptions or pre-determined aspects that had to be considered [45]. Latent themes underpinning the semantic (explicit) data were explored by considering existing knowledge about the SDGs, Minecraft, engineering engagement, and other relevant underlying factors that may shape responses [45]. We are able to interpret the data at this level by drawing on our understanding as long-standing practitioners and researchers of STEM engagement through Minecraft, our own STEM backgrounds, teaching experience, practice in engaging under-represented groups, and experiences as individuals falling within some of these groups ourselves.

Analysis was performed in NVivo 14.23.1. Responses were reviewed and content categorised into codes, which evolved during the process through immersion in and reflection on the data [46]. These codes were then reviewed and organised into themes; both the codes and themes are reported below as outputs of the analysis [46]. The stages in the process of generating codes and identifying themes are shown in Table 1, based on the phases of analysis outlined by Braun and Clarke [45].

Table 1. The stages in the qualitative analysis process, following Braun and Clark's 'Phases of thematic analysis'.

Process Stage	Description of Activity
Data familiarisation	Transcription of the data from interview responses into aggregated dataset, reading and re-reading the data and noting initial ideas.
Initial code generation	Systematically coding data features across the dataset, collating all relevant data to each code.
Identify themes	Organising codes into themes, collating all relevant data to each theme.
Review themes	Reviewing themes against both the coded content and the dataset as a whole.
Define themes	Generate names and definitions for each theme, refining the specifics of each in the process.
Extract and summarise	Selection of extracts as clear examples of each theme, relating back to the research question and summarising findings.

Ethical approval for this study was approved by the University of the West of England College of Health, Science and Society Faculty Research Ethics Committee, approval code HAS.20.05.177.

3. Results

Of the eleven respondents, ten were based in England and one in Wales. Six taught primary school age groups (aged 4–11 years) and five taught secondary school students (aged 11–18 years). Three were aware of the SDGs before engaging with the project and had all previously incorporated them into lessons or activities; the other eight respondents reported that they were not previously aware of the SDGs.

Respondents were asked which of the 17 SDGs were most relevant to them and their students' school lessons/activities; these were used to inform development of session topics, including those listed in Section 2, and for context, are shown in Table 2. Teachers' interest was most directed towards the SDGs addressing climate action and good health and well-being, closely followed by the goals around no poverty, inclusive and equitable education, and peace, justice and strong institutions. These were felt to be tangible topics relevant to students, particularly as the project aimed to reach students from under-represented groups, and aligned with the curriculum and personal development.

Table 2. The 17 SDGs and the number of respondents identifying each as relevant to their students' school lessons or activities.

SDG Number	SDG Title	SDG Description	Number of Respondents Identifying SDG as Relevant to Them and Their Students' Learning
1	No poverty	End poverty in all its forms everywhere.	6
2	Zero hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	5

3	Good health and well-being	Ensure healthy lives and promote well-being for all at all ages.	7
4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	6
5	Gender equality	Achieve gender equality and empower all women and girls.	5
6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all.	2
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all.	5
8	Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.	5
9	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	2
10	Reduced inequalities	Reduce inequality within and among countries.	3
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable.	4
12	Responsible consumption and production	Ensure sustainable consumption and production patterns.	4
13	Climate action	Take urgent action to combat climate change and its impacts.	7
14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.	2
15	Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	4
16	Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.	6
17	Partnerships for the goals	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.	1

Eight respondents, across primary (n = 4) and secondary (n = 4) teaching, were positive that such activities would be useful for careers provision because of the need to improve awareness and experience of engineering, while the remaining three (two primary and one secondary teacher) were unsure; for example, specific careers consideration is less relevant when working with younger children. Eight reported that they would target activities at whole class groups, two at specific groups, and one at both whole classes and specific groups as needed.

Themes, codes and extracts can be found in Table 3 and are expanded upon below.

Table 3. Identified themes and codes within them. Themes are explained in a summary and through selected quoted extracts.

