Does Classroom Architecture Count beyond the Early Years?

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Abstract
The importance of classroom architecture has long been recognized and supported as a significant factor in Early Years teaching and learning, garnering an explicit focus in policy and practice in Scotland. The same cannot be said of practices beyond the early years, where the explicit role of classroom architecture has been less clearly defined. In my study, I adopted an inductive approach, using a systematic literature review followed by a directed content image analysis to explore how the classroom architecture supports teaching and learning in the primary school for children ages 7-11. Within the study, classroom architecture was defined as the use and arrangement of furniture, organisation of resources, and sensory variables. The goal of the study was to better understand how classroom architecture supports teaching and learning to inform teacher practices in Scottish primary schools. Findings suggest classroom architecture is an essential element of positive teaching and learning environments for primary classrooms. Flexible and purposeful use of furniture, attention to seating arrangement, organisation and access to resources, and attention to the impact of sensory variables play a part in children's social, emotional, cognitive, and physical development and can be used by the teacher to create positive instructional environments.

Keywords
Classroom architecture; primary school; Scotland; teaching; learning.

Introduction
The learning environment has long been recognized and supported as a significant factor in Early Years teaching and learning, contributing to the development of children's independent thinking and acting (UNICEF, 1990; Scottish Gov, 2007, 2008b, 2011, 2013b; MacBlain 2018). Practices have been informed by pedagogical approaches that emphasise the importance of the environment. As an example, Reggio Emilia approaches highlight the environment as the third teacher (Robson and Mastrangelo, 2018), defined in part as the physical architecture of a space, including décor, design, aesthetic qualities, resources and activities that support learning (Evanshen and Faulk, 2011; MacBlain, 2018). Approaches like those practised in Reggio Emilia have had far reaching influence on UK policy and practice in the Early Years; making the environment a core component of early years curricula and frameworks in the UK and influencing evolving pedagogies and practices including outdoor learning, Forest Schools, active learning, play-based and creative environments (Scottish Government, 2008a; National Council for Curriculum and Assessment (NCCA), 2009; Davies et al., 2013; Department for Education, 2017).

Education Scotland (2018) highlights 'personalisation and choice' as a key principle of Curriculum for Excellence (CfE), emphasising the importance of learning environment in developing autonomy and creative thinking; two skills necessary for success in real life. A review of Scottish policy for primary and secondary schools suggests the orientation to learning environment is two-fold. Predominantly, policy reflects a focus on aspects of the learning environment geared toward teacher-child interactions that promote positive behaviour; to a lesser extent, is reference to the use of classroom architecture and its role in teaching and learning (Scottish Gov, 2013a; Scottish Gov, 2014, Scottish

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Futures Trust, 2018). Across the literature, learning environments as they relate to primary grades (ages 7-11) have been broadly defined in terms of 'class climate'. Class climate has been characterised by quality of teacher-child interactions, use of technology, and learner motivation (Croll and Hastings, 2013; Pollard, 2014), with minimal attention to the relationship between architectural design and instructional practices. While current research presents evolving pedagogies including active learning, formative assessment practices, collaboration, multiple means of engagement and expression, the attention to the role of classroom architecture to support these instructional practices remains bereft (Higgins et al., 2005). Through an injection of £1 billion from the Scottish government, Futures Trust (2018) is committed to improving school estates. This includes classroom learning environments, with improvements related to access and use of technology, flexible seating, colourful décor, and use of outdoor spaces, suggesting an emerging understanding that architecture is an important factor bearing consideration.

Stadler-Altmann (2015) suggest the emphasis on classroom architecture has been largely overlooked beyond the early years. As a pre-service primary teacher, classroom architecture was not a focus in my professional or practical learning. Fortunately, two experiences gave rise to my interest in this topic. First, while on placement, teaching children ages 6-7 years in a Scottish primary school, I witnessed a distinct change in the children's engagement with learning following a change in their classroom arrangement and furnishings as a result of their teacher's close working with the nursery teacher to enhance the school's approach to transition through play. Second, I read Delzer (2015) relating her experiences of visiting a Starbucks to what children should experience daily in their classroom environment. In her article she highlighted the importance of comfortable seating, and sensory variables to promoting positive experiences. From this moment, I began to explore the literature and research related to classroom architecture more closely noting the wealth of information that was available on the importance of architectural design in the early years but becoming aware that this did not translate to the primary years. It was from this moment that I developed an interest in exploring classroom architecture beyond early years.

