Adaptive school grounds design in response to COVID-19: Findings from six primary schools in South East England

Alison Quinn, Alessio Russo
School of Arts, University of Gloucestershire, Cheltenham, GL50 4AZ, UK

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Abstract
The purpose of this research is to look at how primary schools in England have adapted their outdoor spaces in the context of COVID-19 rules and guidelines to meet the needs of students returning from school closures and national lockdown of Spring/Summer 2020, how that impacted play and learning value of their grounds, and to consider how these findings might inform future school grounds design. Thus, we used a mixed-method approach that included qualitative interviews with representatives from six primary schools (three in rural and three in urban areas), quantitative desk research, and in-person site surveys. We used literature-based scoring criteria to quantify changes in the playground before and after the implementation of COVID-19 measures. The research reveals that the zoning of play areas and other aspects of the school grounds may negatively affected the value of play and learning. We also found a substantial disparity in the amount of outside space per pupil (OSPP) available across schools. Those with the lowest OSPP also had the lowest outdoor and environmental learning provision, lacking the flexibility to accommodate this alongside other requirements of staggered play breaks and PE. The amount of outdoor space that a school has available per pupil averaged at 32 m2 for urban schools and 43 m2 for rural schools. Finally, we have explored how spatial layout and design elements may have supported or inhibited schools' abilities to respond to children's needs, and how this might inform adaptive school grounds design considerations for the future.

1. Introduction

The outbreak of Covid-19 was declared a pandemic by the WHO on March 12th [1]. In response to the pandemic, global school closures peaked with 164 countries implementing nationwide school closures in March 2020 [2,3]. A variety of studies have found that school closures, stay-at-home orders, and the closing of playgrounds and other open spaces may have a negative effect on children and young people [4–6]. The closures affected more than 1.4 billion pre-school, primary and secondary school learners worldwide [2].

The myriad of interlinked concerns for children arising from this included loss of education with the onus in many countries falling to parents to support home-schooling, socio-economic challenges for their families, and physical and mental health and wellbeing concerns [7,8]. A rapid systematic review of 80 studies by Loades et al. found that during and after lockdowns, children are more likely to experience high rates of depression and, most likely, anxiety [9].

Several articles highlight the socio-economic impacts of school closures, including the broadening of the learning gap between children from higher and lower-income families as a result of less suitable learning environments and digital connectivity for the online learning platforms used by many schools [7,10,11]. Additional challenges include homes with inadequate heating, and children without access to outdoor leisure facilities or books. Extensive literature evidences the many benefits of outdoor play and learning provision for children in terms of educational, social, and physical and emotional health outcomes [12–15]. The value of school grounds is not a new concept, with supportive writings on the learning value of outside space and gardens dating back to at least 1907 [16,17]. Titman (1994) [18] identified how school grounds potentially hold value, or not, for children themselves, in meeting their own perceived needs for experience, exploration, experimentation, and security. It has also been suggested in literature that playground design has an impact on individuals' social and physical skill development and motor capacities [19].

Whilst school grounds access is vital for children's wellbeing it is critical to reconsider how schools can stay open without being SARS-CoV-2 transmission hubs [20]. The Association of American Pediatrics (AAP) encourage schools to consider strategies for providing additional emotional and behavioural support for children on their return, given the multiple impacts of lockdown including social isolation, grief, and stress of bereavement, and economic strains within their families and support structures due to employment/financial concerns [21].

However, reflection on spatial design concerning school grounds in the context of the pandemic is extremely limited. In particular, we have not found any studies in scientific literature that have attempted to answer the following questions:

How have UK schools adapted their use of school grounds in response to the pandemic context and related specialist advice and government guidance since reopening in September 2020?

What challenges have Schools faced in using their grounds to accommodate all aspects of school activity?

Is there evidence to support the negative impacts of school closure and social isolation of lockdown on children's health and wellbeing?

How might the use of schools' grounds on re-opening have impacted on supporting children's wellbeing?

Could changes to school grounds design enable schools to respond more effectively to teaching requirements and children's needs in the context of this pandemic?

To this end, the objectives of this paper are:

1. To understand what needs schools had identified in their pupils on their return to school
2. To identify the role school grounds have played in accommodating these needs and how this has been achieved.
3. To explore how spatial layout and design elements may have supported or inhibited schools' abilities to respond to children's needs, and how this might inform school grounds design considerations for the future.

2. Material and methods

The study took the form of a mixed methods, descriptive research approach informed by findings from the literature and consultation with subject specialists (Fig. 1), comprising:

1. Assessment of 6 schools' responses to COVID-19 reopening developed from:
   - Structured interviews with school representatives
   - School Site surveys against a checklist of playground elements and desk research.
2. Qualitative analysis using Quirkos software to organise the findings and identify emerging themes across data [22].
3. Interpretation of the findings data against research questions.

Furthermore, a pilot study [23] with specialists in the field (i.e., a Local Authority Health and Safety Advisor to schools, and a playground and outside learning advocate from Learning through Landscapes) were conducted in the early stages of the project (i.e., July and August 2020). These specialists were approached to strengthen some of the anecdotal information circulating at the time of developing this research project as well as to develop and test the interview questions [23].

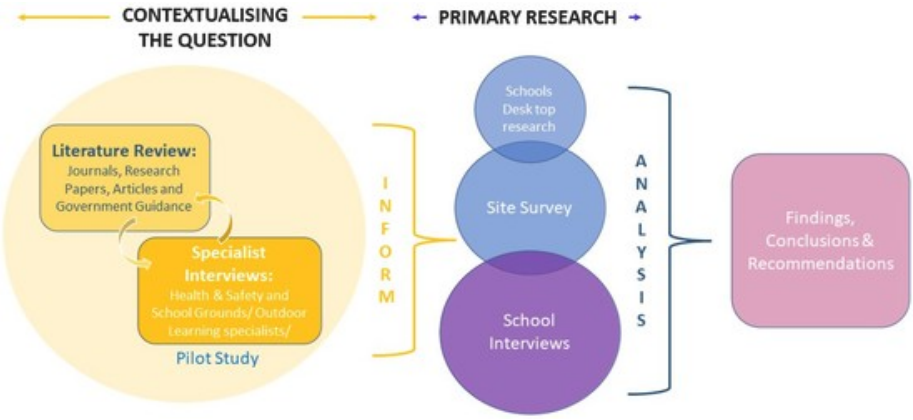

Fig. 1. Research approach diagram

2.1. School selection and recruitment

Previous studies had indicated the challenge of securing school engagement due to the many demands on their limited time and resources [24,25]. Anticipating that during the first term back of full school re-opening, schools would be more stretched than ever, the researcher decided to identify as many schools as possible where they could establish a link through contacts to help “open the door”. Using a purposive sampling technique, 9 primary schools in South East England (Fig. 2) were approached in total. Of these, 2 of the schools were known to the researcher and approached in person and via email, and four introductions to prospective interviewees were made via persons known to the researcher and followed up by direct emails and phone calls. Three “cold” approaches were made to schools with no previously established contact via phone calls and follow up emails, and reminder phone calls and emails. None of the cold approaches secured involvement.

