To know maps: Primary school children and contextualised map learning

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Abstract: *Maps are inherent in younger children's lives, implicitly and formally. Their experiences in their immediate and local places from their earliest years enable children actively to construct their personal geographies, drawing on their everyday observations, journeys, explorations and activities. Place exploration and knowledge foster their spatial awareness, capability and decisions and enable their mental mapping of their known places and imagining of other places real and invented. Their personal geographical learning is essential in developing children's meaning and understanding of formal maps. Primary geography best develops children's map skills through extending their awareness and knowledge of places from the immediate and local to national and global using maps at all scales at all ages. From their early years children should engage with plans and large scale maps, and with globes and world maps, and begin to learn about and use atlases. Children's progression in learning maps skills is accretive and varies; it interplays with their personal geographies. From this can be provided a sequence for learning across children's developing environmental map abilities and their map reading capabilities. Geography provides the opportunities for their contextual learning of map knowledge, use and understanding.*

Keywords*: Maps; personal geography; children.*

Para conhecer os mapas: as crianças da escola primária e o ensino contextualizado do mapa

Resumo: *Os mapas são inerentes às vidas das crianças seja implícita ou formalmente. Suas experiências nos lugares logo nos primeiros anos habilitam construir ativamente suas geografias pessoais, desenhando suas observações cotidianas, jornadas, atividades e explorações. A exploração do lugar e o conhecimento fomentam suas consciências espaciais, capacidades e decisões e tornam possível o mapeamento mental dos lugares que conhecem e a imaginação de outros lugares reais ou inventados. A aprendizagem da geografia pessoal é essencial no desenvolvimento de significado e entendimento dos mapas formais. A geografia do ensino primário melhor desenvolve as habilidades das crianças com os mapas através da extensão de suas consciências e conhecimentos dos lugares próximos e do local para o nacional e global, utilizando mapas em todas as escalas e para todas as idades. Em seus anos primários as crianças devem se empenhar a trabalhar com planos e mapas de grandes escalas, com globos e mapas-múndi, e começar a aprender sobre e usando atlas. A progressão da aprendizagem de habilidades com os mapas nas crianças é cumulativa e variável; interage com suas geografias pessoais. A partir disso pode ser elaborada uma sequência de aprendizagem que perpasse o desenvolvimento das habilidades dos mapas do ambiente e das capacidades de ler os mapas. A geografia propicia a oportunidade de suas aprendizagens contextualizadas dos conhecimentos, entendimentos e usos do mapa.*

Palavras-chave*: Mapas; Geografia Pessoal; Crianças.*

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Setting the scene

Blaut argued in the early 1990s that younger children are 'natural mappers'; they make useful sense of their environmental experience (Blaut, 1991). It has been a contested viewpoint (Blaut, 1997; Liben & Downs, 1997). Over the years there has been much research pertinent to this debate investigating younger children's mapping and their spatial understanding. In particular, this pursues questions about children's developing map skills. Alongside, there has been a parallel wealth of research into younger children's geographical lives in a much broader sense, offering increased credence to Blaut's perspective (Matthews, 1992; Freeman & Tranter, 2011; Nairn & Kraftl, 2016; Spencer et al., 1989). Mapping is much more than a set of skills and capabilities in reading a map document, be this on paper or using digital technology. It requires being in the world – being in places and the environment, and being aware of the wider world beyond oneself. Coming to know about maps – of them and how to use them – involves recognising one's own geography. Personal geographies are about more than the immediate and familiar places we inhabit or visit regularly; they encompass where we know that is elsewhere and what we know of these places – maps play a key role in this learning.

The perspective in this article is that to help younger children[2] develop their map understanding and use – their mapping capabilities and thinking – their essential need is a geographical education in which map learning is contextualised, though the various map skills need purposeful focus from time to time. Mapping builds on children's real world experience, involving them in their learning about their own and the wider world. Environmental and spatial learning are intertwined to develop children's skills in using and understanding mapping and appreciating maps as representations of the real world and imagined places.

We tend to think of maps as formal documents, be they on paper or digitally interactive and multi-layered. We find maps in the street to help locate us and know something about a particular place, and across many websites – 'googling' the world for a multiplicity of place information. We see maps in information books, newspapers, on television, and in visitors' guides. Maps may be highly pictorial, perhaps of city centres, and strongly representational, such as national maps. Maps accompany some stories, set in imaginary places. There is a wide range of scales, from room plans to world maps, as street and road maps, and maps showing particular thematic information, of mall shops or global environmental damage. Maps help us engage with sites of national

[2] The phrases 'younger children' and 'primary children' used in this paper refer to children aged between 3/4 and 11/12 years old, who attend pre-school settings and who are in compulsory schooling referred to in different nations as elementary, primary or basic education.

outstanding beauty and local parks – maps are awesome and mundane. Maps are thinking devices; they help us make decisions about where to go and what to do. 'Maps' are also in our minds. We use our 'mental maps' (*aka* 'cognitive maps') in navigating familiar places habitually as well as places we do not because we learn to use environmental cues. We create and build up over time mental maps of places we hear and read about, perhaps from seeing maps of unvisited places and adding aspects of these to our mental images of 'elsewheres'. We learn to use the word 'map' to refer to map documents and to our mental environmental and spatial knowledge and sketches. Such maps tell us what is there and where and about connections and possibilities. They can reflect and express our needs, interests, preferences, biases, feelings and desires; we think with maps. Maps and mapping are complex, but from a very young age we develop mental maps and readily use these, and very young we begin rudimentarily to read 'document' maps on our journey to become graphicate (Balchin & Coleman, 1973; Boardman, 1983) and literate.

Younger children's geographies

Children live in the spaces of their places and environments, influenced by their cognitive and affective experiences in and of them (Nairn & Kraftl, 2016). Through such experiences younger children develop their environmental knowledge and spatial awareness and understanding of places. From their earliest years these are integral aspects of their evolving cognition. Pre-school and primary age children learn in their everyday environments – their real-world (Liben et al., 2000). From their earliest years they are engaged in developing their innate abilities as natural 'mappers', that is, in putting environments together, its what, where, relationships and interplays. This is the foundation of children's coming to know maps, as cognitive capabilities and as representational images and records.

