**Near and far: engaging children with place through Minecraft**

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Minecraft, a computer game without specific narrative or goals and one of the most important of the current generation (Lane and Yi, 2017), can support learning through enjoyment and play (Ekaputra et al., 2013; Bile, 2022) and attract children to engage (Hobbs et al., 2019d). Using myriad blocks and modifying environments in alignment with real-world processes, children can ‘experience’ and explore concepts that they cannot directly investigate in classroom settings (Ekaputra et al., 2013; Nebel et al., 2016; Hobbs et al., 2018a, 2019a; Bile, 2022). There are multiple realms, updates and versions including Minecraft: Education Edition (M:EE) (Kuhn, 2018), with practicalities varying across editions (minecraft.net, Kim et al., 2021). While Minecraft’s real-world analogies are representative and can lack refinement, user-generated modifications (‘mods’) such as the Geological Survey of Sweden’s (2020) BetterGeo can improve them.

Minecraft is recognised as ideal for facilitating scientific literacy, active construction of knowledge, opportunities to collaborate and problem-solve, and engagement (e.g. Short, 2012; Kervin et al., 2015; Nebel et al., 2016; Lane and Yi, 2017; Hobbs et al., 2019a) and supporting children with Special Educational Needs to develop skills, explore and socialise (e.g. Petrov, 2014, Nebel et al., 2016; Ringland et al., 2016, Hobbs et al., 2020a). Thus, it can allow enquiry to explore issues (Ferretti, 2013; Roberts, 2017), relating to real-world contexts and with consideration of their future evolution, avoiding a reductionist solely solutions-driven perspective (Bonnett, 2012).

While Minecraft’s complexity has increased over time and varying educator experiences with computer games are an acknowledged limitation to its application (Nebel et al., 2016; Kuhn, 2018), its flexibility and students’ affinity with it can support senses of ownership and expertise and allow them to direct activity according to their own skills and interests; less-familiar staff can act as facilitators of child-led endeavours (Hobbs et al., 2019c; Nojiri, 2022). Children are thus able to bring their existing knowledge and experience into the classroom as a powerful, respected learning base (Catling and Martin, 2011; Roberts, 2017) to combine with taught information and gameplay to develop new understanding.

Access to Minecraft and requisite hardware and operating systems is not ubiquitous, and too complex to explore here. However, use in UK schools in increasing; the Welsh Government, for instance, provide M:EE to Welsh schools ‘to ignite a passion for creativity, innovation, critical thinking, problem-solving and personal effectiveness through game-based learning’ (Hwb, 2022). Its dedicated website (Mojang, 2021a) now contains multiple lesson plans and instructional resources, and the game has been used across an extensive range of educational subjects (Short, 2012; Nebel et al., 2016; Martinez et al., 2022). Here, with acknowledgement that various access issues exist, and examples are extracted only from our own experience and sources with publicly available information, in English, we summarise some approaches taken to using Minecraft to engage children with places.

The concept of place contributes to human meaning-making in both space and time (Quiring, 2015; Millei, 2018). While more research on the influence of digital connectivity on children’s sense of place is needed (Martz et al., 2020), computer games have long been used to enhance learning about places and can act as frameworks for their exploration (Quiring, 2015; Wang and Abbas, 2018). Minecraft, as an interactive simulation, is an ideal tool for such engagement (Quiring, 2015). It contains a variety of biomes, and numerous real-world places, with differing complexities and regards to topography, geology, infrastructure and coordinates, have been constructed using it.

Assorted ‘real-world Minecraft places’ online lists include Minecraft’s own ‘Around the world in 80 builds’ (Pearson, 2019). The game’s open-world nature permits recreation ‘from scratch’, exploration, and modification of place-linked structures, allowing engagement at various levels. Modifying environments gives opportunities to explore both current places, and potential past and future scenarios. When unexpected events occur within educational simulations, children often change their parameters to explore and improve their understanding, similarly to a scientist, whereas in typical school experiments, they often aim to reproduce expected results without mistake (Wieman, 2008). The experimentation encouraged by Minecraft’s lack of specific end-goal and the space it provides to make mistakes have seen it described as an example of Papert’s (1980) ‘object-to-think-with’ (Kuhn, 2018).