Six primary schools were engaged, of which 3 were urban and within towns, and 3 rural. For this study, we have applied the UK Office of National Statistics Rural-Urban definition of urban as “areas forming settlements with populations of over 10,000” [26]. The term “rural” has been used to describe schools in settlements of, in this case, significantly less than 10,000 population. Sampling was limited to primary age, state-funded schools including 4 Primary schools catering for children typically aged 4–11, 1 Infant school for children aged 3–7, and one Junior school for ages 7–11.

Fig. 2. Study area (Source: Google Maps)

2.2. Interviews

Structured interviews were held with representatives from 6 primary schools in mid-October 2020. Interviewees included Headteachers, Teachers and Business Managers and interviews were carried out either in person or via zoom (see supplementary material). These were complemented by a site survey to set the context for interview responses, as described below.

Interview questions were shaped by findings from the literature regarding the potential value of school grounds for active play and learning in relation to concerns about children's wellbeing on their return from school closures. Questions also explored the Before and After use of the design elements that formed the basis of the site survey. They asked about the challenges schools had faced in relation to both logistical management and specific needs identified in the children post-Lockdown, and any changes they had made to school grounds in response to these on reopening during the COVID-19 pandemic. A full set of the interview questions is available in Appendix A.

The way in which the interviews were conducted varied between two conducted via video call and four carried out in person. In both cases, the interviewee had seen the questions in advance of the interview. The video calls worked methodically through the questions, whilst the on-site visits were less structured, gathering information as we moved around the site which was then slotted in against the questions, and a summary session at the end to fill any gaps. In each case, the interviews lasted between 40mins and 1 h.

2.3. Site surveys

Site surveys consisted of a desk research element and an in-person site visit. The desk research used Edina Digimap Ordnance Survey (2020) and Google maps applications to measure approximate site areas and land use. By combining this information with school numbers data available online the researcher established a measure for comparing larger sites with smaller sites described as the Outside Space Per Pupil ratio or OSPP. The calculation for this ratio was as follows:

Outside Space Per Pupil (m^2) = Net site area (m^2) / Total no of Pupils

Where Net site area = Total site area - area of buildings.

The 4 in-person interviews were held concurrently with site visits between 13 and 19th October 2020. For the interviews conducted by video call (schools D&C), the site visits were carried out subsequently on 20th October, and 3rd November. Site visits involved noting and photographing design elements against a checklist identified by earlier research as being of value to children's experience of outdoor space to inform the following evaluation:

- The extent to which the grounds support opportunities for outdoor learning and exposure to nature
- The extent to which the grounds potentially cater to children's needs and preferences for outdoor play
- The extent to which children's access to school grounds features has changed under COVID-19 reopening.

In terms of children's needs and preferences, the list was drawn from combined features identified by Thompson (1995) [27] and Titman (1994) [18] including:

- Climbing opportunities
- Large areas to run and chase
- Natural elements such as trees, shrubs, gardens and wildlife spaces
- Places to sit/rest
- Quiet spaces
- Play space across levels (it also includes complexity & division)
- Access to fixed and loose play equipment [28].
- Hidey holes and dens
- Shaded space
- Animals

Each of these elements was considered in relation to how they could be accessed for free and closely supervised play, formal learning, and for PE and emotional support and wellbeing (such as Nurture sessions), drawing on findings from the interview discussions.

This study is not intended as a judgement of schools' performance, but simply a means of capturing schools' differing responses and identifying some of the outcomes to date, in the context of available resources.

Schools are therefore referred to via pseudonyms of School A-F, and pupil number's data has been approximated.

2.4. Compilation and analysis

2.4.1. Interview data

Transcripts and additional notes from interviews and follow up enquiries were compiled using Quirkos software which was then used to code findings. The researcher reviewed data from each interview and applied a process of coding to identify links between responses gathered via interview, site visit and any follow up responses across all of the questions. Initially, the coding was carried out using framework analysis based solely around the survey questions. Emergent coding was then applied to help identify new themes arising from the discussions [29].

2.4.2. Site surveys

In order to add a more quantifiable element to the extent of changes to use and value of school grounds on re-opening, an assessment was carried out of the survey and interview findings as to how each school met survey criteria before and after COVID-19 adaptations were implemented. Each school was scored on the extent to which its grounds accommodated access to each element in the following way:

0 = not at all 1 = weak 2 = Average 3 = Good 4 = Excellent.

This scoring element is adapted from the approach taken by Play England's Quality assessment tool score sheet [30]. The total scores then offered a value that indicated a level of change to schools' "before" and "after" provision, and which is comparable with each other.

It was also intended that the site surveys should inform and provide further design insight into the interview discussion findings in terms of how existing assets and design may have impacted on children's and schools' opportunities for free play, health and wellbeing, formal learning, and the hidden curriculum, drawing on previous research findings. Full survey data are available in the supplementary materials.

3. Results

3.1. Schools interviews

The following findings are summarised from the data collected via interviews with Headteachers, Business Managers and Class Teachers at 6 primary schools in the West Berkshire/Hampshire area in October 2020 (full school interviews data are available in the supplementary materials).

3.2. Challenges presented by COVID-19 relating to School's use of outdoor spaces

All schools in the study were grouping children into bubble cohorts to manage and minimize contact between groups of pupils and teaching staff (Table 1). Sizes ranged from 34 to 68 children and were mostly divided by year group. The smallest school had divided itself into lower and upper school bubbles. All but the smallest school had made changes to the way pupils, carers and visitors accessed their site, including designated one-way walking routes on and off site, gates for entrance or exit only, or use by specific bubbles. To avoid parents congregating on site, Schools

D&E required drop off junior school age children (Years 3-6) at school gates only.

Most schools had used a combination of zoning and timetabling to enable safer sharing of outdoor space. The impact of this is discussed further under section 3.5 below. School A zoned a small portion of its playground for part of lunch break to enable its EYFS bubble extra space in addition to their free-flow learning zone.

Table 1
Summary of challenges experienced and school responses.