A foundation of research supports the importance of physical and architectural environment to children's psychological and social development and well-being in school-based settings (Steele, 1973; Bronfenbrenner, 2005; Weinstein, Romano and Mignano, 2011). Within the bioecological model, Bronfenbrenner (2005) highlights context, the dynamic relationship that exists between an individual and the environment, as one of four significant factors contributing to an individual's social, emotional, and cognitive development. Applied to the school context, where environment informs culture, sense of belonging, and capacity for building relationships, the implications of this dynamic relationship on children's psychological and social development is clear. Dumont and Istance (2010) highlight the contextualised nature of the learning environment, pairing it with the 'learning episode' (p. 29) and characterised by the teacher, learner, content and architecture of the setting. Steele (1973) highlights various functions of the physical environment that impact how teachers and learners think, feel and behave. Building on Steele's work, Weinstein, Romano and Mignano (2011) focus on 5 specific functions essential to the physical environment that support teaching and learning: s*ecurity and shelter*, *symbolic identification*, *pleasure*, *task instrumentality*, and *social contact*. Yet, as Martin (2002) reports, many teachers lack understanding about how to adjust classroom architecture to support teaching and learning. Paired with a review of literature on School Environments, the statement made by Higgins et al. (2005, p.3), 'No one knows how to prevent "learning-loss" when you design a room "pedagogically", whereas we know lots about designing for minimum heat loss', a focused exploration of how the architecture of the primary environment supports teaching and learning is justified.

This study explores how the architectural design of indoor learning environments in primary schools supports teaching and learning for primary school children ages 7-11. The goal of the study was to

better understand the role of classroom architecture in teaching and learning to inform practice in Scottish primary schools. Drawing from early years literature (Evanshen and Faulk, 2011; MacBlain, 2018), this study defines classroom architecture in terms of the seating and furniture arrangement, resource organisation, and the sensory variables including lighting, temperature, colour and acoustics in a primary classroom.

The following sections outline the two-stage approach to data collection including systematic literature review and directed content analysis before presenting findings that contribute to the emerging understanding of how architectural environments support teaching and learning in primary classrooms for children aged 7-11.

Methodology

Approval for this study was obtained from the University of Dundee. The study adopted a systematic literature review design paired with a directed content analysis and was guided by an inductive approach as a way of identifying and critically appraising research and literature to aid the investigation. Cohen et al. (2018, p.4) suggest induction is a beginning point in science, supporting researchers to recognise previously unknown relationships allowing for hypothesis and eventual generalisations.

According to MacLure (2005) systematic review is limited in quality and capacity, and therefore is restricted in its usefulness toward policy and practice. However, Suri (2014) notes systematic review is gaining relevance within Education research where evidence-based practices drive developments; Cohen et al. (2018) suggest a combined approach involving systematic review paired with an additional review provide a greater depth of examination, supporting variable-oriented connections and improving usefulness of findings. Accordingly, a directed content analysis was used to systematically code 200 visual images of primary classrooms to support an investigation of the research question.

Systematic review demands organization, explicit planning and clearly defined protocols that outline the rules of engagement with literature (Petticrew and Roberts, 2008). Through this design, searches are transparent and comprehensive including a range of databased and grey literature. To ensure transparency and clarity in the search Petticrew and Roberts (2008) suggests establishing a clearly defined question that the review will seek to answer. In this study, the following question guided the research:

- How does the architectural design of the indoor learning environment support teaching and learning in Scottish primary classrooms for children ages 7-11?

As a way of further informing the systematic literature review three sub-questions directed the search:

1) What evidence is in the literature suggesting how the arrangement of furniture in the environment supports teaching and learning?
2) What evidence is in the literature suggesting how the organisation and management of resources supports teaching and learning?
3) What evidence is in the literature suggesting how sensory variables support learning?