Children's place experience begins at home. While in initiated through observation, getting to know the physical nature of their place develops determinedly with crawling and toddling (Newcombe & Huttenlocher, 2000). Children learn about individual rooms and their contents, the connections between rooms, their names and how and when they are used. By 2-3 years old they have a working knowledge of their home environment and its spatial layout to the extent that readily they make journeys to seek toys, people, activities, and the sources of sounds and odours. They use this knowledge in thinking what to do and where to go. Crawlers and toddlers explore and repeat familiar journeys, visiting favourite and the necessary home sites. They know their

floor(s) and become aware of areas where they should not venture: maybe a door is never open to them. Toddling infant children construct a mental map of their home, learning its landmarks (features and names) and its paths (routes); they become aware of its districts (rooms), nodes (gathering points) and edges (walls). Their sense of these environmental elements (Lynch, 1960) emerges early, though they may well not yet have the vocabulary or sentence construction to tell others what is where or their way around, let alone to represent their thoughts in models or drawn scribbles. Very young children show their knowledge in their home 'movement maps' through their actions. These earliest mental maps tell us about children's time in places and with toys, features and people and show how they understand and respond to their home, where they like more or less, as well as when these feelings about places come into play.

An important dimension of children's environmental experience, growing knowledge, use and feelings is their developing use of vocabulary and language. Learning to name and talk about the features of the rooms they use, what they play with, and other sites around their home helps to retain knowledge of the landmarks, districts, paths, nodes and edges within their activity areas. The early development of vocabulary and the building of meaningful statements is a key not only to constructing their environmental knowing but also to being able to communicate about it, what they are interested in and where they intend or wish to go. It supports their spatial thinking. As with their growing awareness of features and sites within their home, so their knowledge and language extends through their travels outdoors into the locality less known but in which various paths and landmarks are noticed, named and, in time, become familiar. By the ages of 3 to 4 children's range of language experience can be considerable (Biemiller, 2009). Their vocabulary includes the names of place features, environmental toys and what they see in storybook illustrations. As children develop from 4/5 to 11/12 years old, their local environmental and place awareness and knowledge expands and, depending on context, this provides for their fuller or more limited vocabulary to converse about places. It can be enhanced through local geography studies in school.

Primary age children's experiences in the neighbourhood and the wider world have been researched and analysed in many children's geographies' studies (such as: Blundell, 2016; Freeman & Tranter, 2011; Hackett et al., 2015; Holt, 2011; Matthews, 1992; Moore & Golledge, 1976; Nairn & Kraftl, 2016; Sommerville & Green, 2015; Spencer & Blades, 2006) These have reported children's everyday geographies and their first and second hand encounters with other places through visits, family, friends, the media and stories. They offer insights into children's

growing place and spatial understanding. As younger children become increasingly more attentive to the places around them as they are taken and later venture into their neighbourhood and further afield, they develop their knowledge of the places and the activities in them, from shopping visits, going to playgrounds, travel to see relatives and friends and engaging in leisure pursuits. They become aware of and familiar with roads, traffic, a variety of buildings, open spaces, alley and track ways, busy places and quiet spots, and interesting sites and areas they find unpleasant. Their learning about places locally maintains its cognitive and affective dimensions and often is based in place affordances; they learn what is useful and where, what they can apply to their own interests and activities, and where is safe and to be to avoided. While their early journeying will be accompanied by parents, carers or older siblings, opportunities occur later to run errands next door and nearby, and at maybe 9/10 years old may begin to adventure further within and possibly beyond boundaries set for them, learning from others or using their own initiative. Their knowledge of environmental dangers ranges from traffic concerns to avoiding where teenagers may hang out and how adults react to children in different places. By the time they are 11/12 years old most children have gained useful knowledge of their neighbourhoods, some much more than others, depending on how frequently they are out, what oversight there is and whether they have access to bicycles and bus travel. Geographical studies can explore children's perspectives and through local studies extend their awareness and knowledge.

During their primary years children will have explored and investigated a range of sites and developed wayfinding skills, which may well give them a detailed sense of the layout of their neighbourhood, of its landmarks, paths, districts, nodes and edges. Different children may comfortably relate to where they are in their neighbourhood and beyond, to where their friends live, to where there are attractions and through their interest in pushing boundaries. In different ways and to different levels children will have developed their local mental maps. Some children will have greater, or more partial, knowledge than others, will use richer or weaker environmental and directional language, will hold uni-dimensional or multi-layered spatial and feature connections, and will be more or less confident as explorers and travellers, able or not to bring and relate their deep or limited real world experience and knowledge to reading documentary maps. This perspective seems to be changing, and not for the better. World-wide it seems that children are less frequently or are not taking opportunities to be outside as much as in the past, are less adventurous and are less place experienced and knowledgeable. Much of this results from parental constraints arising from concerns about road safety in urban environments (Risotto &

Giuliani, 2006; Freeman & Tranter, 2011). Spending less time outdoors also may be an impact of children's increasing access to and interest in their digital screens; more children seem to be more sedentary than outdoors.

Experience through the digital world may offer affordances which give younger children insight into and knowledge about the world in a variety of ways. This is an evolving dimension of childhood geographies. The growing use of mobile devices at younger ages may be fostering children's sense of community and neighbourhood through their friendship groups, perhaps encouraging them to meet with friends and make journeys. Games playing in virtual worlds may be supporting some aspects of their spatial learning and thinking, perhaps even encouraging their mental mapping of visually stimulating fictional environments in order to be more effective players (Jackson, 2013). Watching cartoons and film action in fictional if quasi-real places may provide younger children with environmental and place knowledge in a general sense, informing them about the 'world' outside. News feeds and documentary information films introduce children to real places and environments, though contextualised through particular editorial purposes and interests. All of these digitally-provided experiences can, and perhaps do, enable children's environmental knowing, their awareness of places around the world and in the imagination, and their spatial learning; but as yet we know little about this area of younger children's lives from a geographical and spatial perspective.