Requirements/ Challenges	Solutions/Descriptions	A	B	C	D	E	F	Total
Restricting Social Contact	Bubbles	x	x	x	x	x	x	6
	One way pedestrian system to access school site	x	x	x		x		4
	Designated entrance/exit		x	x	x			2
	Designated holding areas for parents	x	x					2
	Parents of Years 3–6 drop at gate				x	x		2
	Staggered drop off times		x	x	x	x	x	5
	Fluid class start times		x			x	x	3
Safe sharing of spaces	Staggered play times for each bubble	x	x	x	x	x	x	6
	Playground Zoning to enable 2+ bubbles to play simultaneously in separate areas	(partial)	y	(partial)	y	y		3 (2)
	Class room zones - designated space outside classes for break out groups/fresh air breaks		x	x			x	3
Design limitations	Building placement within grounds creates narrow external corridors required for access which constrain segregation		x	x				2
	Openness of design inhibits scope for multiple simultaneous uses				x			1
Sharing fixed equipment	Rota system to allow natural decontamination of fixed equipment		x	x		x	x	4
	Equipment restricted to specific year group access only				x			1
	Unrestricted access to fixed play	x						1
Sharing loose equipment	Designated loose equipment per year group to avoid cross contamination	x	x	x	x	x	x	6

Table 2
Summary of challenges experienced and school responses.

Identified needs	Description/ Solution	A	B	C	D	E	F	Total
Socialisation and play	Need identified in interview	X		x	x			3
	Used outside space for learning and extra play	Spring/ Summer		Spring/ Summer		x	x	2 (2)
Structure and normality	Keeping routines similar to pre-pandemic	X						1
Reduction in readiness to learn and learning resilience	Need identified in interview			x		x	x	3
	Informal fresh air "Brain breaks"			x		x	x	3
	Taking learning outdoors					x	x	2
Influence of screens/TV and gaming – play behaviours	Issue identified in interview	X		x	X			3
	Actively encouraging alternative and traditional play activities	X		x				2
Loss of health and fitness	Activity breaks, including walks or daily mile		x		X	x	X	4

3.3. Use of school grounds in relation to identified needs of children on school reopening

Table 2 shows a summary of challenges experienced and school responses. 2 schools specifically mentioned having prepared themselves for high levels of additional emotional support needs in the children on their return but at point of interview in mid/late October 2020, no schools indicated substantial concerns about needs over and above the children's desire to play and socialise. 4 schools described using out-doors as much as possible during the good weather of summer and early autumn to support re-socialisation, and address a loss of learning focus and stamina, with one school describing a loss of “that ability to keep going, …to finish a piece of work”. Schools E and F specifically referenced using outdoor learning to address this.

A drop in general fitness was considered more noticeable amongst older year groups, possibly linked to unhealthy diets at home and increased use of screens. In relation to screens use, school C noted that play behaviour amongst many boys had become more physical and aggressive.

3.4. Physical changes to school grounds

Table 3 shows a summary of physical changes to made to study schools' grounds on full re-opening.

Table 3
Summary of physical changes to made to study schools' grounds on full reopening.

Theme	Solutions/Descriptions	A	B	C	D	E	F	Total
Access	Floor markings to define access routes and encourage social distancing at gathering points - dots, footprints, arrows	x	x	x	x	x		5
	Physical demarcations of new one-way pedestrian routes on and off site - surfacing/ barriers		x			x		2
	Creation of cordoned corridors to enable external access to toilets without internal mixing of bubbles		x					1
Zoning	Class break out spaces defined by temporary plastic fencing or mixture of cones, planters and benches		x	x				2
	Playground zones defined by mixture of cones, tape, planters and benches				x	x		2
Hygiene	Temporary outdoor handwash facilities		x		x			2

3.5. Changes to schools' use of grounds

Table 4 shows a summary of changes to use of study schools' grounds. The most significant change was that break times were now restricted to play within specific "bubbled" groups at staggered times and/or within smaller, zoned areas. Most schools still allowed the same 15 or 20 min for morning break as pre-pandemic, on a staggered schedule. All schools acknowledged that outside lunch break was now shorter by 15–20 min than pre-pandemic. Four schools, including all 3 urban schools, had reduced the play space available to their bubbles through zoning although only a small reduction by school C. Most schools also now rotated access to large climbing apparatus between bubbles on a daily or weekly basis. Urban school E offered no climbing provision to KS1 children (Years 1&2), and School D restricted climbing access to use by Year 3 children only.

Extra "brain" or "movement" breaks were specifically mentioned by 3 schools, with 1 other mentioning use of dedicated class overspill space for "fresh air breaks" to support concentration and wellbeing.

Of the schools that had increased their outdoor environmental and nature based learning, 2 were rural and one urban, and all had strong onsite environmental assets. The third rural school (A) was maintaining a strong existing environmental learning programme particularly for younger year groups. The two urban schools who had reduced this element had limited onsite assets, use of which was constrained by conflicting use of space as a dedicated class breakout space (School C), and a lack of segregation from the main playground area in regular use for breaks and outdoor PE (School D).

School E had zoned its EYFS area to prevent mixing nursery and Reception cohorts, but rotated access to each area across different days. At least 3 schools, including urban schools C and D, reported using out- door space more on partial re-opening in spring/summer when the weather was warm and dry, groups were smaller, staffing ratios higher, and curriculum pressures were less. On full re-opening C&D were no longer able to continue this due to space, pupil to staffing numbers and lack of suitable all-weather facilities.

3.6. Schools' requests for changes to enable better response to children's needs and learning in the context of COVID-19 restrictions

Schools were invited to propose changes they would like to make to their current outdoor provision to enable more effective delivery of learning and support to children under the restrictions of COVID-19, if resources were unconstrained.

The most common theme was the need for more shelter across the grounds to extend use in wet, windy and sunny weather. Requests for sheltered learning spaces varied from class dedicated break-out spaces to an auditorium. Schools C, D and E described their playgrounds as generally "exposed" with an emphasis on shades/covered areas, but School D's particularly open site also required wind breaks. Suitable all-weather surfacing for dedicated learning spaces was important for school F as use of their existing space was limited by weather due to being on a grassy slope.

The two schools wanting to enhance natural spaces for growing, wildlife, environmental learning, and exploratory play were the two urban schools with least existing provision of this kind (see Table 5).