Themes	Codes	Summary	Extracts
Immediate benefits	Broader perspectives	Teachers felt that shared experiences in exploring real world issues could broaden children's views and understanding.	"Shared experience can help to develop understanding even further allow[ing] access to different perspectives."
	Engagement benefits	Allowing access to learning about sustainability for all children, as a way to facilitate both initial engagement and in-depth topic exploration, with the SDGs as an underpinning theme.	"A great way to engage students of all ages." "A sustained period to discuss in depth on of the topics chosen."
	Engineering subject benefits	The appeal, creativity and local industry links of engineering were highlighted.	"[Engineering is] interesting and an area students would appreciate exploring." "It also makes them aware that through engineering they can have a positive effect on the future."
	Minecraft benefits	Minecraft was felt to be appealing, engaging, creative and easy for the students to use.	"The children love using Minecraft and it fully engages them."
Immediate concerns	Engagement concerns	Concerns were expressed about the risk of teacher bias in choosing participants, ongoing engagement post-activity and lower importance of sustainability within the GCSE curriculum.	"When students are studying [at] GCSE, sustainability is a lower importance with the rest of the curriculum."
	Minecraft concerns	Teachers had some concerns about access to Minecraft and that it may be too familiar to students.	"Not all schools/students will have access to Minecraft."
	Engineering subject concerns	Engineering as a subject could be inaccessible to some.	"Level of students engaging in engineering, would this be accessible to all?"
Future hopes	Supporting future engineering	Teachers felt that sessions would raise awareness of engineering as a career, support informed choices and link engineering to	"Future engineering needs to be closely linked to SDG as the next generation designs the future."

		the SDGs. The skills deficit in engineering was also highlighted.	"An opportunity to continue to explore a future career that otherwise, they will gain little (or no) experience of."
	Responsible citizens and future actions	Learning about the SDGs in this way could give children insights into positive actions they can take to become responsible citizens and lead sustainable lifestyles.	"Encourage forward thinking about preventing and improving our world." "Hopefully leading them to a more sustainable lifestyle."

3.1. Immediate Benefits

This was the most prominent theme, with teachers expressing a range of perceived and expected contemporaneous benefits to engaging with the SDGs through Minecraft and engineering. These have been subdivided into positives associated with perspectives, engagement, engineering, and Minecraft. Anonymous alphanumeric identifiers are used to cite respondents; as themes were consistent across primary and secondary school teachers, results are not separated. However, respondent identifiers contain P (primary) or S (secondary) for context.

3.1.1. Broader Perspectives

Working together to explore the topic was anticipated to provide children with opportunities to "access different perspectives", "develop understanding even further" (T3P) and "open their mind to a different point of view" (T1S), and access to "increased cultural capital" (T10S), and to help them "to understand the issues that are faced outside of our little town!" (T6S). Using the SDGs and engineering to support building future sustainable communities was specifically linked to the Geography, Design and Technology (DT), Science, Information Technology (IT), and Personal, Social, Health and Economic Education (PSHE) areas of the curriculum, but was also felt to be relevant to "the majority of them—we encourage our curriculum to be linked to 'real world' issues as much as possible" (T3P).

3.1.2. Engagement Benefits

Sessions were seen as an opportunity to give "all children the opportunity to learn about sustainability" (T2P), with teachers wanting whole classes to access the provision, as well as using small groups in some cases as "some students would benefit from smaller groups to be able to explore their ideas in more detail" (T6S), and opportunities to "broaden their horizons" (T10S). It was reported that in younger age groups, there are more opportunities to consider the SDGs within the curriculum, and that the children who are perceived as "not necessarily the strongest academically" could be those who were most creative in their designs (T1S).

The opportunity to make students aware of "how SDGs can be a theme that runs through each session" (T1S) was highlighted (alongside raising awareness of engineering as a career). The approach was felt to help children "understand things more on their own level—sometimes the issue can be initial engagement" (T3P), with the sessions providing "a sustained period to discuss [topics] in depth" (T4S) where "expert-led sessions will increase pupil engagement" (T8P). For younger children in particular, bringing the creative element of engineering into the classroom was seen as "an exciting way to make the SDGs accessible" (T11P).