Primary children have tended to develop their knowledge of the wider world – its places, environments and peoples – through the experiences of family and friends, learning at second hand. For increasing numbers of children this is complemented by family travel for holidays in other national locations or abroad, as well as through their media encounters with 'distant' places. Through such primary and secondary experiences younger children develop and may extend their knowledge of what places are like, and the variety and similarities of features, in the uses of buildings and land, and of the activities and lives of people. Some children even participate in family travel decision-making (Schänzel et al., 2012). The experiential range they build up enables them to develop, often quite basic, but for some children more sophisticated, mental maps of their nation and the world. These will be partial and incomplete, quite possibly containing erroneous and mistaken 'information'; but their maps indicate that primary children form ideas and perspectives of the world quite young (Wiegand, 2006). Geography is able to capitalise on this evolving learning and enlighten and enhance it.

Children's mental mapping of places and environments can be fostered through their experience of stories from a young age when read to and in reading picture story books and, later, illustrated novels. Most stories for children are based in places, often realist alongside others based in fantasy worlds. Intentionally, such stories and illustrations utilise children's place familiarity through their settings, even where these are novel, set in a rural or island environment for an urban child or in an unconventional world. Stories draw children into their places, with the place usually important if not central to the story, whether a farmyard or a play park for the very young or streets, buildings and landscapes with older primary children. Children create their mental maps of the places – even worlds – in which the stories are set and, depending on age, may draw these or act them out, showing their sense of the setting's environment and space. Some children's authors create their own maps of their story places. JRR Tolkien, author of *The Hobbit* and *The Lord of the Rings* novels set in his fictional Middle-Earth, stated: "I wisely started with a map and made the story fit" (McIlwaine, 2018, p.377); indeed his maps 'grew' as he wrote the stories and the many background tales, creating his imagined place as a documented map. There is a place here for school geography and children's story writing to work together.

This brief summary provides three important messages relevant to the development of children's understanding and use of maps. First, children, from their earliest years, develop experience in and knowledge of their various environments: from their initial home spaces, in and outdoors, to accompanied journeys into and later independent travel in and exploration of their neighbourhood and further afield. They gain knowledge and understanding of their locality and of other places, and build an environmental vocabulary to recall and communicate about places. Second, children construct mental maps from their earliest in-home wayfinding and play, then their travel and navigation in their locality and to other places, alongside the language to express this. Activity builds their spatial constructs and confidence. Mapping becomes a natural process to them. Third, children extend their mental maps to the wider world through their extended family experience, from various digital media sources and from stories, extending their awareness of real and imagined places and environments scaled from the local to the global. Place experience and mental mapping are mutually interdependent in creating primary children's intrinsic natural mapping abilities. Implicitly and overtly, younger children come to know maps throughout their childhood through their creation and use of mapping as an everyday, lived process. They represent places for and to themselves and act on and modify their mental maps. Children's lived experience is a constant to enhance with their geographical studies, locally and of elsewhere. It is a rich

resource upon which primary school geography can take further younger children's evolving childhood geographies.

Younger children learning about maps

There is strong evidence that at an early age children can read and garner information rudimentarily from vertical aerial photographs and clear basic maps (Wiegand, 2006). There have been many sources which set out insights into developing pre-school and primary children's map understanding, including Rushdoony's (1968) gradation of children's map reading skills to routes for progression in map learning (see for example: Wiegand, 2006; Mohan & Mohan, 2013; Mohan et al., 2014; Scoffham, 2018). These studies draw on much research into younger children's spatial development and thinking (for instance: Liben et al., 2002; Golledge et al., 2008a, 2008b; National Research Council, 2006; Davies & Uttal, 2007). The purpose here is to note some pertinent aspects of primary age children's map learning and to indicate its links with what has been stated about their childhood geographies.

Primary children are on a journey to get to know maps. It is lengthy because it involves children applying their growing awareness and knowledge of places and environments to understand what maps show, how to read them and their roles and value. They develop the core skills to 'read' a map and apply these skills together to create a sense of the whole map and know its purpose and uses. The research analyses of Mohan and Mohan (2013; Mohan et al, 2014)) and Wiegand (2006), among others, provide valuable insights into primary children's developing map reading capability and understanding.

Children seem able to grasp the 'bird's eye' *perspective* of a map at an early age. Their play with toys and model buildings, roads, vehicles and other place features is an important introduction to looking down on environments and places. They can use models as surrogates in which to make journeys and stage events, creating, managing and changing these scaled-down places. They are representing 'noticed' aspects of places through toy play by 2-3 years old. Where they have opportunities to look at large scale (1:500 to 1250 scale) vertical aerial photographs, 3 to 5 year old children identify several features, recognising a view of real world features normally unavailable. Smaller scale vertical photographs (1:5000 to 50,000 and 100,000 scales) they find, unsurprisingly, challenging. At age 4 to 5 children begin to 'see' that a clear uncluttered, preferably 'pictorial' map can represent the features and spatial layout of a familiar place, such as a room or

play area, particularly when it is correctly aligned. Between 4 and 6 years old children learn to recreate a muddled toy layout from a photograph taken looking down at the simple model before it was 'vandalised'. Accuracy in feature identification and the variety of features noted on aerial photographs improves and increases with age; by 11/12 years old children begin to view what they see as an area, not simply as discrete features and parts. Likewise with maps, their spatial reading moves from lines and parts to beginning to see them within an area, as within a nested hierarchy. During their primary years there is sound evidence that children recognise what maps are and their usefulness and engage meaningfully with them.