Table 4
Summary of changes to use of study schools' grounds

Theme	Changes	A	B	C	D	E	F	Total
Break times	Play times now in a smaller social "bubble"	x	x	X	X	x	x	6
	Mix play bubbles (Year 1 pupils from a mixed Reception/Year 1 class join with another Year 1/2 bubble for morning break.)	x						1
	Reduction in play space		x	(minor)	x	x		3 (1)
	Restriction in access to fixed play equipment		x	x	x	x	x	5
	No climbing facilities for some bubbles				x	x		2
	Reduction in lunchtime outdoor play to 20–30mins due to staggered breaks	x	x	x	x	x	x	6
Physical Health and Wellbeing	Outside only PE classes	x		Xx	x	x	x	5
	Informal brain/movement/ fresh air breaks		x	x		x	x	4
	Continued pre-pandemic Daily Mile activity				x	x		2
	Continued outdoor ELSA (Emotional Literacy and Support Assistant)/ emotional support activities	x		x				2
	Greater use of outdoor space for ELSA activities		x					1
	Nurture group no longer held due to mixing bubbles				x			1
Environmental Learning	No change to outdoor environmental learning	x						1
	Increased existing outdoor environmental learning under full re-opening		x			x	x	3
	Increased existing outdoor environmental learning under partial re-opening from April–July 2020 only			x				1
	Continued Forest School provision for EYFS stage (4–7)	x				x	x	3
	Reduction in outdoor environmental learning			x	x			2
	Suspension of Environment or gardening clubs	x			x		x	3
Wider Outdoor Learning	EYFS Freeflow space unchanged	x	x	x	No EYFS aged pupils		x	4
	EYFS Freeflow space zoned					x		1
	Removal of some play items for hygiene and confined space reasons (E.g. Sand/water trays/ fabric items/play houses)		x	x			x	3
	Increase in outdoor learning from Sept 2020 Full re-opening		x			x	x	3
	Using space adjacent to classroom for break out groups and fresh air/ movement breaks		x	x			x	3
	Using outside spaces to enable focussed intervention or "catch up" groups with less class disturbance					x	x	2
	Staff inhibited by lack of appropriate outdoor learning space/design of grounds - lack of shelter, surfacing, separation from other outdoor activities			x	x		x	3
	Felt curriculum pressures make it harder to take learning outdoors for older children	x			x		x	3
Loss of use for Extracurricular activities	Prevented children leaving their bikes/scooters at in school grounds during day to avoid bubbles mixing at gathering points around storage areas.			x	x			3
	removal or suspension of use of play and learning structures such as sheds and tepees due enclosed space concerns and hygiene of fabric	x	x				x	3

3.7. School site surveys

Table 6 and Fig. 3 show approximate amounts of different types of space available to each school. Table 6 also lists the total amount of outdoor space (net site) and total number of pupils. This data was used to establish an approximate

ratio of net outdoor space per pupil (OSPP). As a point of comparison, the UK's Department for Education recommends minimum net site areas per pupil place as 10 m2 for Reception to Year 2 aged children, and 50 m^2 for Junior school age children (Years 3–6). For combined Primary schools this averages to 33.3 m^2 [31,32].

Table 5
Summary of changes to use of study schools' grounds

Theme	Descriptions	A	B	C	D	E	F	Total
Facilities for outdoor learning	Classroom space for whole school use, sheltered against rain/sun, with suitable surface		x		x			2
	Auditorium					x		1
	Formalisation of class breakout spaces		x					1
	Covered spaces to extend EYFS style continuous provision space for Years 1–3, including abacus, chalk/white boards	x					x	2
	Large construction materials zone (Shared by EYFS and Years 1&2)			x				1
	Enhance natural spaces for encouraging wildlife, growing and environmental learning			x	x			2
Changes to playground areas	Features to break-up large open playground/sports pitch to add play value and interest				x			1
	More sports surfacing	x			x			2
	Shelter for "exposed" grounds to extend potential use in windy, rainy and sunny weather			x	x	x		3
Hygiene	Permanent outdoor Handwashing facilities		x					1
Access	Formalise external access route to toilets and one-way route on/off site with surfacing, and additional pedestrian entrance		X					1

Table 6
School pupil numbers and school land usage.

		(m^2)							
School	Total pupils[a]	Approx. Total site area[b]	Buildings area (m^2)	Net Site	Hardscape play-ground	Playing fields	Wooded/natural area	Other	Space per pupil
A	119	8351	1045	7306	1359	2928	1900	1119	**61.4**
B	186	8813	993	7820	751	3354	1209	2507	**42.0**
C	193	4805	1285	3520	1168	567	81	1704	**18.2**
D	256	5898	1492	4406	2656	0	311	1439	**17.2**
E	330	21,927	1836	20091	2068	9696	2274	6053	**60.9**
F	93	2789	495	2294	592	0	875	826	**24.7**
Mean	196.17	8763.83	1191.00	7572.83	1432.33	2757.50	1108.33	2274.67	37.40
SE	35.69	2787.03	188.01	2653.03	323.89	1511.44	353.14	791.37	8.34

SE= Standard error.
[a] Pupil numbers rounded to the nearest 10 to preserve anonymity of the school.
[b] Net site = Total site area − Buildings area.

3.8. Outdoor space per pupil (OSPP)

The site surveys showed a significant disparity between levels of outdoor space per pupil (OSPP) across the schools. The school with the smallest ratio (D) offers only 28% of that of the school with the largest per-pupil provision (A), providing interesting context within which to interpret the qualitative data findings. OSPP ratios for each study school are shown in Fig. 4, including the division of that space between types of land use.

3.9. Scoring of site assets

Table 7 shows a summary of scoring from the school site surveys. The following scoring system was used to assess the extent to which each school's grounds accommodated access to assets before and after the implementation of COVID-19 related changes:

0 = Not at all; 1 = Weak; 2 = Average; 3 = Good; 4 = Excellent.

The asset list was based on a list of preferential design elements identified as potentially beneficial for children's development, learning and wellbeing drawn from precedent research.

The before and after total scores have been set against the contextual data of OSPP, Rural/Urban location and the main approach is taken to managing play space.