3.1.3. Engineering Subject Benefits

Engineering was described as "interesting and an area students would appreciate exploring" (T6S), including both those with limited knowledge of "what engineering is and all the different ways to be an engineer" but who "like to create and build" (T11P), and in schools for which engineering has been "our most popular career choice amongst school leavers over the recent years" (T5S). Engaging in this way was seen as a means of "building cultural capital" (T8P) with students needing "to be creative and the future will need a creative solution to meet the SDGs" (T1S) in relation to the subject. Links to regional "excellent career opportunities within this sector" (T5S) were highlighted as a local benefit in particular areas. The project approach was felt to make children "aware that through engineering they can have a positive effect on the future" (T1S).

3.1.4. Minecraft Benefits

"The children love using Minecraft and it fully engages them" (T2P); the game was seen as appealing to children and "a great idea to capture young individuals" (T5S) "of all ages" (T4S). Respondents reported that it is "a great tool to get them learning without even realizing" (T11P) and "easy to understand and familiar to most students" (T6S) so that they "need little guidance on using [it]" (T1S). It was also viewed as an opportunity for students to "easily be creative" (T1S) and potentially "explore further learning at home" (T4S). Its "accessibility for students that may struggle with traditional lessons (for a variety of reasons)" (T9P) was also highlighted.

3.2. Immediate Concerns

Concerns were less evident than perceived benefits, and this was the least prominent theme overall. Comments and expressed reservations fell within concerns about engagement, Minecraft, and the content of the engineering subject matter.

3.2.1. Engagement Concerns

These concerns were highlighted by one teacher (T1S), who noted that there may be less space to engage older school students, as "when students are studying GCSEs, sustainability is a lower importance with the rest of the curriculum" compared to younger age groups and that, after initial engagement, students need to have a "journey onwards [to] a career". This teacher also stated that they would expect to run activities with a whole class, and not differentiate for specific groups, as "if you target specific groups, you are making a judgment based on a biased view and not by outcome".

3.2.2. Minecraft Concerns

It was noted that "not all schools/students will have access to Minecraft" and that "not all parents would allow" it in relation to previously mentioned opportunities to continue learning at home (T4S). One teacher was concerned that the game "has no direct limits" and that "they are not able to test, fail, adjust and succeed" (T1S). Two others, while recognizing that the game is familiar to most students, felt that it "Could lose the impact as it may be too familiar" (T6S) or that "pitfalls might include students going off-task" (T7P). Two others reported that "all children can access this" within their school, but that their school technical support may be needed (T8P).

3.2.3. Engineering Subject Concerns

Level of understanding was mentioned, as "engineering requires a good level of mathematical understanding, which could be a barrier for some students" so that "would this be accessible to all?" was queried (T4S). Engineering was also seen as potentially "too complex for them to understand the 'point' of it" (T6S); "the implications of some engineering focused tasks can be hard for young children to grasp" (T9P).

3.3. Future Hopes

As well as immediate perceived benefits, teachers discussed a range of potential longer term positive impacts that they foresaw as an outcome of engaging with the activities. These were based around making children aware of engineering as a career and what skills future engineers will need, and supporting children to become responsible citizens and consider what actions they can take to live sustainable lifestyles.

3.3.1. Supporting Future Engineering

In light of the "lack of engineers needed to fill future jobs" as "there are many engineers coming to retirement and no one to replace them" (T1S), and that "engineering is a field that students lack understanding of" (T6S), "won't have much knowledge about" (T7P) and "can be unaware of the opportunity for" (T1S), teachers expressed a need for students to be given opportunities to learn more about engineering as a career option. This can be difficult through other routes such as work experience as "many companies struggle to be able to get [students] placements due to technical part of the job" (T6S). It was felt that "any action to support this career is very positive" (T1S) and that emphasizing engineering and the SDGs "would encourage them into this field" (T6S); sessions were seen as "an opportunity to continue to explore a future career that otherwise, they will gain little (or no) experience of" (T3P), with targeting of under-represented groups an opportunity to "widen the diversity of those who eventually work in this sector" (T10S). Students "can make informed career decisions if they are given the chance to experience" different options, and this was noted as particularly relevant for some year groups, such as "Year 9 students who may be undecided on choosing GCSEs"; by linking the SDGs to engineering, it was anticipated that "we will hopefully have engineers who want to change the future to be more sustainable" (T1S), with "great benefit to understanding [engineering] and how it is applied to solve real-world problems" (T7P).