In recognising what they see on aerial photographs and maps, younger children begin to realise that these documents are *representations* of the real (and an imagined) world. They appear to appreciate instinctively that aerial photographs and maps are scaled down views of reality (Plester et al., 2006). In relating a map to the immediate environment, the youngest children seem to make better sense of the relationship when using a map employing pictorial *symbols* rather than plan view. Their own map drawings up to 6/7 years old tend to be pictorial or 'naturalistic'. Picture symbols would seem to be the useful symbols to introduce young children to what can be shown on maps. These may be stylised front views of buildings to show 'characteristic' aspects, reflecting the street views and story illustrations familiar to children. Indeed, young children tend to draw roads in 'plan view', including 'picture' vehicles, probably for the same reason. By 6/7 years old children may have been introduced to plan view map drawing, using colours to differentiate mapped features and encouraged to provide a key, or legend, to show what the different colours and shapes stand for. They may see keys on published maps. By 8/9 their own maps tend to use both pictures and plan views, recognising the latter as used on larger scale maps. By 11/12 years of age children are making better sense of more abstract symbols, and seem reasonably able to draw local maps in plan view. Their understanding of symbols such as pictograms (found on many maps) involves a move from perceiving them literally to recognising that they stand for a particular type of feature or activity, such as realising that a sheep symbol does not mean there is a sheep at a specific location but that it represents hill farming. With all primary children symbols need to bring real world knowledge to make some sense of what maps show, for the points, lines, areas and colours on medium to small scale maps to make some sense in representing features and activities. Unless taught, children tend not to recognise that much has been left off any map. Using and learning about maps in geographical studies is not only about interpreting what is there but about what may not be shown.

A key purpose of maps is that they show *location*. From 3/4 years old children may be able to locate items on a table or a floor, given relational instructions like 'next to', or when using a clear uncluttered, perhaps pictorial, map aligned to the surface showing where items are. At 4/5 they can begin to locate a hidden 'treasure' in a familiar larger place, such as their outdoor play area, having been shown it on a large scale vertical aerial photograph or an appropriate map they have talked about and aligned to the area. Moving through their primary years children increasingly become able to state the location of features, often employing landmarks as referents, and may begin themselves to align a map in, say the school playground or a park, and to indicate their own location. Between 3/4 and 11/12 years old children's locational language expands and becomes more sophisticated and precise, though they may need encouragement. When they begin to learn about co-ordinate grids from age 7/8 years old, children generally seem capable of identifying grid squares using alpha-numeric co-ordinates for the rows and columns to find features and to state the grid reference. In their later primary years children may begin to use all-figure grid references. Such skills can be applied to locating features and other information children note on large to medium scale and atlas maps. They should use locational skills consistently throughout their geographical studies.

Another important core map skill is identifying *directions*. Directional skills are essential for wayfinding in the environment and on maps, since co-ordinating directional information effectively is vital to navigating and completing journeys successfully. In the environment 4/5 year olds can say which way they are going and turning, using landmarks and path information they see. Relative directional language, such as 'left' and 'straight ahead', is still emerging; knowing 'left' from 'right' can take some years to become instinctive. In engaging tasks children as young as 5/6 years old learn to find their way around a maze map with some trial and error. In real world navigating, aligning the map to features is a skill with which the youngest children need help but during the middle to upper primary years they learn to do so using familiar landmarks and pathways. It is a skill to reinforce during local geography fieldwork. Some older primary children continue to realign their map as they turn corners on journeys, while others orient the map mentally to the environment – a field-independent perspective – it is a matter of individual preference; both approaches make sense. Children continue to learn by using environmental and relative directional vocabulary. 9 to 11/12 year olds appear to be reasonably successful in using a map to navigate a route, though it is vital they attend to the map and the immediate environment simultaneously in order to use landmarks accurately and to turn at junctions at the correct point

along a route. They can be encouraged to identify and describe what they pass, is nearby and might be seen further away, creating a sense of an area not just the linear routeway. When motivated by using mobile devices, a group of 10 to 11 year olds did not always follow where their device indicated they should turn (Hergan & Umek, 2017); they seemed very little better at navigating attentively than those using paper maps. Though it is thought important in many curricula to introduce children to compass directions, there is a lack of research into children's use of them in map reading in class or outdoors.

Appreciating real world *distance* and *scale* on maps and relating these to an environment is challenging for primary children. From an early age children appear aware of and refer to the differences in scale among their various toys; they may not play with certain items in models because they are 'the wrong size'. It would seem that to begin to appreciate the idea of 'scale' children need to have some sense of distance in the real world. This understanding evolves slowly since it requires an understanding of linear measures, experience of distances journeyed and an ability to measure; especially, scale requires appreciating ratio as reduction or enlargement. Notions of relative distance emerge quite early – stating 'near to' or 'far from' – as children develop their spatial vocabulary at 3 to 5 years old. In beginning to make real world measurements of large spaces, such as in the classroom and playground, at around 8 to 10 years old, children are still learning about formal measurements. This enables them to begin to estimate and establish distances in familiar and visible spaces, but while they may have much travel experience older primary children may have only a limited sense of the kilometres or miles travelled. Indeed, with an emphasis often on journey times, 11/12 year olds may think of their travel in time-distance, not in metric measures. As they begin to grasp linear measurements of real distances in familiar visible spaces, children can be introduced to scaling down through a representation on their map such as a 'one pace' standing for ten paces or one centimetre representing one metre on the ground on a scale bar. Though this is a challenge, in geographical studies the idea of the size of the Earth and of the distances goods travel by land, sea or aeroplane is important in topics on trade or migration, for instance: how far have goods and people come, and what does this look like on the globe or a map? Discussion of distance and scale in geographical contexts helps children be aware of and begin to grasp these ideas.

Atlas maps involve considerable generalisation and require primary children to understand the role and meaning of symbols, scales, directions and locations at a different level, as well as to use a contents page and an index to seek information from them. Atlases are information sources

children need to use. Primary children encounter a variety of world map projections and have to grapple with the relationship between a globe and a flat map, as well as with satellite photographs of the Earth. Using world and atlas maps helps to develop their awareness of continents and countries and provides access to some places they come across in their geographical studies and through the media. Even so, this is challenging and under researched with primary children, as are their skills and understandings in reading digital maps from regional to world scales. 5 to 7 year old children become aware of the 'shape' of the world through encounters with globes and world maps. As with the notion of the nested hierarchy of home, street, locality, region and nation, so their understanding of the relationship of nation, continent and world develops slowly to 10 to 12 years of age. Places, countries and continents are drawn as separate, unrelated entities at 6-7 years old but come to be located in context over the next few years, though not always accurately (Wiegand, 2006). Looking at, playing with and investigating floor and wall maps and finding information in atlases does not mean that these relationships are readily appreciated, just as at 11/12 years old children do not really understand the meaning of the named dots, lines and areas shown in different colours on atlas maps. There may well be a link with the growth of their knowledge about the world, its nations, environments and peoples. Primary children's knowledge is fraught with misconceptions, misunderstandings and even bias alongside rather general and very particular awareness about different countries and peoples (Barrett, 2007).