4 Discussions

4.1. Changes to site access

All study schools had changed school arrival/departure arrangements either by staggering or extending times (schools

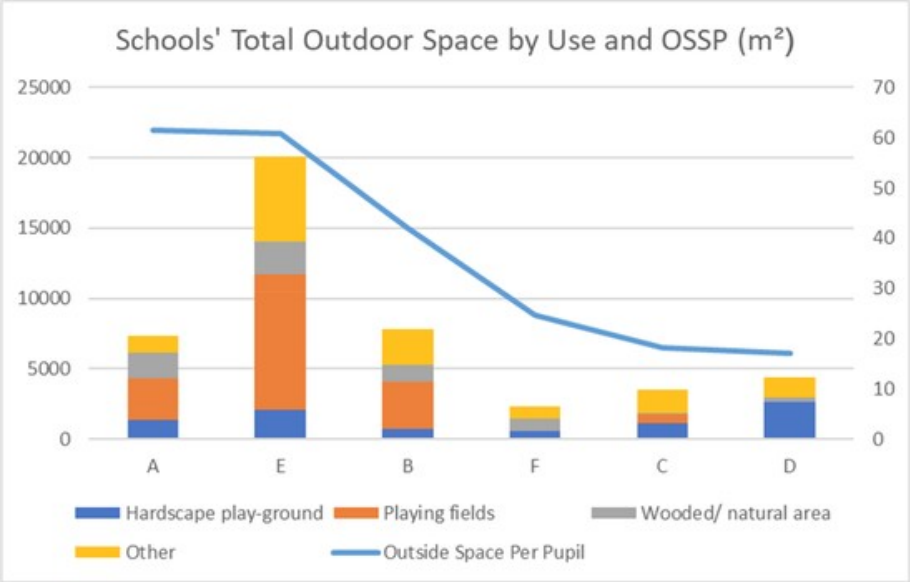

Fig 3. Schools' total outdoor space by use and OSSP

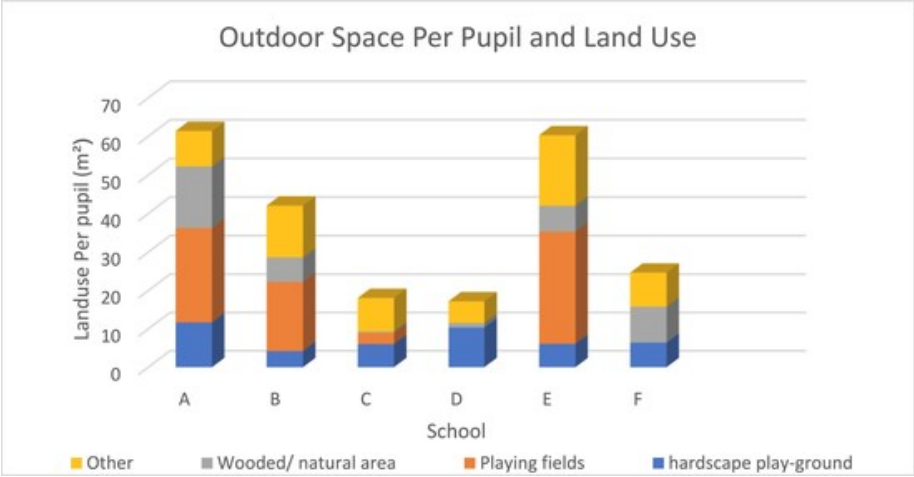

Fig 4. Net Outdoor Space Per Pupil (OSPP) with relative land use.

B–F), and/or changing site access (schools A-E). Changes to physical access included designated one-way walking routes for children and carers to enter/leave the grounds, or, at schools D&E excluding carers of older year-groups from the site altogether. Schools A, B, C & E had designated specific waiting areas for carers to drop or collect children. School B had also created an external route to enable access to indoor toilets without class bubbles crossing internally.

Schools with more generous outdoor space per pupil (OSPP) ratios were able to accommodate waiting areas using existing playground areas. Two schools with the lowest OSPP were more challenged in terms of movement on, off and around the site. School C particularly commented on the challenges caused by the narrow site layout in relation to access, with the main school building lying between the entrance and car park at the front, and main play space at the rear with narrow external corridors along which the majority of entrance points to the school building are located. In this instance, carers were restricted to the front of school car park area, queuing on designated markers and dropping off at 2 gates on either side of the building, two classes at a time. At times this meant parents from one class queuing through the arrival gate used by carers of both class cohorts onto the pavement beyond.

School D had changed collection points to external school gates, with no site entry to carers at all and staggered timings to ensure 2 cohorts left by separate exits at one time. To help accommodate this, the school had liaised with the Local Authority to pedestrianise a narrow road by the back entrance, creating a safer gathering point for carers, enabling social distancing.

Both of these schools had also prohibited the use of bikes and scoot- ers to travel to school as accessing the storage space was deemed to risky in terms of mixing cohorts.

4.2. Changes to free play

On return to school, experts proposed enabling children to access play opportunities as a way of supporting their wellbeing and helping them get ready for formal learning [33]. At that point in time, school grounds were still the only

place where children could congregate in larger groups due to restrictions on social contact outside of school.

Whilst schools generally felt there had been less challenges around emotional wellbeing than anticipated, some of the behavioural changes observed by schools may exemplify children's natural means of stabilising their wellbeing: namely, a strong desire for play and socialisation. Loss of learning stamina and resilience may also be linked to children's need to prioritise play. However, it is beyond the scope of this study to verify this. Schools also observed an increased dependency on screens and influence of gaming/tv culture, and a loss in general fitness, and in some instances noticeable weight gain, both of which suggest children had not been accessing regular active play opportunities outside of school.

UK government guidance recommended staggering access to play facilities by cohorts to avoid unnecessary interaction and minimize cross-contamination of surfaces, etc, and regular cleaning of high touch surfaces [34,35].

Approaches taken by all schools to enable safe access to spaces and equipment included staggered timetabling. Although morning breaks were unchanged, children had shorter lunch breaks because of this timetabling.

The four largest schools also implemented full or partial zoning of their play spaces to enable more than 1 cohort to be outside at once. Schools B&D applied this to their main play space, using planters, cones and floor markings to divide the space in two. School E, with by far the largest total grounds area and OSPP, applied this to two of their three distinct and separate play spaces for EYFS and KS2 (Y3-6). School C had zoned a lower section of their playground to create the class breakout zones, but the majority of the main playspace was in use by 1 cohort at a time.

All but School A had reduced access to fixed, high touch play equipment either via a rota system enabling natural decontamination between groups, or by assigning equipment to specific cohorts. All schools provided loose play equipment for each cohort to supplement play, and 2 schools specifically referenced supporting children to play actively through the introduction of playground games by teaching staff. One was implementing this and one aspired to do so.

Schools B, C and F had outdoor zones adjacent to classrooms to provide break out space for bubbles, with School C using these to supplement outdoor time at lunchtime and additional informal breaks, Fig. 5.

Table 7
Combining grounds survey scoring data for before and after covid-19 related changes, outdoor space ratio and playspace zoning.