Burton, Brundrett and Jones (2008) indicate an organised framework for handling literature lends itself to a more integrated, focused, critical and analytical approach to sources. For this reason, steps were taken to ensure a systematic approach to the review of literature ensuring breadth and depth of coverage. Explicit search criteria were defined to guide the search and sources were screened according to a set of inclusion/exclusion criterion. An excel spreadsheet was used to organise search

information including terms, date of search, number of sources returned and how many of these were used. In total, 14303 sources were returned with 207 used. It is important to note that the number of sources identified on the spreadsheet as 'used' do not represent the exact number of sources read and analysed. The 'used' sources refer to materials which were downloaded and read if they were relevant to the topic. The snowballing technique – looking at the bibliographies of selected literature – provided further reading relative to the topic (Ridley, 2012). Total sources reviewed and used in the synthesis included 45 pieces of professional literature, educational research, and policy. Details outlining the inclusion criteria and the sourced literature are provided in Table 1 and 2.

Table 1. Inclusion Criteria.

Criterion type	Inclusion Criteria
Topic Relevance	Boolean operators were used to support/refine searches; key word searches related to one of the three sub-questions supported the search and articles that were relevant for answering the overarching question were used.
Proximity in time	CfE was introduced into Scottish schools in 2010 (Scottish Parliament Information Centre, 2013) therefore, policy related searches were restricted. Only policies from 2010 to 2019 were used in the review.
Geographical range	Initial searches were confined to Scotland and then to UK sources. However limited findings resulted in a need to broaden the evidence-base searches. Therefore, new searches were conducted, but with the term "UK" removed and only sources with education systems similar to Scottish schools were reviewed.
Age applicability	Relevant literature focusing on classrooms with children aged 7 – 11 years was reviewed. This was to provide evidence corresponding to primary four to seven classrooms found in Scottish schools.

Table 2. Types of Literature Sources Searched.

Type of Literature	Search Procedure
Journals articles	University of Dundee (UoD) library, Scopus, British Educational Index (BEI),
Grey Literature	Scottish government reports; reports from schools; research publications, international publications (UNCRC); Professional publications
Books related to learning environments	Library catalogue from the University of Dundee Books available in the Education Section of the University of Dundee Library
UK and Scottish websites	Scottish Government Education Scotland
Worldwide websites	Educational Resources Information Centre (ERIC) and Google Scholar

Theory related to classroom architecture that emerged from the systematic literature review guided the directed content analysis in the second stage of analysis (Hsieh and Shannon, 2005). Three search engines (Google, Bing, Yahoo Images) were used to collect and review 200 pieces of photographic evidence showing architectural environments in early years and primary schools. An online approach to this phase of data collection and analysis was chosen for its expediency, accessibility, and efficiency (Cohen et al., 2018). Image analysis provided the opportunity for scrutinizing key features and

relationships between theory and practice to better understand how architectural designs can be used to support teaching and learning in the primary years. Drawing from theory emerging from the systematic literature review, the following themes informed the analysis of images:

- Room layout
- Furniture layout
- Type of furniture
- The available spaces for teaching and learning.
- Evidence of resources
- Organisation of resources
- Types of resources
- Evidence of lighting type

Cohen et al. (2018, p.684) indicate limitations with image analysis, suggesting the potential for partial, selective, biased, or incomplete analysis. These authors identify the need for reflexivity to support overcoming the limitations associated with image analysis. Rose (2007) suggests a list of key questions to guide reflexivity. From this list, the following questions were adapted to provide a written text that supported the image analysis:

- What is the image about?
- What is the image showing?
- What are the features of the image?
- What interpretations can be made about this setting?
- Do the interpretations align with the intention of the individual who produced the image?
- Does a written commentary accompany the image?
- Can the image be interpreted as a stand-alone image, or does it need to be in context with a series of images?
- What contradictions, if any, exist within the image?
- How is the image described?

The image search was guided by the terms, ‘Nursery Classrooms, UK’ and ‘Primary classrooms UK’. The data set included 200 images from early years and primary classrooms in UK education systems similar to Scottish schools. The collection of early years and primary images supported a robust comparison of each setting, which informed the findings. Figure 1. is illustrative of the analysis, depicting images that represent typical features identified in nursery and primary classrooms in the UK and the approach used to capture evidence of key features.

Note: nursery setting

Note: primary setting

Figure 1. Image 1a) of nursery and 1b) primary classrooms in the UK.
Each image was scrutinised according to themes that emerged from the systematic literature review and informed the three sub-questions, Table 1. provides an example of the notes from image 1b that supported the content analysis.

