Abstract

Aims: To gain practice-based insights, we evaluated outcomes from a science-themed Minecraft Club for children with Special Educational Needs over a four-year period. Science topics were introduced, followed by themed building in Minecraft in a multi-player setting. Particular focus was placed on the benefits of playing a shared-interest game in a social and educational context.

Methods: Mixed-methods interviews and surveys were used to gather feedback from children attending the club and their accompanying caregivers. Inferential statistics assessed the influence of individual differences and club attendance time on responses.

Findings: Children consistently enjoyed attending the club and most felt that they had developed their scientific knowledge. Social-communication skills and confidence were also positively impacted, as reported by both children and caregivers. The accepting and inclusive nature of the club was of high value.

Limitations: Sample sizes and data collection methods were necessarily restricted and mainly qualitative due to the purpose of the club and the nature of the attending cohort. However, valuable insights were gained from respondents.

Conclusions: Both children and caregivers communicated that Minecraft Club succeeds in providing a context through which children can develop social and communication skills, build confidence, make new friends, and learn about science. These insights have important implications concerning the potential social and educational benefits of Minecraft for children with Special Educational Needs, and the value of extra-curricular clubs that provide safe and supportive spaces for children to thrive.

Keywords: Minecraft, Special Educational Needs, shared special interests, collaborative play, wellbeing

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Introduction

Minecraft, the second-best selling video game of all time (Peckham, 2016), is extremely popular amongst children of all ages. The game involves placing and breaking blocks with a wide range of appearances and properties to build an almost-infinite range of constructions. It can function either as a single-player game or a shared virtual world with multiple users playing on the same server. With many parallels to real-world settings and processes, Minecraft is a highly entertaining and interactive platform for communicating scientific concepts (Hobbs et al., 2019b; Short, 2012).

Science Hunters is an outreach project that capitalises on Minecraft's popularity and functionality to communicate scientific knowledge to children. This approach naturally enthuses children to engage with scientists and scientific topics through the use of a familiar and appealing medium. The project specifically aims to reach children from groups who may face barriers to accessing educational opportunities (Hobbs et al., 2019b), with a strong focus on those with Special Educational Needs (SEN). A fundamental component of the project's provision is its 'Minecraft Clubs'. The longest-running of these, initiated in 2015, is specifically for children with SEN. Minecraft is a shared interest of many children with SEN, and countless anecdotal reports suggest that the social-interactive aspects of the game have great benefits for confidence, social motivation, and communication skills (Hobbs et al., 2019b; Ringland et al., 2016). Minecraft Club uses a dedicated server that enables children to play together in a protected social space that can be customised and developed to align with each session's learning objectives. Most children attending this club present with autism

spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and/or dyslexia (although the club is not formally restricted to children with these conditions).

Over more than four years of delivery, extensive feedback has been collected from children and adults attending the club. The objective of this practice-based analysis is to document how children benefit from playing Minecraft – a shared interest – in a common space and provide insights into such provision.

Minecraft as an engagement tool

Engagement can be conceptualised as active involvement in learning with cognitive, affective, and behavioural components (Park *et al*., 2012), and is considered to be critical for learning in children with and without disabilities (Dykstra Steinbrenner & Watson, 2015). In the UK, 69% of 6–10-year-olds and 81% of 11–14-year-olds play video games (Association for UK Interactive Entertainment, 2018) and the potential of video games as vehicles for learning and engagement is being explored (e.g. Gee, 2007; Nebel et al., 2016; O'Sullivan *et al*., 2017; Prensky, 2001; Sánchez-Mena & Martí-Parreño, 2017). Minecraft was selected as the medium for engagement in Science Hunters as it presents a valuable opportunity to engage young people with scientific concepts and facilitate breadth and depth of affective and cognitive engagement (Nebel et al., 2016; O'Sullivan et al., 2017). Children can become immersed in its virtual world, exploring concepts such as creating volcanic glass and experimenting with materials to protect a house from approaching lava (Hobbs et al., 2018a), which cannot be investigated in 'child-friendly' real-world settings. The opportunity to safely interact and communicate with other players in a shared virtual world can also support development of peer collaboration and mentoring skills, whilst offering playful and interactive social learning opportunities (Kervin *et al*., 2015).