Asset Types	School A		School B		School C		School D		School E		School F	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Outdoor classrooms/designated learning space	4	3	3	3	3	3	2	0	4	4	2	2
Big hard and/or soft surface spaces for running/chasing/ball games	3	3	3	2	4	3	4	2	4	2	4	4
Play space across different levels/divisibility	3	3	2	0	4	3	1	0	3	2	4	4
Climbing opportunities:	3	3	4	3	3	2	2	1	4	2	2	2
Other fixed play equipment	2	2	2	1	3	3	2	2	3	3	4	3
“Loose” play equipment	3	3	3	3	3	3	3	3	3	3	4	4
Natural spaces with planting/trees/shrubs to explore/nature areas	4	4	4	2	2	1	2	1	3	3	4	4
Hidey holes/den areas	4	4	3	1	2	2	2	1	3	2	3	3
Shady/sheltered spaces	3	3	3	2	1	1	2	1	2	2	3	3
Quiet areas	3	3	4	2	2	2	2	1	3	2	3	3
Seating	3	3	4	1	3	3	4	3	3	3	3	3
Garden or growing spaces	3	3	3	3	3	1	2	1	3	2	3	3
Animals	3	3	0	0	0	0	0	0	2	2	0	0
TOTAL SCORE VALUES:	**41**	**40**	**38**	**23**	**33**	**27**	**28**	**16**	**40**	**32**	**39**	**38**
Difference	−1		−15		−6		−12		−8		−1	
Outdoor space m^2/pupil ratio	61		42		18		17		60		25	
Urban/Rural	Rural		Rural		Urban		Urban		Urban		Rural	
Zoned Play space?	No		Full		Partial		Full		Partial		No	

Four other schools also referred to using additional “brain” or “movement” breaks across the day, some of which were free play.

The site survey scoring summarised in Table 3, attempts to quantify elements of play and outdoor learning value for each school site, showing a score for before and after the implementation of site changes in response to COVID-19.

Schools A&E who maintained full play area access, experienced the least impact on their score. Interview findings indicate they also re- ported the most positive changes to playtimes, describing them as calmer and happier, and play behaviours as being more active, inclusive and, in one instance where access to fixed play equipment was now restricted, more creative with children finding alternative ways to spend their playtime. A teacher at School A had suggested that staggered playtime duties actually take up less staff time in total because of the decrease in incidents and therefore any follow-up work required. School B, which implemented full zoning also reported a noticeable drop in fall-outs, commenting that the CCTV cameras had not been used to review playground altercations

Fig. 5. Break out zones adjacent to classrooms at schools C (above left I) & B (above right II). Zoned play spaces at school D (III).

at all in the 6 weeks the children had been back, previously a regular occurrence. School D also felt their new Year 3 intake had settled more quickly and confidently in their bubble cohort, although whether this was related to playtimes was uncertain. The site survey scoring highlights that those schools implementing a full zoning approach (B&D) experienced the highest drop in scores, followed by partial-zoning schools (C&E). This was caused not just by a reduction in the size of space available for play, but because of the way the zoning and related procedural decisions affected access to play features for individual cohorts. Typically, zoned spaces lost elements of complexity as the spaces were smaller and lost the benefits of access to level changes or boundaries between spaces which were used to create formal zone boundaries instead. School B saw the greatest score differential, despite its close to average OSPP of 42 m^2. Zoning had restricted play access to some of the natural assets, which doubled as spaces to shelter, hide and explore, and quieter spaces and seating. Two timber-built design elements that had the potential to add play variety were not in use: one shelter with seating being used as storage for loose play equipment boxes, and a castle structure remained out of use since before COVID-19 due to supervisory concerns. The most marked impact of zoning on play experiences was on school D, already disadvantaged by its significantly lower OSPP of 17 m^2 pupil. The school acknowledged the limitations of its grounds provision in interview responses and had been working on grounds improvement plans prior to the pandemic. The majority of its grounds are one large, mostly open space, relatively exposed to the elements with few natural features – see Fig. 5, III. The concentration of most fixed play features fall in zone 1 (out of shot in the photo), closest to the school building. This provides reasonable variety of play features but less space to run, with a potential outdoor learning space having been removed, and zone boundaries expanded in response to pupil feedback, whilst Zone 2 has very little play interest be- yond sports goals. A further procedural decision had been taken restricting use of the fixed climbing equipment to only one-year group. The rotation of access to fixed play equipment at most of the study schools enabled children to have some further variation to their play for part of the week/a week at a time. However, School E had also taken a decision to remove access to climbing equipment for KS1 pupils which they had previously shared with KS2 classes.

The following adaptative design considerations for free play have been summarised:

- Importance of size (pupil numbers): Numbers of pupils appears to influence a logistical requirement for creating play zones to accommodate more than one cohort at play at one time, as well as staggering playtimes.
- Importance of relative size (OSPP): Schools with a low OSPP will benefit from greater flexibility over use of spaces. Features should be easily adapted between different uses such as play/sports/learning.
- Distribution of fixed elements: avoiding a concentration of fixed play elements and distributing them more

evenly across play areas would give a better opportunity for fairer sharing when spaces are zoned, although this may create challenges in terms of supervision.

- Encouraging creative play: School F's observation of increased creativity of play when fixed play structures are off-limits is interesting, but may require an environment that is otherwise stimulating, requiring more creative design approaches.

4.3. Changes to outdoor learning, additional movement breaks and PE

Active play and learning are considered to support a child's ability to learn, particularly those with additional learning needs such as attention deficit disorders [36,37]. Schools C, E & F observed symptoms of a drop in focus and loss of attention and learning stamina amongst returning pupils, and a need to re-establish learning readiness. These schools described children struggling to follow tasks to completion and finding it harder to sit down and concentrate. This seemed particularly apparent amongst younger children. Outdoor learning would therefore seem to be of increased relevance to meeting children's needs, and one school was assured of the benefits their pupils were gaining from enhanced outdoor learning provision.

Schools D, E & F also reported a noticeable loss of fitness in pupils, thought to have been caused by a combination of lack of activity, with at least 2 schools confident that many children had not been benefiting from daily walks permitted under lockdown, and sedentary habits created by over-use of screens for TV and computer gaming. Another factor in fitness and weight was in some cases confirmed to have been due to easier access to less healthy snacks and food choices whilst at home. Whilst very significant weight gain seemed to be limited to a few cases, it was considered more noticeable amongst older year groups.

UK Government reopening guidance to schools recommends PE should be held outside wherever possible [35]. 5 out of the 6 schools were holding all PE outside as advised, and there is further overlap of health benefits from the additional movement breaks referenced by most schools to support learning focus.