Theme	**Notes to support analysis**
1. Room layout	Social and individual working; teacher and student centred
2. Furniture layout	Clustered tables
3. Type of furniture	Wood, plastic, hard furnishings
4. Available spaces for teaching and learning	Groups, stationery
5. Evidence of resources	Some: books, rulers, stored materials (labelled tubs)
6. Organisation of resources	Storage bins on shelves and table tidies that include individual resources (pens, pencils, rulers)
7. Type of resources	Unclear
8. Evidence of lighting	Natural lighting and artificial lighting

Table 1. Notes recorded according to each theme and used in the content analysis.

Image 1a is a nursery setting; it shows tables being used to create spaces such as writing, creative and role-play areas and a book corner. The majority of the images which returned from the search had these features and align with current findings that suggest nursery settings in the UK are divided into areas that support a balance between structure and free-play, allowing the environment to serve as the third teacher (Burham, 2016; Robson and Mastrangelo, 2018).

Image analysis suggested a dramatic change in the use of space in primary settings, compared to the nursery setting: image 1b) is indicative of our findings, showing tables grouped together with some resources available on the table and little evidence of 'areas' within the environment. The next section provides a complete review of our findings.

Findings

Architectural Environments in the Primary Years

From our two-stage analysis involving the systematic review of 45 literature sources published between 2009 and 2019 including professional literature, research articles, government publications, paired with the directed content analysis consisting of 200 images of early years and primary UK classrooms, the study findings are presented according to the three sub-questions that drove the review:

How can the arrangement of furniture in the environment support teaching and learning?

Farmer, Lines, and Hamm (2011) identify the 'invisible hand' of the teacher in their analysis of the teacher's impact on the social ecology of the child. Through this lens, the arrangement of seating within the classroom becomes a significant factor in child development, determining interactions, behaviours, and general climate. Martin (2002) found the room arrangement directly influenced choice of child-led or teacher-directed instructional approaches. The review of literature suggests three common types of seating arrangements define primary and elementary classrooms, rows, u-shapes, and small groups. While rows have been found to facilitate direct instruction and learner focus through increased concentration and teacher enforced on-task behaviour (Gremmen et al., 2016; Blatchford and Russell, 2018), other studies cite negative implications for this arrangement. Weinstein et al. (2011) suggest social contact is restricted through this arrangement, with teacher-student

interactions confined to the front row of seating, while Drew and Mackie (2011) argue this type of arrangement constricts active learning, through decreased opportunity for collaboration. Collaboration is regarded as a significant factor supporting children's social, emotional, and cognitive development through increased use of domain specific vocabulary, problem-solving, and relationship building (Kagan, Kagan, and Kagan, 2015). U-shape and small group clusters support collaborative interactions (Blatchford and Russell, 2018), although interactions in u-shaped seating become less collaborative with large class sizes, limiting their usefulness. Current literature highlights the benefits of flexible seating, creating a dynamic teaching and learning environment that provides opportunity for student choice and supports teachers to adopt varied instructional strategies (Wannarka and Ruhl, 2008; Barrett, Davies, Zhang, and Barrett, 2015; Galleto and Bagalanon, 2017; Woolner et al., 2018). Galleto and Bagalanon (2017) suggest there is no perfect arrangement for each class, but careful reflection should guide teacher choice, providing a range of opportunity including enclosed areas with low distraction, independent working, and collaboration that supports the teaching and learning for each child.

How can the organisation and management of the environment support teaching and learning?
Across the literature, there was general agreement about the importance of resource management including access, storage and teacher's strategic use to support learning. A good supply of resources that can be used flexibly, are well organised, accessible, and include clear identification have been found to stimulate motivation, create enduring interest, inspire curiosity and creativity, promote responsibility and autonomy while providing personalised learning (Maher et al., 2012; Jindal-Snape et al. (2013); Ashbridge and Josephidou, 2018; Pollard, 2014; Barrett et al., 2015; Larkin 2016; Lippman, 2016; Kariippanon et al., 2017). Murdoch (2015) signals the importance of resource management beyond the early years, highlighting their role in inquiry-based pedagogy, an approach widely promoted to support higher order learning throughout primary school (Barron and Darling-Hammond, 2010). In their systematic review of literature identifying learning environments that promote creativity, Jindal-Snape et al. (2013) found access to, and availability of, a range of tools and materials promote children's creativity. Maher et al. (2012) found the teacher's purposeful choice and use of resources on the interactive whiteboard (IWB) were significant factors influencing learning through improved lesson pace, learner motivation, and classroom dialogue. Larkin (2016) found teacher's strategic choice of mathematical manipulatives, symbolic vs concrete, impacted children's learning. They suggest a sequenced framework for resource use that will support children's learning beginning with familiar objects, and progressing to substituted objects, digital objects, photographs, graphics, diagrams and symbols.