Benefits of Minecraft for children with Special Educational Needs

Our Minecraft Clubs are designed to facilitate engagement and socialisation in neurodiverse children, including those with ASD, ADHD, and dyslexia. ASD is a neurodevelopmental disorder affecting approximately 1-2% of children worldwide (Elsabbagh *et al*., 2012; Maenner et al., 2020). It is characterised by profound impairments in communication and interaction, resulting in difficulties engaging in 'real life' social situations (American Psychiatric Association, 2013). ADHD affects approximately 7% of children worldwide (Thomas *et al*., 2015) and is characterised by inattention, hyperactivity-impulsivity, or both (American Psychiatric Association, 2013; Silverstein *et al*., 2018). These symptoms can negatively impact on 'executive functioning' – cognitive processes underpinning concentration, attention, and planning (Diamond, 2013) – and reduce performance in social, educational, and work settings (Harpin, 2005; Loe & Feldman, 2007). Dyslexia is a specific learning disorder that affects reading accuracy, reading fluency, spelling, and information processing skills (American Psychiatric Association, 2013) in approximately 5-17% of school-aged children (Habib & Giraud, 2013). Symptoms can impact short-term memory, organisational competencies, academic or occupational performance, and interfere with everyday life (American Psychiatric Association, 2013; British Dyslexia Association, 2019; Snowling, 2019). Difficulties associated with interaction, confidence, and attention are common features across these neurodiverse conditions and each can inhibit children's engagement and socialisation with others (American Psychiatric Association, 2013; Bathelt et al., 2018; Livingstone et al., 2018; Tseng & Gau, 2013).

Neurodiverse children and their families often experience barriers and differences in socialisation. Behavioural difficulties can lead to 'othering' (marginalisation of those who are 'different' or do not conform to 'normal' expectations; McDougall, 2017), negative judgements of children and their caregivers, and bullying (Gwernan-Jones et al., 2015;

Twyman et al, 2010). Children and families with neurodiverse conditions such as ADHD, ASD and dyslexia can thus feel criticised, isolated, excluded, and may experience reduced levels of wellbeing (Claassens & Lessing, 2015; Gwernan-Jones et al., 2015; Mazurek, 2014; Ringland et al., 2016). These issues are exacerbated by the challenges and difficulties associated with enhanced caring responsibilities that additional needs require (Gwernan-Jones et al., 2015). While Science Hunters sessions in other settings include children from a range of groups, a dedicated club for neurodiverse children was specifically created to provide a space in which they could engage with science through Minecraft without the pressure to perform or maintain persistent high levels of regulation.

Research has shown that playing video games has the potential to facilitate cognitive, social, and emotional competencies (Granic *et al*., 2014), and they may be particularly well-suited to supporting the development of social and educational skills in neurodiverse children (Gaylord-Ross *et al*., 1984; Griffiths, 2002; Peñuelas-Calvo et al., 2020). Minecraft appeals to many people with SEN due to its multi-sensory and playful learning environment, which facilitates practical construction of meaning (Jiménez-Porta & Diez-Martínez, 2018). Appropriate use of Minecraft in learning contexts also offers opportunities to practise 'joint engagement' (simultaneous interaction with people and materials), requiring coordination of attention and social transactions (Dykstra Steinbrenner & Watson, 2015). Importantly, Minecraft is also a shared special interest (which can be beneficial for developing skills of children when embraced and supported; Winter-Messiers, 2007) of many children with ASD (e.g. Hobbs et al., 2019a; Ringland *et al*., 2016; Smith, 2014). Children with ADHD are particularly sensitive to motivation, needing stimulation in the form of feedback, reward and consequences, which can be achieved through play in the game (Krča, 2016). Minecraft thus provides a unique platform for introducing and engaging children with topics that may not interest them when presented through 'traditional' means. In the words of one child with

ADHD, when playing Minecraft 'There's less pressure to get things done than in real life, and I can just express my creativity without worrying what other people think' (Martin, 2016, p. 1).

Science Hunters approach

The Science Hunters approach utilises adults scaffolding and collaborative learning approaches (Vygotsky, 1978; Mercer and Littleton, 2007), supporting children to construct meaning together through dialogue during learning and play (Bruner, 1974). Each session begins by introducing real-world scientific concepts and challenges. A themed Minecraft building activity is then presented, providing an opportunity for children to explore and advance their understanding of the topic (Hobbs et al., 2019b; 2019c). The majority of the session is then dedicated to creative and non-constrained building in Minecraft. While adults provide support and guidance, individual activities and outcomes are directed by the children themselves, who participate according to their skill level rather than their age (Thorsteinsson & Niculescu, 2016). We ensure that each individual's contributions are acknowledged and valued, enhancing children's participation and promoting their motivation to learn (Brown and Kennedy, 2011). Evaluation of educational outcomes associated with participating in sessions, including statistically significant increases in knowledge relating to scientific topics, are reported elsewhere (Hobbs et al., 2019c).