Supporting younger children's country, world and atlas learning is a core role for geography, focused through developing and deepening their knowledge of countries, environments and peoples. This means using atlases consistently but thoughtfully in such studies (Catling & Willy, 2018). Throughout their primary geography studies children should use and refer to national and world maps. Unless they explore what atlases show and investigate examples, children tend only to recognise that, for instance, the named dot for 'city', the blue line for 'river' and the beige colour for 'desert', are little more than word pronunciation and feature identification tasks. They will only slowly come to appreciate what these features are, how they look and their varied sizes and extent during their primary years. Studies of particular cities, rivers and landscapes help them begin to build up information they can apply to atlas maps. The scales of national and world maps are hard to grasp and ratios such as 1:100,000 or 1:1,000,000 are a real challenge, just as is appreciating the reality of the distances and areas involved. Borders might be identified but primary children are still developing a notion of 'country' at 11/12, their meaning weakly understood (Throssell, 2015), but setting studies in the context of countries helps to extend their

awareness and knowledge. We know next to nothing about older primary children's appreciation and use of the abstractions of latitude and longitude, though they can learn the names of and be able to identify the Equator, Tropic of Cancer and South Pole on a world map or globe. A link can be made through reference to the role of GPS in car navigation and mobile phone location, geographical contexts in everyday life, but it remains tenuous. Atlas maps contain many words, not always easy to read due to their orientation within a map. The number of graphics in close proximity and overlaying each other can inhibit connecting names correctly to symbols. Names are not necessarily read phonetically and abbreviations may not be known even by older primary children; what font sizes and styles indicate, such a nation's capital city, may mean little conceptually, though children may state the name of a 'capital', which ought therefore to be investigated in geography through studies of capital cities to recognise what this notion means.

Primary geography teaching is essential for primary children to begin to develop knowledge relevant to and realistic senses of what atlas maps show. Nevertheless, we must remain alert to the distinction between garnering information from and understanding what atlas map symbols, scales, grids, directions, projections, numbers, names and titles mean to younger children. Evidence suggests that many children older than 11/12 years are not knowledgeable about nor understand what atlas maps really are telling them or about their limitations (Wiegand, 2006). Primary children do not, without much experience and by applying knowledge about the world, realise that wall and atlas maps are grossly generalised, nor do they recognise that much is excluded – that atlas maps are highly selective and essentially thematic, showing for instance natural (physical), political, environmental, demographic or economic information on separate maps. The value in introducing children to small scale atlas maps through geographical studies is to enable them to begin to develop their understanding even though sensibly we should not presume they understand much from their as yet limited experience. Learning begins with building experience of, maintaining engagement with and in using such resources as world play mats, wall maps and atlases from children's earliest years and throughout their primary geography studies. But we need much further research into what primary children recognise, realise and appreciate as they see and use atlas maps.

There are evident variations in the extent to which primary children develop their awareness, experience and understanding of core map skills and of different maps, their purposes and their meanings. Effectively, children develop a relative understanding before they come to appreciate more formalised requirements. Relative cognition of perspective, location or size appears early but

knowledge and understanding of symbol representation, grid co-ordinates and metric scale have to be taught. Children learn about the relationship between maps and the real world, in the immediate environment and of places further afield, actively and practically, through geographical fieldwork and enquiries. The value in using maps in geographical studies is that children can apply their everyday prior and continuing learning about places and mapping to viewing documentary maps of other places at various scales. They can begin to compare maps of different places because as they become more familiar with maps of their own place, enhanced through local geography studies. They begin to examine maps at different scales to see what is included and what excluded from one map to the next smaller scale. Primary children begin to be able to see what they can find out from a map and become aware of the limits to information available from a map. Becoming aware of a map's limitations, whether a local map or of elsewhere, is a useful stimulus to learning from other geographical sources. The significant point is that primary children are on a map learning journey. They are starting to get to know formal maps and to understand what maps can and cannot provide for their readers. This is most helpfully enabled through their geographical studies (Catling & Will, 2018).

There remains a great deal to investigate. For example, we know little of primary children's use and understanding of digital maps, at all scales, of how such maps may motivate them and how they might read them in various formats and contexts, such as the interactive aspects of maps, scaling up and down, aiding navigation, highlighting different aspects of environments, real and imagined, and used within games. Digital maps may offer new possibilities for younger children through digital geographical information systems. GIS data, pictures and text potentially provide for rich encounters with local environments and other places, if accessible. Digital hardware and software need to be readily affordable for all primary schools, and all primary teachers need to be able to read and teach using them. We know little of primary teachers own map skills, and there are concerns about their geographical knowledge and skills (Catling, 2017). More basically, how does map teaching occur and how is it sequenced in primary geography? We need much further research.

Some conclusions: Getting to know maps

Several conclusions can be drawn from the foregoing account. There is an irrevocable intertwining of younger children's map learning and their everyday place and spatial knowledge and

understanding. Children have much to come to know and appreciate. Their primary geography education enables and supports their journey to place and map literacy.

While younger children's 'mapping' experience and understanding develop between the ages of 2/3 to 11/12 years old, different children develop their understanding at different rates and in different areas of mapping. A child who has considerable freedom to roam from, say, 6/7 years old will have a very different personal geography from a child who is outside much less often, taken to many local places by car and is chaperoned. Younger children's mental maps of places will be very different in the type and depth of environmental knowledge and in terms of real world spatial cognition. A child who has encountered maps from an early age and has used them with their family outdoors, and frequently in their geographical and other studies, will be differently knowledgeable and skilled compared to a child who rarely sees maps, has none at home and whose teacher makes very limited efforts to introduce and develop geographical and map skills, understating and use. A child who is well travelled and who is used to seeing and following maps on mobile devices will have a different sense of maps to one whose only computer access is in school and which is largely limited to national language and mathematics subjects. Teaching children map skills and about maps identifies individual differences in map learning, no less than across all learning.