3.3.2. Responsible Citizens and Future Actions

Exploring the SDGs through engineering and Minecraft was deemed to "make [students] aware that through engineering they can have a positive effect on the future" (T1S). Addressing the topic in this way was seen as a route to "encourage forward thinking about preventing [negative impacts] and improving our world" (T5S), including "understand[ing] the issues that are faced outside" of their own town (T6S) with "trying to solve real-world problems [being] meaningful and motivating for students" (T7P). Engaging in such activities was hoped to give students "a full insight into what they can practically do" (T2P), "hopefully leading them to a more sustainable lifestyle as they grow to be responsible citizens" (T1S); "the idea of immersing the children in these concepts becomes a way of ensuring that they are continually conscious about important issues and their futures" (T3P).

4. Discussion

4.1. Immediate Benefits and Concerns

Immediate benefits were the most strongly represented theme and teachers expressed clear anticipated positive impacts for their students. Engineering was seen as interesting and important to present to children, who might not otherwise have opportunity to gain experience of it as a field, while Minecraft was felt to be an effective tool to engage children and support them to explore the subject creatively. This aligns with previous work on using Minecraft for education and engagement [7,8,15,18,19], including that within Science Hunters projects [29,30,44]. Exploring the SDGs collaboratively and considering sustainability and future communities in this way offers opportunities to access different views and broader perspectives, including consideration of issues beyond students' own locale. This links both to the known benefits of Minecraft as a collaborative activity [7,14,17,47] and its utilisation for engaging children with place [8,48], the concept of which can contribute to their spatial and temporal meaning-making [8,49]. Concerns that Minecraft may be too familiar to children are not borne out by the numerous accounts of use of the game in educational and engagement contexts, and ongoing provision of "hundreds of lessons created by educators around the world, for students of all ages" to the Minecraft Education resources website [50]. Further mitigation is provided by the novel use of the game in school lessons, with scaffolded learning content, rather than as standard computer gameplay, as well as knowledge that efficacy of learning increases when it is fun [51]. Nonetheless, this provides an insight into concerns teachers may have, and practitioners using the game may find it useful to highlight some such examples as a form of reassurance. Access barriers to the game are important to consider; while some schools have their own onsite provision (including through programmes such as that of the Welsh government to provide Minecraft's Education Edition to Welsh schools "to ignite a passion for creativity, innovation, critical thinking, problem-solving and personal effectiveness through game-based learning" [52]), others do not, and access varies widely. Exploration and discussion of the causes and factors underpinning this variability are complex and require future research; however, on a practical level, practitioners should ensure that they are able to facilitate access for the purposes of sessions to avoid exclusion from the activities on this basis. In our experience, even when this is clearly stated during initial contact, it can still be a key query for teachers exploring uptake of the engagement offer, and bears emphasizing.

Teacher experience with Minecraft (and computer games more generally) also varies, an acknowledged limitation to application in educational settings [8,11]. Expressed concerns around a perceived inability to test ideas, fail, make adjustments, and find successful solutions in the game may be interpreted in this light, as Minecraft provides these opportunities through the nature of its function and supports a trial-and-error approach [47,53]. In its creative mode, players have access to unlimited numbers of blocks with a wide range of appearance and functions, within the limits of the game's inventory and underlying functions, and the game's educational version offers a teacher-managed control interface [11]. Within this, players are able to quickly place blocks, test out functions (for example automated processes or 'electrical' applications) and then just as quickly remove blocks and make adjustments which can then be retested. As such, the game provides a 'low stakes' environment to virtually build (as opposed to using real, finite, and potentially non-adjustable or costly physical materials) and test creations and allows children to explore settings and processes that they could not access in a real-world classroom setting, and in Science Hunters sessions, within the framework of the topic under discussion [30]. This includes exploring and testing on accelerated timescales. For example, we have often utilised the function that seeds planted in Minecraft will germinate and grow quickly, rather than having to wait days or weeks in real life to discover whether success has been achieved, if the correct conditions such as preparing the ground and modifying the environment (for example, adding a water supply) are provided [54]. Teachers emphasised that opportunities to consider real-world problem solving in this way would facilitate student engagement. Furthermore, the game's open-ended nature has been shown to foster STEM engagement in several studies [55], including those from under-represented groups [56].