Whilst all except School D described using their outside grounds extensively for learning under partial summer re-opening, aided by good weather, a greater staff to children ratio, and a relaxation of curriculum pressures, under September's full school re-opening only Schools B, E & F indicated they had consciously increased outdoor learning activities. Of these, schools B&E had good and excellent provision of outdoor and natural learning spaces and resources onsite, and average and generous OSPP ratios, respectively. Schools B&F also made use of “zones” outside the classrooms for breakout learning space. School F had small grounds with a low OSPP and very little in the way of designed outside learning spaces. However, good levels of complexity in the site's design creating room-like spaces segregated from the wider play space by natural features, teamed with its rural setting and ready access to offsite amenities such as woodland and playing fields, contributed to the achievement of an impressive level of outdoor activity.

4.4. Urban vs rural

The amount of outdoor space that a school has available per pupil (OSPP) averaged at 32 m^2 for urban schools and 43 m^2 for rural schools, indicating that in addition to benefitting from any natural nearby assets, which schools B&F both acknowledged doing, rural schools typically had 34% greater outdoor space per pupil than the Urban schools in the study. Rural schools were shown to be using nearby offsite greenspace effectively to augment environmental learning. Although scarcer in an urban environment, identifying walkable local greenspaces could be a good way for urban schools with lower OSPPs to extend their outdoor and environmental provision. Two of the urban schools, one of which was on the edge of the town centre, had extremely limited natural assets making the delivery of outdoor environ- mental learning more challenging than for those schools with natural assets throughout their sites. According to relevant studies, primary school students require adequate space to engage in physical activity during recess [38,39]. Previous research has indicated that increasing space available per pupil encourages greater physical activity [37]. In light of the needs study schools identified in their pupils for play and physical activity in support of their readiness to learn, it is possible that children at schools with lower OSPP may be disadvantaged in terms health, wellbeing and learning outcomes, particularly where zoning further limits play space, but further research would be required to validate this. For example, Grunseit et al. (2020) investigated the relation- ship between school playground areas and students' total physical activity (PA), and the results showed that increasing space by up to 25 m^2 per student resulted in better PA outcomes [39].

4.5. Adaptive design: space constraints and the importance of good design

Two of the study examples exemplify how considered design can greatly enhance the functionality of a small site. School F has the smallest site in the study that benefits greatly from the interesting terraced design and natural features of its sloping, rural setting. Most spaces are compact but open and flexible. School C's constrained site also benefits

from a terraced slope which adds interest, and a considered, coherent design for its main play area packed full of play features to which it has continued to provide access for all year groups. Conversely, School D, the second largest school by pupil numbers, faced significant challenges of a very constrained, flat and open urban site, with the vast majority of its play space in one block and lacking coherent design or complexity. Consequently, it proved difficult to use for multiple simultaneous activities, and zoning had further limited its play and learning design value.

The Headteacher in School D highlighted the lack of natural assets in their grounds. Adding green space to asphalt-covered schoolyards can expose children to nature, increase daily activity levels, and promote social health [40].

We have summarised the following key design interventions:

- Purpose-designed outdoor learning spaces are not a pre-requisite for outdoor learning, although they can make it easier and more designated learning spaces were requested by all but one of our study schools. Apparent priorities for learning spaces from schools' perspectives included shelter and all-weather surfacing, and seating. An element of containment and/or spatial divisibility from the wider site is also beneficial to enable simultaneous discreet activities where OSPP is limited.
- Positioning of the main building(s) within sites influences functionality and ease of divisibility of surrounding spaces. Narrow outdoor corridor spaces with multiple access points can prove problematic in relation to discreet bubbles accessing school assets. Schools such as A and E with generous OSPPs of >60 m^2 benefitted from larger portions of outside play and learning space on 2 or 3 sides of the main buildings, with design elements such as mounding, surface changes and planting helping to divide the larger spaces into distinct areas.
- Settings influence the experience of outside learning. On an urban site design may need to work harder to create welcoming space for play and learning than rural sites which benefit from surrounding natural assets. This was a significant disadvantage for School D.
- Flexibility of space is of particular importance for schools with lower OSPP ratios where a play space may need to accommodate PE and Learning activities. Careful consideration should be given to materials such as surfacing and any furniture to enable ease of movement or multiple uses.

Because the majority of studies on architecture/design and COVID- 19 in schools have focused on within buildings [41–43], our research, which focuses on a very original topic, is difficult to compare with the current peer-review literature, which unfortunately does not address the resilient design of school playgrounds. However, at the time of writing this article, our findings are consistent with Waite's article published in an architectural magazine [44].

Waite's article, in particular, emphasises on how primary schools can adapt to a post-lockdown world as well as the importance of playgrounds and outdoor space in schools, describing it as an opportunity for a “new wave of innovative outdoor classrooms” [44].

Adaptive design and school social distancing interventions, which are far less disruptive than full school closure and could help to keep the pandemic under control, should be considered by policymakers and researchers [3].

4.6. Study limitations

This research was carried out in the summer/autumn of 2020 and was written up in the context of available precedent research, government guidelines, and understanding of the COVID-19 virus at that point in time. As this study explored novel and rapidly changing context, precedent research of experiences under the COVID-19 restrictions was very limited. The work was carried out ahead of the 2nd & 3rd national lockdowns in England, the emergence of new COVID-19 variants, and the second wave of school closures. In particular, this study was conducted before the appearance of a new more transmissible variant, B.1.1.7, in the South East of England which contributed to a significant spike in spread towards the end of the year [45].

Research guidance on design of school spaces recommends involving children as the experts on how these spaces are used and experienced [46]. Due to the time constraints around setting up the project and gaining access to schools, this was not feasible. Instead efforts were made to include site elements in the survey that reflected typical preferences of children based on precedent research. However, evaluation of these elements was carried out by an adult and will include an element of subjectivity.

Although 50% (3 no.) of the schools involved conformed to the ONS Urban definition, they were not inner-city examples, all being within at least a 5-min car journey of woodland or countryside, and walking distance of other urban greenspace.

The findings should be considered as a limited sample, and further research into a wider range of schools would be recommended to build a more complete picture of experiences.

5. Conclusions

The first objective of this study was to understand what needs schools had identified in their pupils on their return to school.

At the point the interviews were held, study schools indicated that the general wellbeing of their pupils was not presenting as a significant concern, with two reporting this had been much less of an issue than they had anticipated. In addition to overarching needs for safety and structured learning, what study schools observed in their pupils was:

a) A strong desire for play and socialisation opportunities
b) A loss of learning stamina and learning readiness
c) A loss of fitness
d) Evidence of greater dependency on screens and links between increased video games usage, adverse play behaviours and weight gain/fitness loss.