Adding relevance to children’s experiences and the world around them may increase interest (Murphy and Beggs, 2005) in taught topics; linking gameplay to local places or those covered in formal learning, current affairs or global citizenship (Maude, 2016) contexts may offer such opportunities. Engagement with places in Minecraft occurs across scales including children’s own schools, local landforms, known landmarks, palaeoenvironments and archaeological sites (e.g. Iwahashi et al., 2020; Šajben et al., 2020; CCEA, 2022).

The value of students recreating their learning environments in-game, due to the ‘natural connection between Minecraft and physical environment’, was highlighted by Mojang (2015) in one of its earliest Education Edition posts and M:EE challenges children to ‘map our world’ (Mojang, 2022a). Many schools, for example in Taiwan (Lee, 2021), Malaysia (Ng, 2017), the UK (BBC, 2020), the USA (Kindelan, 2020) and Australia (Corvo, 2020), have been reconstructed in Minecraft, often involving children in building. Iwahashi et al. (2020) recreated students’ school buildings as a base to explore surrounding geography, geology and palaeoenvironments. A closing rural school in Japan was memorialised for students to ‘visit whenever they wanted’, covering many academic subjects during collaborative in-game construction and creating an ongoing connection to their school’s physical presence (Nojiri, 2022).

Geospatial information can be incorporated into real-world place representations. Ordnance Survey data were used to create a (Guinness World Record-achieving) Minecraft map of Britain in 2013, map Northern Ireland and show British Geology in Minecraft (Ordnance Survey, 2015; British Geological Survey, 2014-2022). Land Cover and Crop Map data form a basis to show the current farming landscape, explore potential future change and visualise new sustainable and resilient farming systems in-game (Centre for Ecology and Hydrology, 2018). O’Leary’s (2015) 1:1000 scale recreation of Antarctica was based on British Antarctic Survey data. Various user-generated and commercial websites offer opportunities to utilise geospatial and Geographical Information System data, providing, for example, high scale Earth maps in Minecraft, conversion between Minecraft and real-world coordinates or custom-mapping of specific places. Mojang partnered with UN-Habitat in 2012 on ‘Block by Block’, using accurate Minecraft models on every continent ‘including in Nigeria, Peru, Mexico, Kosovo and Nepal’ for community participation in local urban design (Westerberg and Rana, 2016). While the ultimate impact on planning outcomes of these projects has been questioned, the role they ‘have played in engaging disempowered groups such as youth, women, and people with disabilities’ is recognised (Bashandy, 2020). In Brazil, de Andrade et al. (2020) engaged children in planning development of their rural community, using a geospatially-accurate Minecraft model. They discuss Minecraft’s application, children’s values and expression regarding their hometown and other projects using Minecraft in similar ways. In June 2022, Yevhenii Korol’s world of his home city Kyiv was launched to allow ‘young people to learn about Ukraine, and explore the culture, history, and architecture of its capital’ (Mojang, 2022b); a place in the thoughts of many at that time.

Exploration is not limited to present-day places. Resources developed by Northern Ireland’s educational body CCEA invite children to imagine being in Scandinavia 1000 years ago and engage with a functioning Viking society through farming and other endeavours. They then have the in-game opportunity to go on a mission; an archaeological dig on Northern Ireland’s Rathlin Island (CCEA, 2022), raided by Vikings and known for its Viking archaeological finds (Williams, 1990; Mitchell, 2006), adding local context for children. Minecraft thus allows for immersive engagement with both topics and related local history. More explicitly place-based historical explorations cover local to country scales, focusing on, for example, recreating historic parts of Bristol (Local Learning, 2017), a true-to-life archaeological dig in ‘mini-Melbourne’ (Victoria State Government, 2019), the Tang Dynasty capital city Chang’an (Miller, 2017) and ancient Egypt (Mojang, 2021c). Some M:EE lesson plans encourage exploration of culture of indigenous peoples; for example, in Manitoba in a Minecraft Anishinaabe community, through a project led by the Louis Riel School Division (LRSD) Indigenous Council of Grandmothers and Grandfathers, Indigenous Knowledge Keepers, and LRSD’s Indigenous Education staff (Mojang, 2021d) and Piki Studio’s Aotearoa-based Ngā Motu world to immerse children in Māori culture (Microsoft New Zealand News Centre, 2019). Many resources create clear links to present-day places, which can also be facilitated through now-lost locations, e.g. Mojang’s (2021b) lesson plans on the 79AD Vesuvius eruption encourage students to observe Pompeii and its destruction, consider the implications and mitigation possibilities, and follow links to learn about other real-world volcanoes.