There is ample evidence from the studies of younger children's geographies that primary age children are spatially intelligent. Evidence from more abstracted spatial tasks, including mapping some tasks, shows the variations in children's capacity to solve such activities, for instance, maze puzzles and by relating a model or map to a room or another model. Young children can find their way about spaces and know about locations, even when they cannot see the layout all at once – home and school are obvious examples. Primary children have spatial acuity; they are able through exploring to make sense of the spaces they are in and develop in their mental mapping and drawings from 'linear' and route senses of places to aerial spatial awareness and understanding, usually by the end of their primary education.

The youngest children who enter pre-school and primary school bring with them knowledge of places and environments from their direct experiences. This environmental cognition provides a basis on which to begin to understand something of the features which maps show, especially of familiar places, where they can connect the pictures, shapes and symbols to real world features and perspectives they see. They know about roads, buildings, open spaces and much more, enabling them to be able to discuss and share their knowledge of places when 'walking' a

document map in peer activities. Indeed, their knowledge enables them to identify some features on vertical aerial photographs at an early age and to begin to use such photographs in initial problem-solving activities, such as locating a 'hidden' toy. They can also do this using a basic map in their classroom and school grounds. It forms a foundation for their studies of the local area, to better understand its geography by using maps in outdoor and classroom investigations. Likewise, using maps with picture sources, perhaps via the internet, primary children can begin to grasp some idea of other places, drawing information, even rudimentarily, from large scale maps and from national and world maps and atlases.

The key to interconnecting and developing children's environmental and spatial experiences with map knowledge, skills and understanding lies in the context in which this occurs. The one curriculum subject which actively promotes this interrelationship is geography and it should do so from the earliest years in school (Catling & Willy, 2018). It is no accident that researchers refer to 2/3 year olds' personal geographies as a key element connecting their evolving environmental and spatial cognitions. The role of geographical studies from the first school years must be to draw on children's environmental experience and growing knowledge through studies of and in their local, familiar places. To extend and deepen their knowledge, understating and skills across the ages of 5/6 to 11/12 years old children should investigate particular aspects of their places, for instance local services, access, land use or pollution. Locally-based studies across the years ground their geographical ideas, information and understanding in their real world. Parallel with this geography must take children to other places and foster their awareness, knowledge and understanding of other environments and lives and of the world as a whole. Drawing on children's personal geographies enables the subject to introduce them to new places and geographical perspectives. In this context geography involves children in working with a wide variety of maps, from playmate picture maps and story maps to large scale plans of rooms and buildings, to maps of the school grounds, the locality, the wider region of their area, and nationally and continentally to the world map. It needs to be emphasised that this is not a concentric sequence to apply. Globes and world maps should be introduced to and talked about with the youngest children, just as large scale local and other smaller scale maps should be used in geographical enquiries with older primary children.

Maps need to be used, even though we know there are limitations to primary children's understanding of them. How else are they introduced to all sorts of maps and to map skills? How else do they learn about and to use maps? Maps need to be employed in a wide range of primary

geography investigations: to find out information, to confirm or challenge what different sources state and to question and critique children's own perceptions and misconceptions, and to record what is found out, analysed, evaluated and concluded. Children can draw their own maps, learn through maps and make maps as informed outcomes of their studies. Children's learning about and through map use needs to be active, involving practical, meaningful investigations in class and outdoors, consistently. They should use maps in fieldwork, applying their evolving map skills and knowledge. Maps help to build and extend primary children's geographical understanding as their studies develop and deepen. Primary children discover the value and usefulness of maps in daily life as information sources in a wide variety of contexts and at many scales. They learn to notice maps – on television, websites and postcards, in the street and at leisure resorts, in brochures and books, and in many other sites and contexts. They begin to realise that all maps have a purpose and a role and that they can use them to gather information about places and topics, whether for a location, ideas about what is there, a route and accessibility or what people might do for work of leisure. Geographical studies enhance children's map learning and understanding, extend their place and environmental knowledge and their help them to learn to make informed and useful decisions based on knowing about places, geographical topics and maps: their personal mental maps develop more fully and effectively and their recognition of when to use a map or several maps is enhanced.

There is much good advice about teaching children about maps (see: Sobel, 1998; Mohan et al., 2014; Wiegand, 2006). This article has considered the interrelationship between children's geographies, their personal environmental mapping, their developing mapping skills and their learning about the usefulness of maps. Table 1 offers a suggested sequence of experiences to introduce 3/4 to 11/12 year olds to environmental mapping and formal map learning. It is arranged in age phases, to encourage a structured development of children's map experience and understanding. It is set out using the 'dimensions' of place exploration and knowledge, environmental spatial awareness, core mapping skills and map knowledge and uses. The first two are distinguished as 'environmental mapping ability' and the latter two as 'map reading capability'. This structure is a heuristic devise to identify rather than separate these dimensions. It should be used to encourage planning teaching across the dimensions within each age phase and to stimulate activities and investigations which encourage their interplay to enable children's map learning. While Table 1 does not emphasise this, map learning must be integrated in geographical studies. Of course, other subjects have a role. For instance, there are evident links with

mathematical learning of numeric and spatial concepts, with vocabulary and reading development, with stories for children of different ages, with maps for history topics and places, and with art and in using computer software and devises. These can support but do not lead learning about maps and mapping: geography's role is to lead.

Table 1 provides a basis for primary children to get to know maps and their uses and themselves as mappers. Variations between individual children are to be appreciated, their learning encouraged, focused on their next steps in their map and geographical learning. Primary children bring their own geographies and mapping potential to their learning. Different school and home circumstances, from teachers' and parents' knowledge and enthusiasm for maps to access to resources, will have an impact. What we know is that children bring more knowledge and understanding of mapping and geography than we realise on which to build. By having a map display to which children contribute, in encouraging them to go on map hunts, by drawing their own real world, story and fantasy maps, and by using maps in their geographical studies and other investigations, younger children are motivated to engage with maps, to be fascinated by them and to begin to appreciate their purposes and usefulness – to enjoy and value maps and mapping, by which means they begin come to know maps.