Science Hunters Minecraft Club for children with Special Educational Needs

Parents and therapists using Minecraft in clinics for neurodiverse children appreciate its benefits, but have been found to desire stronger connections between virtual and face-to-face social relationships (Zolyomi & Schmalz, 2017). Minecraft Club addresses this limitation by encouraging children to play together in the same physical space via a shared

server. Minecraft Club is free to attend and hosted fortnightly on a university campus, allowing children to become familiar with a university environment, staff, and students. To promote inclusivity and respect of privacy, proof of a formal diagnosis is not required. Eligibility for Minecraft Club is based on trust and parents/carers are only asked to confirm that the child being enrolled has, or is under assessment for, a condition which classifies them as having SEN. They are, however, welcome to disclose conditions and needs, and discuss support that the child might require. Staff actively ensure that the club space, logistics, delivery, and atmosphere are suitable and adaptable for a range of needs as necessary, with places limited to a maximum of 16 children per session.

All participating children are accompanied by adults (e.g. parents, extended family, support workers, or other carers). To accommodate the interests and requirements of attending children and adults, the club has 'Guidelines to keep Minecraft Club "Fun for everyone!"' (the word 'rules' is deliberately avoided), constructed following evaluation of our practice and participant feedback. These guidelines provide clear boundaries and expectations for children, and their caregivers, for whom this can be important (e.g. Department for Education and Skills, 2005; Riffel & Eggleston, 2017) (Figure 1). Great emphasis is placed on tolerance and acceptance, creating a safe and welcoming environment where everyone's needs are considered.

The initial introduction to the science topic provides a clear focus for the session and signposts for children's imaginative building and exploration. This structure supports the needs of children with SEN, as engagement and attention issues can inhibit access to longer, text-based, forms of learning (O'Sullivan *et al*. 2017). Children with SEN should be enabled to work at a level at which they can succeed, until ready for a challenge, and benefit from non-competitive learning environments where it is not problematic to make mistakes (Cassidy, 2013). Indeed, feelings of acceptance are extremely important for these children

(Ringland *et al*., 2016). With this in mind, there is no requirement or pressure to complete any specific task or achieve any predetermined goals – children primarily attend to play and learn with, or alongside, like-minded peers in a safe and supportive environment. The routine of the club, starting and finishing at the same time each session, also aids with difficulties in play cessation experienced by some participants (Frölich *et al*., 2009; Higgins et al., 2018; Larson, 2006; Mazurek & Engelhardt, 2013).

Topics cover a wide range of subjects, from renewable energy, to plant propagation, to ultra-low-temperature Lego (Chawner *et al*., 2019), and children are encouraged to suggest topics they would like to be covered. This flexible approach avoids highlighting differences in ability between children, allows them to explore their own interests within the topics, and draws a clear distinction between the club and formal education settings. Furthermore, providing flexible and varied opportunities to engage with simulated and real-world problems in appealing and adaptable environments is key to supporting intellectually able students with SEN (O'Sullivan *et al*., 2017). Moreover, the creativity and openness of play in Minecraft is at the heart of its appeal to many people with ADHD and ASD (Kulman, 2015; Mazurek *et al*., 2015).

Ultimately, while adults are present to support children and ensure a safe and welcoming environment, children are left to play in Minecraft according to their interests and abilities. As Lane and Yi (2017, p. 171) observe, while we should encourage children to maximise their learning and development whilst playing Minecraft, 'we should also marvel that they do this by their own volition, and importantly, stay out of the way'.

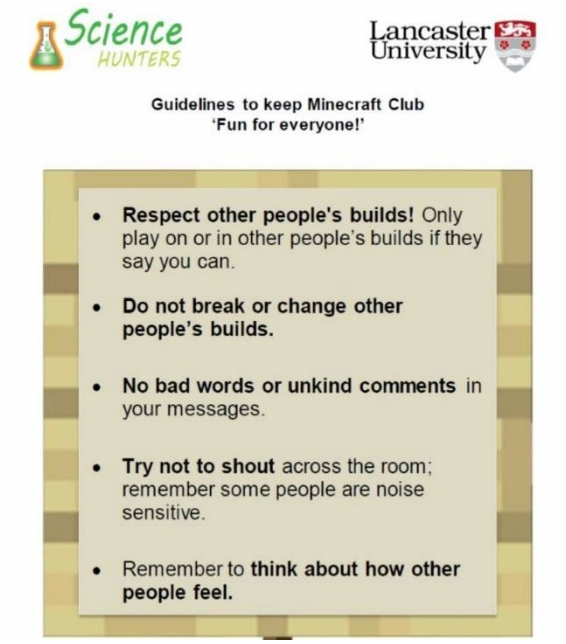

Figure 1. 'Guidelines to keep Minecraft Club "Fun for everyone!"' for the Science Hunters Minecraft Club for children with SEN.