Views around whether teachers would target the described activities towards whole classes and/or specific groups were mixed and did not appear related to the age of the students. Some teachers felt that they would prefer to offer activities to all children rather than select specific groups, with one highlighting potential teacher bias in selecting students as a concern with this. Others, however, felt that targeting towards students studying relevant subjects would be useful, and underlined that both options could be utilised, so that all children are able to participate and those that would benefit from working in smaller groups have access to such provision. This is consistent with teachers' interests in SDGs targeting well-being and equitable education and in line with the Science Hunters inclusive, flexible approach [57], which includes working with both smaller groups and whole classes and is supported by these outcomes—'one size does not fit all' and understanding STEM subjects and the world around us has value for everyone, whether or not they will eventually go on to further study or work in related fields.

One teacher expressed concerns around challenges with the significance of the SDGs in the curriculum for school years approaching the end of compulsory school education and their ongoing engagement. In the specific context of this study, Science Hunters projects, while not excluding other groups, target Key Stages 2 and 3 (age 7–14 years) with a core focus on Key Stage 2 (age 7–11 years). This is a research-informed operational decision based on evaluation of age groups most likely to be motivated by the use of Minecraft in this way [29], knowledge that children's interests in science form by 14 years [58] with decline beginning around age 10 [59], and the increased flexibility to engage with such activities in lower year groups, as highlighted by the teacher.

In a broader context, therefore, activities that are directed towards older age groups may need to be specifically targeted at narrow curriculum areas where content is particularly relevant, and developed in close collaboration with teaching staff to ensure that they can be effectively accessed and utilised for these age ranges. While the GCSE level (age 14–16 years) highlighted here is nation-specific, similar challenges are likely to apply elsewhere. The needs of students reaching completion of their compulsory education requires distinct consideration compared to younger age groups, particularly regarding how to provide effective, locally relevant support for their future career pathway choices after their initial point of engagement. Where the aim is to encourage students toward STEM careers, longer-term programmes understandably have more impact on career aspirations than one-off or shorter-term interventions; however, such single or short course activities, which are not isolated but operate within a broader ecosystem of children's learning and experiences, can be inspiring and have inherent value [60].

In this case, activities (and the associated legacy resources made freely available online beyond the project's lifespan, enabling teachers to utilise them) within this specific project could be accessed as standalone sessions, or as part of a series of ongoing engagement. Which option best suits each school and group, and how schools might be able to promote continued engagement after the activity takes place, is specific to each setting. For all ages, it is important to consider (within the bounds of aspects such as operational feasibility and availability of funding) how activities can have lasting impact. This includes whether activities are delivered as one-off interventions or over longer periods of engagement, and how this will be delivered for each group. The challenge of how to effect lasting impact through STEM interventions is a sector-wide one [60].

Other identified concerns, including those around the level of content and requirements for children to be working at a certain level, are generally mitigated by appropriate pitching of content and the ready adaptability of Minecraft to different skill levels [57], and are addressed specifically by Science Hunters through inclusive and flexible project design and delivery. This theme supports the inclusion of features such as embedding educational content within the context of 'having fun' in the game, and having no defined outcome (and therefore no 'right' answer) but operating within the framework of the topic. This approach enables children to explore their own interests, in line with their abilities and the focus of the session, directing their own activities with flexible adult scaffolding and support. It also emphasises flexible, adaptable delivery methods to tailor and differentiate the experience to suit the needs of each participating group and individual student [30,57]. Furthermore, previous research using Minecraft has demonstrated that complex concepts can be rapidly grasped through game learning [61], and in relation to the Science Hunters approach, our own research has shown enhanced topic learning and understanding through participating in sessions [30]. School STEM clubs, without the more rigid requirements and testing of formal lessons, can be important positive factors in students choosing to study STEM subjects [62], as well as for personal enrichment and supporting a more informed populace [63]; most importantly, our project aims to give children an opportunity to enjoy STEM learning in ways that they might not usually have access to, or find more difficult to engage with in formal academic lessons, as highlighted by teachers in their interview responses.