Table 1: A suggested map teaching and learning sequence for children aged 3/4 to 11/12 years old (Revised and developed from Catling, 2005)

Ages	Developing environmental mapping ability		Developing map reading capability	
	Place exploration and knowledge Children can:	**Environmental spatial awareness** Children can:	**Core map skills** Children can:	**Map knowledge and uses** Children can:
3/4 to 5/6 year olds	• Play on floor play mat maps with toy vehicles, people and animals, using roads and paths with town and/or country features • Make model layouts of places using toy furniture, buildings, vehicles, people and animals, which they imagine themselves in for play • Play in playground child-scale model environments, with road layouts and buildings painted on walls or boards along the roads, and talk about what they see and the way they go, naming features and places • Explore the pre-school grounds and the nearby streets, talking about features passed; retrace	• Walk around the pre-school rooms, building and grounds and in the area around the school; talk about the way they are going using directional vocabulary, such as forward, side and right/left • Retrace routes in the pre-school and local area on other occasions showing the way; take different routes and point to features and give directions back and onwards • Point out directions and begin to tell ways to go in the pre-school room(s) and outdoor area while staying in one place, referring to features and giving directions • Place buildings on large sheets of paper, on which they can draw roads and paths between features to drive toy vehicles along	• Name what is seen in 'aerial' photographs, taken looking down on toys and low features in the room; match each to its feature • Draw round the base of toys and small objects; remove each item to leave the plan-shape of the object; talk about it • Play with a large-scale maps, drawn to show vertical views of furniture in their room(s) and of features in their outdoor area; use the map in the area to find features; point them out on the map and in the room • Draw 'maps' showing places in the pre-school classroom(s) and grounds; talk about what is shown • Look at large-scale oblique and vertical aerial photographs of the pre-school site and local	• In the outdoor area use a large-scale aerial vertical photograph to locate hidden 'treasures', the places of which have been marked on the aerial photograph • Look down on model layouts and on low items in the classroom and talk about what they can see; draw the shapes they see • Match vertical 'aerial' photographs of toys and furniture in the room(s) and of features in the outdoor area to the features and to them on the maps • Use a large-scale picture map of their room(s), showing only items of furniture in the room marked and coloured, to name and match them with their

	routes pointing out familiar or new features; build familiarity of and in these places • Talk about places they go to locally and what is there and what they do, such as at the playground and shops • Talk about other places visited and heard about and what is there		area; name and talk about features they can see; trace routes • Talk about what can be seen on a large colour picture map of a fun place, such as in a picture story book or of a leisure park • Use a colour-based co-ordinate grid to locate toy items placed on the grid • Play with softball or inflatable globes and floor play mat maps showing the country and the world; name land and sea	features • Play a treasure hunt game using a room map they are used to, where they are shown the hidden treasure on the map to find in the room • On softball or inflatable globes and wall or floor maps of the world begin to name continents and oceans
5/6 to 7/8 year olds **[5/6 to 7/8 year olds]** (cont)	• Identify, name and talk about features in the school building and grounds and in the local area and in other places they know, and say what types of features they are and what they are used for • Undertake fieldwork in the school grounds and local neighbourhood to identify, name and describe different types of local features and facilities • Sort toy vehicles, animals, buildings, etc and group them according to types of feature; explain their grouping, using naming vocabulary • Make a model of a familiar or an imaginary place, using road strips and toy buildings to show features in an area; talk about what is shown in the model, the type of place it is and what can be done there • Use photographs to find out about one or more other places, such as a village or a neighbourhood in a town or city, that is unfamiliar; name what is there and different types of features, and say what they think people do there	• Play games following directions in their classroom or school grounds, using landmarks, paths and vocabulary such as right, forward, half-turn, etc; • Follow 'arrow maps' showing a way to go and where to turn related to drawings of features in a room or outdoor area • Give directions to each other using landmarks, paths and directional vocabulary in the classroom and outside • Talk about the relative location of themselves and features they can see in the school grounds from particular sites, using names and phrases such as in front of, nearby, next to, behind, etc • Make or use a model of a place to navigate a vehicle or person around, talking about the directions faced and turned and referring to features and routes • Draw picture maps of places or routes with which they are familiar and of places they come across in stories or create from their imagination • Sort toy vehicles, animals, buildings, etc of different sizes by relative size; explain their grouping, using vocabulary such as larger, smaller, etc for different scales	• Look down on toys and objects to draw a plan view and plan shape of them • Begin to use symbols and a key, such as colours, pictograms and shapes, to draw their own maps of routes or places that they know and imagined • Use a large-scale map of their classroom, school grounds and the area around the school to identify features *in situ* and talk about what is where and routes to use; walk around and point out features on the map and in the area; discuss how maps show features and routes • Begin to use alpha-numeric co-ordinates to give grid references on picture maps and plans of familiar places • Recognise and follow the four core compass directions to move in named directions • Estimate relative distances, using terms such as nearer than, further away; begin to check how many steps a distance is • Compare a globe and world map and look for the same features shown on each, becoming aware of rivers, mountains, countries and cities, and finding these in the map key	• Look at a large-scale oblique aerial photograph of their local area and point out features they recognise; look at a large-scale vertical aerial photograph of the same area and identify features; find the same features on both photographs • Use photographs of features in the school grounds and find these in a vertical aerial photograph and on a map of the grounds • Look at a large-scale vertical aerial photograph and similar scale outline map of the local area and identify and name features; find and name these features on the photograph and map • On tracing paper, trace features on a large-scale vertical aerial photograph; remove the vertical aerial photograph; then identify and name the features shown on the tracing paper • Talk about what globes and world maps show, and about some features they see in atlas maps and wall or floor maps of the country and the world; recognise some major global features on world maps, linking these to photographs of the features, and referring to the map key • Begin to match the same continent or country on a globe with that on a world map, both at the same and different scales
7/8 to 9/10 year olds	• Talk about and compare knowledge of different features, routes and areas in places and environments they have visited or know about • Use fieldtrips in the school grounds, local area and perhaps further afield to identify, name and describe features and areas they	• Walk routes In the school grounds and local neighbourhood, noting landmarks and directions turned and give instructions about which way to go, using directional vocabulary accurately • Describe journeys they have been on and routes they have followed, noting relevant features, using appropriate	• Have reinforced the reasons for having a key on a map they draw; include a key on their maps to show what the pictograms, shapes and colours they use mean • Use a map of their classroom or the school grounds, to add features and a key to identify what they show	• Orientate a large-scale plan of their classroom, the school building or grounds to the area it shows to identify where features are and to show a route around • Recognise features in the local area shown in photographs and find these features on a vertical aerial photograph and a map of the same area