Between its inception in 2015 and the end of the 2018/2019 academic year, the club has engaged 101 children aged 5-17 years, thus covering the full UK compulsory school age range (Department for Education, 2019a, 2019b). Most attendees were of primary school age (5-11 years; n = 71, 70.3%) with the remainder of secondary school age (11-18 years; n = 31, 29.7%). All attendees had SEN, with some having obtained formal diagnoses including ASD, ADHD, dyslexia, or comorbid conditions, whilst others were under assessment. The majority (85%) were male, possibly reflecting suspected underrepresentation of diagnosis of ASD and ADHD in girls (Renoux *et al*., 2016; Loomes *et al*., 2017) and perceptions of video gaming as a male domain (Shaw, 2010). While Minecraft is popular with girls and boys, boys are more likely play the game, and start playing it at a younger age (Mavoa et al., 2018).

Methods

As part of the wider Science Hunters project, Minecraft Club is evaluated on a continuous basis to monitor outcomes and ensure ongoing good practice and effective provision. Within this evaluation, alongside quantitative descriptive and monitoring data, valuable practice insights can be gained by seeking qualitative feedback from participating children and the adults who accompany them (Gibson *et al*., 2004). Enabling participants to express their views and contribute to the co-development of Minecraft Club is central to our ethos. The club was delivered by five different project staff members, plus multiple rotating staff and student volunteers during the four-year data collection period.

Participants

To avoid selection bias, all children and their accompanying caregivers attending Minecraft Club between 2015 and 2019 were invited to participate, regardless of age, length of attendance or communication needs. There was no pressure on any attendee to engage with the interviews. Those willing to participate were assured that they could be completely honest and that the team were interested in all feedback about the club. Sample sizes were therefore determined by the number of children and adults who agreed to participate.

Twenty-nine children participated, including 23 males (79.3%) and six females (20.7%). Children ranged in age from 5-14 years ($M = 9.79$, $SD = 2.18$), corresponding to school years 1-9. Six children (20.7%) were of secondary school age and 23 (79.3%) were of primary school age. Children who did not participate were not asked to provide a reason. Those that volunteered reasons mainly expressed that they did not wish to be distracted from their gameplay. The sample demographics, representing 26.6% of the entire cohort across the sampling period, are broadly representative. Of children (n = 26) who reported how many times they had attended the club, three (11.5%) had attended fewer than five times, six (23.1%) had attended 5-10 times, and 17 (65.4%) had attended on more than 10 occasions.

Thirty-seven caregivers responded. Two (5.41%) brought children of secondary school age, 26 (70.3%) attended with primary school age children, and nine (24.3%) did not indicate the age of their child.

Materials

Feedback was gathered via mixed-methods cross-sectional approaches. Children gave feedback via one-to-one semi-structured interviews. Adults responded via anonymous online or paper forms.

Procedure

Interviews were conducted during Minecraft Club sessions by trained staff who were familiar to the children. The interviews were conducted in a 'conversational' style and kept deliberately brief to avoid interfering with children's enjoyment of the club. Brief demographic information (girl/boy, school year group) and the number of times children had attended the club (fewer than five sessions, 5-10 sessions, or over 10 sessions) was recorded. Closed questions addressed whether children enjoyed Minecraft Club ('Have you enjoyed the sessions?') and thought they had learnt anything through participating ('Have you learnt anything new during the sessions?', 'Do you feel like you have developed any new skills?') . Descriptive statistics were synthesised for these results. Due to the small sample size, non-parametric analyses were performed to determine whether significant differences were present between answers of boys and girls, primary (Years 1-6; age 5-11 years) and secondary school (Years 7-11; age 11-16 years) children, and children who had attended the club for different lengths of time. These are key individual differences between Minecraft Club participants, as their stage in the school curriculum and existing experience of Minecraft Club may influence their perceptions. For example, a child who has attended fewer than five

times may still be settling in, while a child who has attended more than ten sessions is likely to be more comfortable in the setting. Neither children nor caregivers were asked about children's SEN as not all children attending are aware of their conditions or have received final diagnoses.

Children were also invited to elaborate on their answers via open extension prompts ('What aspects did you enjoy the most?', 'If not, why not?', 'Are there any other aspects of the Minecraft sessions that you feel have benefitted you?', 'Is there anything else you would like to share about Minecraft Club or any improvements you think could be made?') and were able to make any additional comments they wished to. No identifying information was recorded and responses were processed by a separate analyst to ensure anonymity. Thematic content analysis was performed on children's open responses.

Adult questionnaires were kept deliberately brief to avoid placing a burden on caregivers. They included closed questions regarding their child's basic demographics, length of attendance, enjoyment of the club ('How much has your child enjoyed the Minecraft Club sessions?') and open questions for expansion on answers, or any other comments ('Please tell us a bit more here', 'Is there anything else you'd like to tell us?'). Feedback could be completed away from the club, responses were returned anonymously, and no identifying information was requested. Thematic content analysis was performed on the adults' responses. Differences between feedback of parents/carers of primary and secondary school age children were not analysed due to the low number of caregivers of children attending secondary school.