In what ways do sensory variables in the environment affect learning?
A number of sensory variables that support physical comfort and influence learning have been identified. Various sources of lighting have been found to have a positive influence on learning. Sleegers et al., (2013) suggest a whiter, brighter light supports increased concentration, while warmer lighting has been associated with enhanced communication (Choi and Suk, 2016). Barrett *et al.*, (2015). Found access to natural lighting with a view of nature is important, although warns that large windows can promote glare, which was found to impede learning. Classroom acoustics factor into the physical comfort of learners with a number of authors citing the deleterious effect of poor acoustics on learning related to speaking, listening, and reading comprehension (Crandell and Smaldino, 2000; Anderson, 2004; Stansfeld et al., 2005). Rudner et al. (2018) suggest the use of soft furnishing to support successful listening, allowing children to put their effort into learning, rather than listening, which requires an increased amount of motivation and effort in a noisy environment. Temperature is a third aspect of physical comfort that has been explored in our review. Wargocki and Wyon (2007) report that cooler temperatures with increased ventilation support sustained pace of working, while Barrett *et al.* (2015) suggest controlled, cooler temperatures promote increased concentration. A final aspect of physical comfort is the room colour, which has been found to have emotional and

physiological effects on learners (Kuller, Mikellides and Janssens, 2009). Barrett et al. (2015) found pops of colour against a calm background is most facilitative to learning in order to prevent over stimulation of the senses.

Discussion of Findings

Architectural Environments in the Primary Years

Whilst the importance of the architectural environment for effective teaching and learning in the early years is well documented (Elkind, 2008; Scottish Gov, 2007, 2008b, 2011, 2013b, Martlew, Stephen, and Ellis, 2015; UNICEF, 1990) the same cannot be said for the primary years where the focus on classroom architecture has been dominated by attention to class climate, emphasising seating arrangements for the purpose of achieving behaviour management (Croll and Hastings, 2013; Pollard, 2014). Findings from this study add to the limited body of research highlighting the need for attention to class architecture in primary classrooms as a significant factor for consideration in teaching and learning with the capacity to influence how teachers and learners feel, think, and behave (Steele, 1973; Weinstein et al., 2011). This review highlights key characteristics related to three aspects of the architectural environment that most effectively influence teaching and learning. These include the arrangement of furniture, the organization of resources; the use or presence of sensory variables in the environment.

Impact on Practice

Martin (2002) indicates many teachers are confused or unaware about how to use classroom architecture to support teaching and learning. A review of Scottish policy suggests little guidance exists to support teachers beyond the early years to organise their classrooms. Weinstein et al. (2011) identify 5 features of the physical environment: social contact, task instrumentality, pleasure, symbolic identification, security and shelter (p. 230) that promote positive teacher-learner feelings, thoughts, and behaviours. Attention to the features should be given explicit attention in professional practice, guiding teachers to the intentional use of classroom architecture to support practices. The systematic literature review highlighted 2 features that teachers can positively influence through attention to the classroom architecture. First, flexible seating promotes students' feelings of comfort and sense of pleasure through choice, an important factor in building group cohesion and improved engagement leading to improved active participation (Weinstein et al., 2011). Second, the use of cluster tables promotes collaboration (Kagan et al., 2015), which is essential for social contact, supporting teacher-student and student-student interactions, another factor important in promoting positive school experiences.

Moreover, Weinstein et al. (2011) argue the importance of task instrumentality – the purposeful organisation of a classroom to support meeting learning objectives. To this end, resource organisation and management can be purposefully designed to promote higher order learning skills through developing children's capacity for self-direction, autonomy, and collaboration (Barron and Darling-Hammond, 2010). By providing free access to resources, and the creation of areas for independent and collaborative learning these capacities can be nurtured. Further, through understanding of and control over the sensory variables within a classroom, teachers can ensure an optimum environment facilitative of teaching and learning that supports students feeling comfortable and safe – precursors that must be satisfied for students to fully engage with learning (Weinstein et al., 2011).