Whilst it is possible that factors a and b were symptomatic of a need in the children to manage their wellbeing and address any latent stresses or anxieties, it was beyond the scope of this research to verify this. The loss of fitness was in keeping with health concerns established through the initial literature review [47,48].

The second objective identified the role school grounds have played in accommodating these needs and how usage has been adapted to do so.

Study school findings ranged from very little change to outside space use at the two smallest schools, to more visible, physical, and functional changes at the larger schools. School grounds were now being used to accommodate socially distanced access routes and holding-spaces for carers at drop off and collection time, segregated free-play break times for multiple cohorts, plus additional informal movement and play breaks, PE sessions and outside learning space. Schools with the most comprehensive responses had maintained morning & lunch break times by cohorts, in some cases rotating access to fixed play equipment to maintain varied play opportunities and had increased outside learning and informal activity breaks in response to concerns about ventilation and safety, loss of learning stamina, and as part of encouraging healthy and active lifestyles. Use of outside space for learning was also facilitating more targeted catch-up learning, assisting intervention groupwork to learners requiring more support.

This data was compiled as a combination of interview findings and physical site survey data, and the changes on each site were then quantified as a “Before” and “After” play and learning value for each site, based on access to a series of design elements compiled from precedent literature.

The third objective explored how spatial layout and design elements may have supported or inhibited schools' abilities to respond to children's needs, and how this might inform school grounds design considerations for the future.

The interviews and site survey data combined to provide insight into spatial and design factors that had influenced schools’ abilities to accommodate outside and environmental learning, PE and play opportunities.

Smaller schools managed to accommodate use of play spaces by distinct pupil cohorts without the need for zoning, whereas zoning appeared a necessary factor for larger schools due to the logistics of fitting multiple play & lunch times into the school day. Zoning generally had an adverse impact on site learning and play value, due largely to restrictions it placed on the variety of play elements accessible to each zone, and in some cases preventing use of shared learning assets.

Schools with more complex and divided site design, such as school F, were able to effectively balance the multiple demands on outdoor space use under COVID-19, as were those with higher OSPP, although management decisions are also vital to informing most effective use.

Finally, in this study, we identified a significant disparity between the amount of outside space per pupil available to different schools and that more complex and considered design of lower OSPP school grounds significantly from increased the play and learning value and flexibility of use when compared with more open, less complex designs. We found that there are learning points to be drawn from schools' experiences, including the apparent value of outdoor learning in supporting children's return-to-school needs, and in particular the need for considered design approaches to accommodate greater school site flexibility including: designing playful, multifunctional spaces rather than play objects; dispersing design elements across the site; and factoring in ease of divisibility to enable segregated simultaneous site uses. The lower a school site's OSPP, the greater these requirements.

Further research involving the voice of the child would provide play experience findings to help validate or challenge the play value scores of this study's site surveys. In doing so it may be possible to devise a self-evaluation checklist for schools to review their play provision under COVID-19 restrictions. Future studies might also involve children in evaluating the suitability of their whole school site in order to inform design of the buildings and grounds, and develop a research approach that incorporates children's ideas [49]. A longer-term study would also be able to reflect the impact of changes on the hidden curriculum, such as how children feel their needs are being understood and met by the school and how this is impacting on their attitude towards it. Further studies could also explore links between schools' use of outdoor play and learning in supporting children's longer term health and wellbeing in the aftermath of the initial and subsequent COVID 19 Lockdowns.

Smaller cohort sizes at playtimes appear to have had positive behavioural outcomes at some of the study schools in

terms of relationships, more rapidly embedding new pupil intakes, and play and activity levels, with positive implications for overall staffing time. Further research from a perspective of education and play psychology would help to verify the causal factors for this which may be beneficial to informing mainstream school practice outside COVID-19 restrictions.

Acknowledgment

Our thanks go out to the interviewees themselves and their colleagues, who made time to contribute to this piece of work across a period when so much was still unknown and in flux and schools were trying their best to bed in new arrangements to ensure the safety of their pupils, staff and school communities. This research does not infringe the ethical principles set out in the University of Gloucestershire's Handbook for Research Ethics. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. School Interview Questions:

1. What challenges has the context of COVID19 presented for your school in relation to use of outdoor your spaces? (logistical/Support needs of children)
2. Reports indicate that Lockdown has potentially had a variety of negative impacts on children, ranging from anxiety and emotional strains for children and their families, lack of social interaction, lack of exercise, increases in screen time, lack of educational progression, to name a few.
   A) Where the school has picked up on particular support needs of the children, has use of outside space/school grounds proved useful in addressing any of those issues?
   B) If resources were no object and you could make changes to your outdoor grounds, are their ways you would like to use your outside space to address any of the needs you have identified?
3. Has your school made any physical changes to your school grounds, and if so what are they and why?
4. How was your school using your outdoor spaces prior to COVID and how has this changed (if at all) in relation to the following:
   a) Free play and Break Times?
   b) Physical Health & Emotional Wellbeing? (inc. PE & SEN)
   c) Environment & Nature?
   d) Wider Curriculum?
   e) Other uses?
5. What, if any, impact do you believe these changes have had already or may have in the longer term on:
   a) how your school would previously have delivered learning, or had been planning to deliver new learning opportunities?
   b) supporting physical health or emotional wellbeing and development of your pupils?
   c) Why do you believe your answers to a) and b) to be the case?
6. Who has been involved in deciding changes to use and management of outdoor school spaces? (HT/Governors/H&S adviser/staff/pupils/parents/others?)
7. Have there been positive experiences or outcomes emerging from the changes in use or management of your outdoor spaces in response to COVID19? Would you wish to continue with any of these changes if COVID19 safety precautions were no longer necessary?
8. What access do pupils have to the following features or design elements:

	Free Play	Supervised Play	Formal Learning	PE/Health & Wellbeing	Other/ notes
a) Outdoor classrooms/designated learning space					
b) Big hard and/or soft surface spaces for running/chasing/ball games					
c) Play space across different levels					
d) Climbing opportunities: play equipment/climbing walls, or natural items such as trees/logs/ boulders					
e) Other fixed play equipment (please describe)					
f) "Loose" play equipment that can be used or manipulated in different ways for play (please describe)					
g) Natural spaces with planting, trees, or shrubs they can get in amongst and explore and/or nature areas/ponds					
h) Hidey holes/den areas					
i) Shady/sheltered spaces					
j) Quiet areas					
k) seating					

8. a) If funding were no constraint, is there anything else you would like your pupils and teaching staff to be able to do in your outdoor space that you are currently either unable to do, or would like to do better within the context of COVID

restrictions?

b) How might changes in design features or layout assist with this?

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