Results

All children (n = 28) who indicated whether they enjoyed the club responded positively. As 100% of responses regarding enjoyment were positive, inferential statistics

were not performed. Of those who indicated whether they thought they had learnt something from attending (n = 26), 88.5% (n = 23) responded positively. Mann-Whitney U and Kruskal-Wallis H tests performed on responses found no significant differences between boys and girls ($U = 56.0$, $p = .836$), primary and secondary school students ($U = 43.0$, $p = .324$), or children who had attended the club fewer than five times, 5-10 times, or more than 10 times ($H = 0.381$, 2 d.f., $p = .826$) regarding whether children felt that they had learnt something by attending the club. Results remained similar when comparing children who attended < 10 and > 10 times using the Mann Whitney U test ($U = 5.0$, $p = .857$).

Forty-eight comments, containing 58 items of categorisable content (Table 1) reporting gains from attending the club, were gathered from 25 children ($M = 2.3$ items per child; range: 1-5 items). Figure 2 shows results of thematic analysis of this content. Children most commonly referred to opportunities to play with others, make friends, and socialising (n = 20, 34.5%), and playing Minecraft and gaining computer skills (n = 16, 27.6%). A further 11 comments (19.0%) referred to gaining communication skills or confidence. Combined, the 'socialising' and 'communication' categories (n = 31) comprised 53.5% of all categorised content.

Insert Table 1 about here

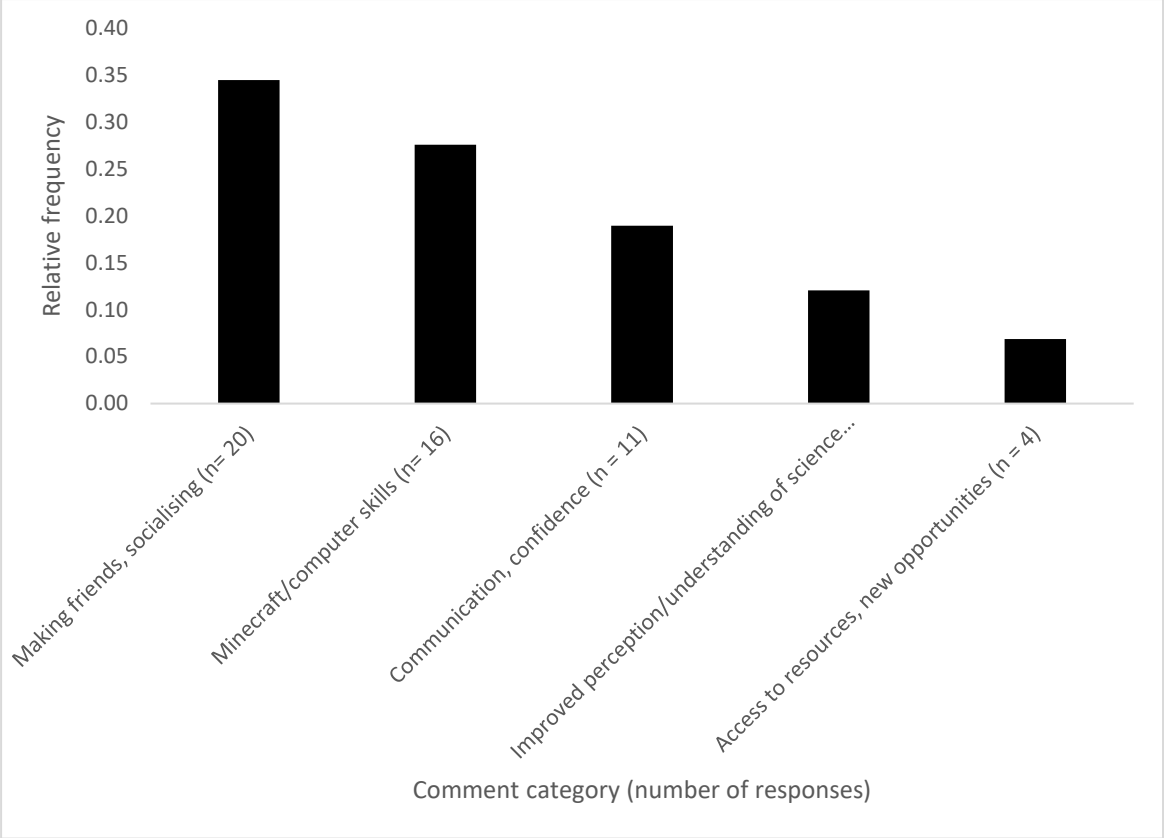

Figure 2. Themes identified in feedback about Minecraft Club from attending children.