The initial background reading that informed my interest in this topic, indicated a wealth of guidance exists, supporting early years teachers on how to use classroom architecture to facilitate teaching and learning (Scottish Government, 2008b; 2013b). However, to the best of my knowledge, there is little guidance in place for teachers beyond the early years in Scotland on how to use classroom architecture to support teaching and learning. The findings from this study provide a synthesis of literature highlighting how classroom architecture can support teaching and learning in primary

classrooms for children ages 7-11. These findings can be used to inform teacher development, and the development of clear guidance that highlights for teachers the importance of this topic in practice to support developing positive teaching and learning environments.

The findings of this study also suggest an interesting perspective that perhaps elements of the Early Years Approaches including Reggio Emilia and Montessori could be applied throughout the entire primary school. As an example, Montessori believed in the use of flexible environments defined by natural lighting and access to rich resources (Montessori, 1964; Pound, 2014), an understanding that emerged from our review of literature.

Limitations to the research

During the review, no Scottish-based research could be found explicitly related to exploring the impact of classroom architecture on children's learning beyond the early years. UK-based research was reviewed, and provided findings related the effects of flexible seating, use of resources and sensory variables on learning, most of which related to the HEAD study (Barrett et al., 2012) currently exploring the impact of sit-stand desks in England. While this provides evidence on the effects of the architecture on learning through flexible seating (NHS, 2018) it was necessary to expand the search criteria to include a wider body of international literature to achieve a robust synthesis.

Conclusion

This study supports the idea that classroom architecture has a role in teaching and learning beyond the early years. 'Personalisation and choice' is a key principle of Curriculum for Excellence (CfE) (Education Scotland, 2018), acknowledging this as a fundamental aspect of developing children's autonomy and creative thinking capacities (Kariippanon *et al.*, 2017). Findings from our review of literature, suggest attention to the architectural environment contributes positively toward these outcomes. Through attention to the furniture arrangement, resource management, and sensory variable supports, the teacher can facilitate children's personalised learning experiences, thereby fostering these important life skills.

At the heart of Scotland's Curriculum for Excellence (CfE) are two policies, 'Getting It Right For Every Child' (GIRFEC) (Scottish Government, 2008c), and the United Nations Convention on the Rights of the Child (UNCRC) (UNICEF UK, 1990). Each of these policies highlight the importance of developing the whole child (Scottish Government, 2014) through the delivery of a child-centred curriculum (Scottish Government, 2008c; Reid, 2013). Child-centred curriculum means putting the child at the heart of all decisions made about their learning and catering for their individual needs (Scottish Government, 2008c). Findings from our systematic review provide evidence of how classroom architecture can support delivering a curriculum that promotes holistic development. Flexible approaches and purposeful use of seating and furniture arrangement, resource organization and management, and use of sensory variables, can be used strategically to promote social, emotional, cognitive, and physical development, supporting the overarching aims of the CfE.

Further Research

Further research is needed in Scotland to build on the findings synthesised through this study. Future Scottish-based research should include empirical studies that investigate the implications of classroom architecture on children's social, emotional, physical, and cognitive development, in support of the goals of CfE.

The findings give way to a new line of inquiry, proposing the potential to bridge elements of early years' theory with current practices in primary classrooms. Further research may involve an exploration of how approaches such as Montessori or Reggio Emilia could be implemented in primary classrooms to support teaching and learning in line with the aims of the CfE.

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Appendices

Appendix 1.

When the image analysis was carried out, the image below was selected an example of the material that was reviewed. This image was evaluated using the list of key questions to guide reflexivity from Rose (2007). It shows a year 6 classroom in a school in Kent. The image shows cluster tables, pots of resources on each table, some evidence of wall displays and good lighting. When compared to a typical early years setting, the features of the classroom are very different.

Rose Street Primary School. (2017) Our New Building: The Year 6 Classroom. Available at: http://www.rose-street.kent.sch.uk/wp-content/uploads/2016/07/Year-6-300x225.jpg. (Accessed: 21 October 2021).