4.2. Future Benefits

Using engineering and the SDGs within Minecraft sessions to consider the features and design of future sustainable communities was noted to relate both to specific curriculum areas such as Geography, DT, and PSHE, and children’s learning journey as a whole due to the links to real-world issues; sustainability is an interdisciplinary topic that fits within various areas of children’s learning [64]. The use of game-play to bring the content to children “on their own level” and the benefits for those children who may face barriers to engaging with more ‘academic’ activities were seen as key positives in allowing all children access to opportunities to learn about sustainability—an outcome which is in itself linked to SDG4, “[e]nsure inclusive and equitable quality education and promote lifelong learning opportunities for all” [5,65,66]. This underpinned hopes for future benefits, including supporting children to “grow to be responsible citizens” by “immersing the children in these concepts [as a way to ensure] that they are continually conscious about important issues and their future”. Children, as those who will inherit sustainability challenges, have been positioned as ‘critical agents of change’ [4,5,67,68], including in addressing these pressures, and should be supported to develop the skills to navigate them [67,68]. While enabling children and young people to make connections between their own actions and influences on global climate change can facilitate development of a sense of self-efficacy [69], this includes recognising that children may not be in a position to, for example, influence household-based decision-making [68]. Science Hunters has a core focus on delivering to children from under-represented groups, and includes STEM professionals from such backgrounds, which bestows benefits of both representation during sessions, a key factor in promoting diversity through STEM communication [70,71], but also lived experience during activity design. This project focused on how engineering can be used to explore sustainable design and the roles of engineers within this. This comprised considering future infrastructure and broad environmental factors, rather than personal responsibility or pressure to take certain actions, such as reduction of consumption which is less relevant to resource-constrained family circumstances [68]. It is notable therefore, that the engagement opportunity was both viewed through a lens of what children “can practically do” whilst recognizing the ‘becoming’ element of childhood as they grow towards ‘better futures’ [4], as well as other benefits beyond the core focus of the sessions and feeling that engaging with such content would support children’s more general sustainability education.

The focus of this study is not a ‘careers’ project—the core aim is to support children from under-represented backgrounds to learn about the session topics, with relevance to their worlds, through an activity they enjoy at a level that suits them, and see engineering and engineers in a ‘different light’ outside of stereotypical representations or more traditional perceptions of the field and the roles within it. However, teachers considered that participating children could be encouraged to become engineers themselves in future, and made aware that they could have a positive effect on the future through the field. Although the importance of early experiences in influencing STEM career choices is recognised [58,71], and despite an acknowledged engineering skills gap in the UK [72], it has recently been noted that while engineering is beginning to become more visible in the primary curriculum (including through STEM programmes), it continues to suffer low visibility in pre-service primary teacher training [73]. While teachers can find it difficult to make contact with engineers and make use of their support, it has been shown that even limited contact with engineers can be beneficial [73]. Bringing engineers’ input to schools through engagement activities is one such route to facilitating contact between schools and engineers, and providing supported opportunities for students to access exposure to real-life engineers. Engineering education outreach projects can also bring benefits to teachers through expert engineering input, and engineers through development of transferable skills such as communication and teamwork [74]; such projects can promote dialogic engagement and mutual benefits. As Emembolu et al. [75] point out, raising awareness of careers and STEM fields from early in children’s education in this way does not have to be intended to point them towards a certain career, but to expand awareness of opportunities and possibilities to support informed choices.

The skills deficit was also mentioned, with concerns around children’s awareness of engineering as a career option (although where awareness was higher due to localised exposure opportunities, it was noted as a popular choice) and lack of opportunity for practical experience due to difficulties in securing placements at a suitable level for school students. In this context, where “any action to support this career is very positive”, the engagement activity was seen as an alternative opportunity to enhance awareness, providing experience to support students making informed choices about further study and career pathways. The need for engineers to be creative, and the SDGs as a theme underpinning activities, were identified; the Institution for Engineering and Technology’s 2023 International Green Skills Survey found that more than half of respondents thought that engineers entering in the workforce should have skills including “specialist environmental or sustainability knowledge” [76]. This applies more broadly to engagement with engineering, creativity, and sustainability, and in the specific case of using Minecraft, the game not only encourages creativity but also supports evaluation and decision-making practice in an informal, familiar context. These skills are seen as key for future engineers [77].