Specific comments from children highlight Minecraft as being a key element of their engagement with the club (see Table 2), while others highlight the link between the club and social-communication skills and wellbeing. While two (3.4%) suggestions for improvement were given concerning the Minecraft version used (which provides restrictions for controlling the game space for educational purposes), there was no negative feedback regarding learning, skills development, or social and wellbeing aspects.

Insert table 2 about here

All adults who indicated their child's enjoyment of Minecraft Club (n = 34) answered positively. Responses provided 45 feedback comments from 26 respondents, containing 131 pieces of categorisable content (*M* = 5.0 items per adult, range: 1-9 items; see Table 3).

Insert table 3 about here

Results of thematic content analysis (Figure 3) demonstrate that children's enjoyment and wellbeing (22%, n = 29), as well as social aspects of the club and 'fitting in' (20%, n = 26), were paramount in adults' perceptions of benefits gained. Contrasting with the content of children's feedback, Minecraft and computer skills were mentioned only three times (2%). Examples of comments left by accompanying adults are provided in Table 4.

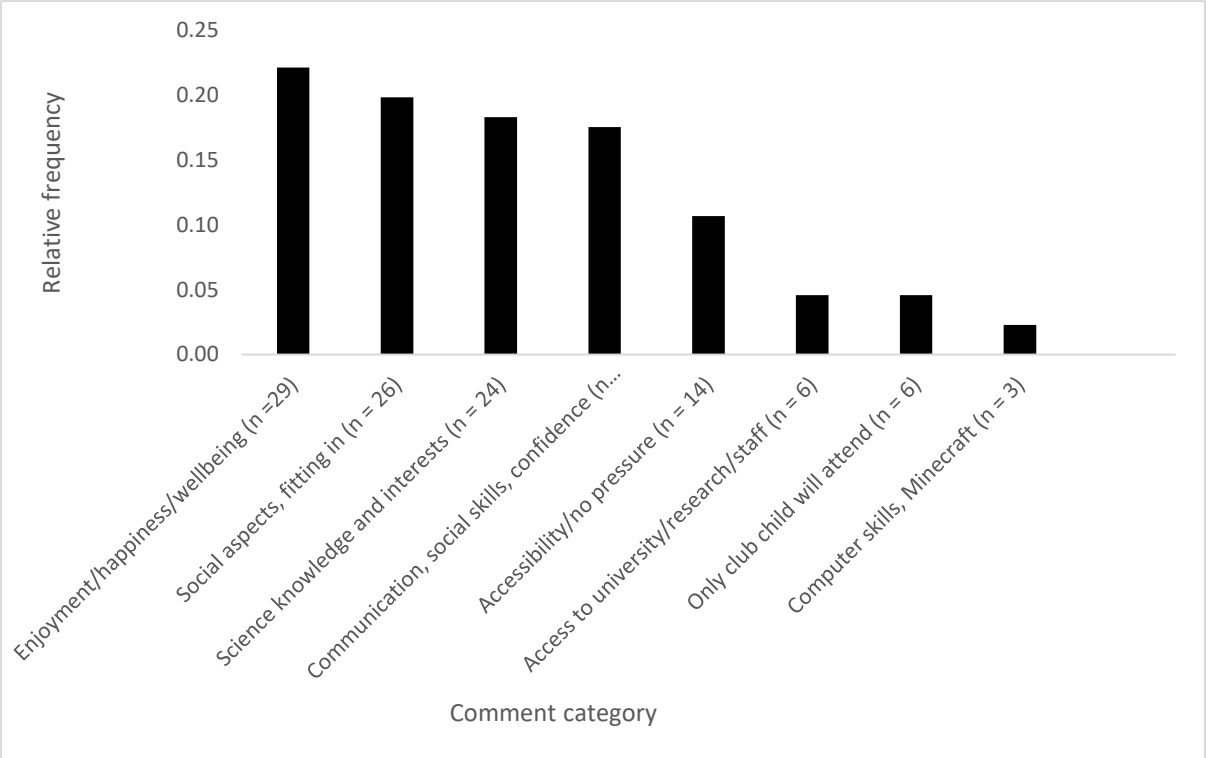

Figure 3. Themes identified in feedback about Minecraft Club from caregivers.

Insert table 4 about here

Two (1.5%) less-positive comments were recorded which related to the temperature and noise levels in the room where Minecraft Club is hosted. These comments likely reflect the increased impact of sensory environmental features on caregivers who are themselves neurodiverse and highlight barriers to engagement in settings that are designed for