	know and which are familiar and new to them • Make a model to show part of the local area, eg a park or a shopping street, or of an imagined environment, such as an island • Investigate one or more other places to find out where each is and about the features there, what people do and what life is like	directional language • Draw maps of a familiar route in which features are placed in the correct order, such as the route to school or the shops from home; check the accuracy of the map of the route by following it while travelling it (which can be undertaken out of school time) • Draw maps of features, to show where they are in a room and an outdoor area that they can see and move around in while they draw, being encouraged to be as accurate as possible to show features' positions and distances between them • Draw (sketch) maps of familiar places, like the area around home, or routes, such as the way to the shops from home, all of which area or route they cannot see at the same time • Start to use some conventional (national map) symbols when making their own maps of real or imagined places, and provide a key	• Identify and draw the shapes of features from vertical aerial photographs • Be introduced to conventional map symbols and use them with appropriate maps to find features, such as roads, buildings, water, and so on, in the key and on the map • Use metric measurers to measure straight line distances in their classroom, and around the school building and the playground with reasonably accuracy • Use a scale bar to measure straight line distances on a large-scale map • Use alpha-numeric and four-figure co-ordinates to give grid references for grid squares on maps • Use a directional compass in their school grounds to find the four compass points and to use these to follow and give direction instructions; follow and give N, S, E & W compass directions on a map • Identify different types of feature on atlas maps, such as cities, countries, seas • Use maps of a range of scales, including street and atlas maps to find places and to note directions from one place to another	• Use the symbols on a large-scale maps and/or street maps of the school neighbourhood and of other places to identify features, routes and other information about the environment • Discuss what the sorts of features are shown on maps • Use fieldwork to find, identify and name types of features, such as shops, parks and other key features, on a map of their neighbourhood and code these to show the types of features they are • Name. locate and illustrate with photographs features on your national map, maps of other places and continental and world maps • Be introduced to particular aspects of atlas maps, such as the Equator, the Tropics of Cancer and Capricorn and the North and South Polar Circles • Compare a globe with a world map and talk about how each is informative and helpful and how they differ; consider what their uses are
9/10 to 11/12 year olds **[9/10 to 11/12**	• Use fieldwork locally and elsewhere to extend awareness of the variety of different types of features and their comparative sizes in the environment • Use appropriate geographical terms to describe features • Undertake enquiries into other places, including places where people live and into larger areas such as regions and countries; identify where they are, find out about the features of the places and what they are like, what facilities and services there are, what people do for work and leisure, how they travel around and to where, and what the connections are with other places, regions, nationally and internationally • Make comparisons between the local area of their school and one or more other places they investigate • Share information about different places, near or far	• Talk about the spatial relationships of features in the local area and in other places they investigate and know about • Use appropriate spatial vocabulary to give and follow accurate instructions about routes in the school grounds and beyond, where appropriate and safe to do • Make reasonably accurate scaled maps of the classroom and school grounds, by making measurements, so that someone can find their way around using the map • Make a reasonably accurate model of the school and/or part of the local area, and relate this to a map of the same place; use it to outline and follow journeys through the model and map • Use a variety of maps to locate features and places and to describe directions from place to place	• Draw (sketch) maps, using symbols with a key to show features on maps • Use the scale bar to help measure both straight line and winding distances between two points on maps, including local area maps, street maps and road atlases • Become aware that some symbols on small-scale maps are in disproportionate size to the real features they represent, such as roads on road maps • Draw acceptably accurate (sketch) maps of familiar places and routes they know, while doing fieldwork and/or from memory, include a key and an indication of distances (scale) • Use the 8 (and perhaps later 16) points of the compass to give and follow directions in the school grounds, on a map and during fieldwork • Discuss the purpose of the information they see provided with a map, including the title, key, grid co-ordinates, compass rose or directions and scale bar	• Orientate outside a large-scale map of a local area, using landmarks and compass points • Use a large-scale conventional map to find the way around an area and relate their position and the features they see to their location on the map • See how the same features are shown by similar of different symbols on maps of different scales and types • Discuss the way that symbols become more general about what they show as the scale of maps decreases, such as from local to national maps and to world maps • Make their own (sketch) map to show some important features on a published map • Draw their own thematic (sketch) maps, perhaps using their own data, to show geographical distributions and patterns; provide a title to describe the map's purpose • Annotate an outline map of an area using a vertical aerial photograph of the same area to name a variety of the types of

year olds] (cont)	away, which they have travelled to		• Use four-figure and perhaps begin to use six-figure grid references to locate features in grid squares on maps • Use the contents page in an atlas to find specific map pages • Use a map index with its map to identify locations using page numbers and grid references • Develop an understanding of the real distances that they measure on large-scale maps, particularly in their school grounds and local area • Follow a route on a map from the description of features, directions and distances • Begin on their own maps to use arrows to indicate slopes in the environment • Become aware from the hachures and layer tints on relief maps and the contour lines on medium scale conventional maps that the landscape shown is not flat and begin to notice which way the land slopes down and up • Identify features on atlas maps, such as coastlines and national borders	features • Point out and discuss some patterns that maps show, such as a road pattern or the distribution of villages and towns • Note the key features shown on atlas maps and how they are shown; consider why these features are included • Compare maps showing the same area at different scales and with different purposes; describe some of the information that can be discovered by using these maps together • Compare how parts of the world are shown on globes, wall maps of the world and atlas maps; say what is similar and different • Become aware of the lines of latitude and longitude included on the globes, world and atlas maps and begin to find out how they are used to locate places, and how they relate to time zones • Consider who uses maps and why • Debate which places locally, nationally and around the world children should know and create personal and class maps to show these

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