4.3. Limitations

Limitations include that interviews were not anonymous and were collected in relation to a specific project, our position in relation to the project, and the limited size of the dataset. We are in some regard “insider researchers” in that we conducted research on our own project delivery, and therefore bring both benefits of insight and risks of assumptions [78,79] and ultimately operate on the basis that Minecraft is an effective engagement tool. An inductive approach to analysis without use of a pre-existing coding framework and with awareness of our position was chosen towards mitigation of such potential preconceived expectations. We also acknowledge, in the context that Braun and Clarke [46] describe this as a resource for thematic analysis, that we bring researcher subjectivity to the data analysis. Questions were administered in advance of participation, and therefore were not framed as feedback on the delivery itself. Responses were returned by email, avoiding ‘on the spot’ conversations with the project team, and participants were operating within a professional context. It was emphasised that the primary aim was to facilitate effective delivery, with space to note potential pitfalls; any apprehensions or more negative comments were therefore expressed in this context and the interviews effectively captured concerns, as identified in the resulting themes. However, responses were necessarily not anonymous, as they were also used to support tailoring of activities to the needs of participating groups where relevant. While not all respondents went on to host a project session at their school, we cannot know how many potential respondents who did not feel that such provision would be beneficial did not respond at all.

Interviews were conducted with teachers working across a range of age ranges, roles, and locations (not specified for confidentiality reasons) and this study provides insight into their views within the real-world context of this case [80], which sits within the broader STEM engagement sector. However, the size of the dataset was constrained by the capacity of the project and teacher availability and consent; given the limited funding available for this type of project, and the pressures on teachers, a larger dataset was beyond the scope of this work and outcomes are necessarily limited and interpreted within the context of the related engagement project. These limitations are considered and reflected in our framing of this study as an example of the views of educators on our approach to incorporating the SDGs into our engagement activities.

4.4. Future Research

Potential future work includes further exploration of the views of teachers towards incorporating the SDGs into activities and using Minecraft and engineering in this way, including gathering views from teachers in other locations and settings, and outside of the situation within the specific project described here. There is also scope to explore, for example, views or changes of perceptions of children in relation to the SDGs and engineering.

In relation to this work, we plan to expand our analysis to include the views of leaders collaborating on delivery to community groups and participating engineers, which can be compared to those of teachers, alongside post-participation feedback from children. More broadly, there is much potential to explore engineering and the SDGs in Minecraft, separately or in combination. Perspectives of teachers may vary over time, particularly as governments, curricula and global contexts change, and there would likely be interesting comparisons to be drawn between views of teachers across the UK, and between UK teachers and those based elsewhere. Furthermore, our cohort is necessarily limited; future research could focus on obtaining data from a larger and more varied group of respondents, using fully anonymous data collection. This could include exploration of factors influencing some schools to incorporate SDGs into their curricula, while other teachers report that they are not aware of them. Capturing insights specifically from respondents who do not feel the provision would be beneficial is another potential avenue. In-depth analysis of the complex and variable factors affecting school access to Minecraft as an educational resource would benefit practitioners aiming to use the game to engage children across subjects; this will inevitably be affected by influences such as locality and political situation as well as temporal variation and, as such, requires context-specific consideration and likely multiple studies in defined contexts.

5. Conclusions

SDGs around equitable access to education and resources, climate action, and health and well-being were of particular relevance. While teachers had some immediate concerns about the use of Minecraft and engineering to engage children with the SDGs, these can be mitigated through project design and communication with teachers, and the perceived immediate benefits outweighed such reservations. Immediate benefits included Minecraft as an effective engagement tool, opportunities to consider engineering as a field, and access to different points of view. Furthermore, potential future benefits were identified, including supporting children to grow into future responsible citizens and increasing awareness of the SDGs in the next generation of engineers. In summary, as expressed by respondent T1S, "Future engineering needs to be closely linked to the SDGs as the next generation designs the future".

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