neurotypical individuals, even when awareness of needs is high. Thus, providing both children and caregivers with the opportunity to provide feedback of this nature is vitally important when constructing a club-like setting involving neurodiverse groups. However, there were no negative comments regarding social and wellbeing, learning, or skills development. Outside of the anonymous data collection presented above, some adults voluntarily provided non-anonymous comments via verbal or email feedback which provide deeper insights into caregivers' perceptions of the benefits of attending Minecraft Club for their children (with consent for their comments to be shared). For example, one caregiver explained that a child who did not previously feel comfortable sending text messages will now do so after practising typing messages on the shared Minecraft server to others in the room. Another described that their child benefits from knowing that his creative efforts will be validated by the group and is able to envisage himself as scientist in future as the club helps him to see that diverse ideas have a place in science. Another documented how their child, who is usually conscious of his social-communication difficulties, has gained such confidence that he will now answer questions and offers to help others. Furthermore, he now requires significantly less support in school as he has transferred his new skills and confidence from Minecraft Club to his formal educational setting. Whilst we acknowledge the self-selection bias in these additional responses, which were not included in the above analyses, we feel that they represent a snapshot of the myriad benefits experienced by many children who have attended our Minecraft Club and offer insightful supplementary information to the analysed data.

Discussion

Feedback from children and adults concerning our science-themed Minecraft Club is extremely positive. The majority (88.5%) of responding children felt that they had learnt

something from attending and, due to the 'embedded learning' approach of the club, it is possible that the remaining 11.5% had not recognised learning when it occurred. Perhaps more importantly, 100% of responses indicated that children enjoyed attending. While children, perhaps unsurprisingly, focused on playing Minecraft when discussing their experiences of Minecraft Club, they also clearly indicated that they benefit socially and emotionally from attending the group with other children who share common interests. Additional insights from parents/carers support these findings, and further explain that the nature of the group is key to supporting development of social skills and facilitating improved wellbeing. Making friends, fitting in, and feeling valued without judgement regardless of completing tasks or conforming to expected social behaviours are themes that are mentioned consistently throughout the comments. Importantly, more detailed feedback provided by adults expressed benefits beyond the club, such as improved confidence and wellbeing, ability to perform social interactions that were not previously achievable, and reduced need for support in formal learning settings.

Regardless of demographics or specific needs, Minecraft is the motivating factor that draws children to the club as it is an intense interest. Playing Minecraft offers various mechanisms through which children can potentially develop myriad social and educational skills. This skill development is scaffolded by the process of designing and completing builds, independently or collaboratively, and communicating with others within the shared virtual space. The ability to play within the same physical space enhances these benefits by allowing communication to move from the virtual world to the real world, leading to face-to-face conversations and peer support when difficulties arise. The 'safe space' provided by our Minecraft Club ensures that these interactions can occur and develop spontaneously, without the need to modify natural behaviours beyond following basic guidelines which facilitate adaptive engagement rather than imposing restrictive conditions.

The data presented here are necessarily limited due to restrictions associated with the nature of the club and cohort involved. All attending children have SEN, as will some of the caregivers (owing to high heritability of conditions such as ASD, ADHD and dyslexia; Russel & Pavelka, 2013). All adult respondents care for at least one child with additional needs and therefore have many demands on their time and resources. Some children were better able to articulate their thoughts than others due to differences in both age and language skills. Some children have difficulties with verbal and/or written communication and there were unavoidable differences in the lengths of time that children had been attending the club (families are free to join the club as places become available and are welcome to attend for as long as they wish). However, information was gathered from all children and adults who were willing and able to participate, and the presence of multiple session facilitators during the data collection period removes any influence of delivery by one particular person on the success of the club.

We acknowledge that interviews with children were conducted by familiar adults, creating a source of potential bias. This is an important limitation as children may have felt obliged to offer 'pleasing' responses. However, it would not have been appropriate to introduce unfamiliar interviewers given the nature of the setting, which is not principally designed for conducting research. We felt that the possible negative impact of introducing unknown interviewers on children's wellbeing and engagement with Minecraft Club outweighed its benefits, particularly as adults were provided with an opportunity to provide anonymous feedback including open responses. Children were reassured that they could be honest, and the club is always delivered with a relaxed approach. Attendees know that they can express dissatisfaction and are not expected to conform to 'neurotypical' norms in the same way that they are in other settings, such as providing 'pleasing' responses. This is illustrated by the fact that several children communicated that they did not think that they had

learnt anything and some voiced less-positive opinions on the version and settings of Minecraft being used. Likewise, adults (responding anonymously, but knowing the team viewing the responses) sometimes commented on negative aspects of logistics, for example the temperature in the room used for the club, indicating that at least some respondents were comfortable to provide negative as well as positive feedback and make requests for adjustments.

Thus, while caution should be exercised in generalising these results, responses from children and adults involved in Minecraft Club offer valuable practice-based insights into the benefits that can be gained for children with SEN in playing together with like-minded peers in a supportive group setting focusing on a specific common interest. Unfortunately, COVID-19 restrictions caused the cessation of face-to-face delivery in early 2020. Minecraft Club has resumed in a virtual format, offering an opportunity to compare outcomes associated with face-to-face and online engagement. This is also part of a wider project exploring use of Minecraft to engage children with engineers and engineering, which will allow comparison between groups of children with and without SEN, providing further practice insights concerning the utilisation of Minecraft and inclusive approaches.

Conclusions

Minecraft presents a familiar and non-threatening context that enables children with additional needs to practice communicating, cooperating, playing, and socialising with others. Data collected over four years of delivery indicate that playing Minecraft within the same physical space in an extra-curricular club provides opportunities to create and nurture the development of educational and social skills. Moreover, benefits extend beyond interactions within the club alone; the Science Hunters approach to shared special interest play provides a valuable activity for children with SEN, representing an example of how shared special

interests can successfully be used to scaffold learning and improve wellbeing for these children and their families. While these results reflect feedback about this specific club, they serve to inform best practice by demonstrating the potential benefits for neurodiverse groups associated with playing Minecraft in an informal social and educational context.

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Table 1. Coding scheme for content analysis of children's feedback in relation to gains from attending Minecraft Club.

Category	Description	Example
Making friends, socialising	Participant indicated that they had made social connections	Meeting people, talking to people (female, age 7)
Minecraft/computer skills	Participant indicated enhanced digital (general) or Minecraft (specific) skills	How to create a working programme (male, age 14)
Communication, confidence	Participant indicated increased confidence or communication skills	Learned how to communicate and talk to people on Minecraft (male, age 14)
Improved perception/understanding of science	Participant indicated deeper understanding of, or appreciation for, science	Helped me build and understand science stuff (male, age 10)
Access to resources, new opportunities	Participant indicated access to resources/opportunities not otherwise available	Playing on a newer computer (male, age 8)

Table 2. Examples of feedback comments from children relating to Minecraft, and social-communication skills and wellbeing.

Minecraft
‘This is cool because it's Minecraft. I prefer doing this than science in school’ (male, age 10)
‘I just come for Minecraft’ (male, age 8)
‘Minecraft’s helped me to like science more’ (male, age 9)
Social communication and wellbeing
‘I’ve learned about Minecraft and how to ask friends for help when I get stuck’ (male, age 6)
‘I’ve made friends in real life not just through Minecraft’ (referring to connecting with others remotely on shared servers) (male, age 11)
‘You can learn new skills and its fun, it allows you to be more social’ (female, age 10)

Table 3. Coding scheme for content analysis of caregivers' feedback in relation to Minecraft Club.

Category	Description	Example
Enjoyment/happiness/wellbeing	Respondent indicated increase in positive feelings in child	My son really enjoys coming to Minecraft Club and his self-confidence has grown tremendously since he started
Social aspects, fitting in	Respondent indicated benefit of inclusive group with similar peers	Socially, going to new places and confidence
Science knowledge and interests	Respondent indicated interest in or knowledge of science topics in child	My child often comes home from Minecraft Club and tells me facts he has learnt in that session
Communication, social skills, confidence	Respondent indicated increased social or communication skills or confidence in child	It has helped [child] to socialise with unfamiliar adults and his peers
Accessibility/no pressure	Respondent indicated positive impact of	It is great that the children are free to either follow the structure of the science

	accepting, informal nature of club and tasks	topic, or to do their own thing
Access to university/research/staff	Respondents indicated benefit of club's university and research-based setting/access to staff and students	He is aware what a privilege it has been to access this kind of equipment and it makes him really happy
Only club child will attend	Respondent stated that Minecraft Club is the only extra-curricular activity child will attend	This is the only club my son will attend
Computer skills, Minecraft	Respondent indicated enhanced digital (general) or Minecraft (specific) skills in child	Gaining computer skills as he only has an Xbox at home

Table 4. Examples of feedback left by caregivers.

Caregiver comment

‘It has helped him to socialise with unfamiliar adults and his peers’

‘It has been great for him to be doing an out-of-school activity in a setting where he can be an expert, with other people who enjoy the same things’

‘Socially it has been very rewarding for my child along with the tasks every week and the science behind it’

‘My son really enjoys Minecraft Club and his self-confidence has grown tremendously since he started’

‘He loves Minecraft Club. He loves the routine of the sessions and his friends here. I think it is great that the children are free to either follow the structure of the science topic, or to do their own thing’

‘He has made friends with people/children who he is able to get on well with’

‘The balance between task and just doing whatever they want has worked well for us – by that time at night he is tired and if he doesn’t want to do the set task he just won’t, so it has been good that this has been suggested but not pushed’

‘I have really enjoyed seeing my child feeling like a ‘fish in water’ at Minecraft Club. He counts down the days until the next one.’

‘My child has always struggled in school. Coming to Minecraft Club enables him to feel clever. He enjoys helping the younger children and feels important. The group also provides him with science knowledge in a practical and significant way using Minecraft to extend his thinking in the subjects.’

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