Our UK-based Science Hunters programme involves connecting to specific places ranging from local features (Hobbs et al., 2018b; 2019b) to exploring ecosystems and rainforests (Hobbs et al. 2020b; in prep.) and natural hazards (Hobbs et al, 2018b; 2022) around the world, in Minecraft. A constructive, child-led delivery structure anchors experimentation and construction in Minecraft to discussion-based introductions containing real-world examples and hands-on activities (e.g. Hobbs et al., 2019a), supporting a dialogic approach to topic exploration. Projects mainly operate with schools and at public events (including remotely where appropriate, e.g. during the COVID-19 pandemic). Children from under-represented groups, who may experience disadvantage, including those with Special Educational Needs, from lower socioeconomic backgrounds and children in care are a priority; we work with settings to address access barriers.

Using local features and recognisable landmarks gives direct relevance to children (Hobbs et al., 2018b; Hobbs et al., 2019b), while a place-specific focus to learn about coral reefs produced statistically significant improvement in topic knowledge (Hobbs et al., 2020b). In libraries and primary schools, children have engaged with the Amazon rainforest (and colleagues’ research there) as a place both using a pre-constructed world they can explore, and more open-ended, constructive activity in relevant biomes. Evaluation indicated that participation in sessions raised interest in and knowledge of the Amazon rainforest (Hobbs et al., in prep.).

A session inviting children to construct animals adapted to particular biomes in Minecraft, exploring habitats and their locations, produced statistically significant increases in topic awareness in schools (Hobbs et al., 2019a). Real-world links to Minecraft biomes were further utilised in ‘home packs’ which included a global map of real-world biomes and related materials such as seeds and wood samples (Hobbs et al., 2018b). Children have also engaged with extra-terrestrial settings, including considering future human lunar habitation (Hobbs et al., 2020c). In Minecraft’s virtual world, they can think not only about the future, and what actions might be needed to achieve goals (utilising ‘mental time travel’; Prabakhar and Hudson, 2014) but design and experiment with possibilities through simulating physical places they cannot travel to.

Multiple topics use specific places for context in exploring environmental hazard and risk (Hobbs et al., 2022). For example, volcanoes and volcanic processes, in a session which has produced significant knowledge increases (Hobbs et al., 2019a), are linked to real-world volcanoes and eruptions. Adaptation in response to current events, such as eruptions in the news, avoids redundancy and ‘fossilising’ (Young, 2011) over time as children forget or are too young to remember specific events, decreasing their relevancy. Further sessions consider mitigation against eruptions, earthquakes and floods using place-linked examples (Hobbs et al., 2022), also demonstrating the relevance of engineering across disciplines and from different perspectives. Content on flooding has been adapted to link to local examples; similarly local sites can be used when exploring, for example, tunnel construction. Through anchoring game-based exploration to discussion-based topic introductions, places do not have to be directly or exactly replicated in Minecraft in order for children to engage with them through their play, as they can link their game-based experimentation to the real-world context.

The popularity of Minecraft, and processes and environments analogous to the real-world within it, offer opportunities to engage children with both their local settings and faraway places, in the past, present and future from exploration and familiarisation to modification and reimagining. This can range from ‘visiting’ local features to imagining space bases, across history and the future; there are almost endless possibilities.

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References:

Bashandy, H. 2020. Playing, Mapping, and Power: A Critical Analysis of Using "Minecraft" in Spatial Design. *American Journal of Play*, 12(3), 363-389.

BBC. 2020. *Minecraft: A head teacher used the game to create a virtual secondary school tour for kids joining Year 7*. <https://www.bbc.co.uk/newsround/53373921>

Bile, A. 2022. Development of intellectual and scientific abilities through game‑programming in Minecraft. *Education and Information Technologies*, <https://doi.org/10.1007/s10639-022-10894-z>.

Bonnett, A. (2012) Geography: One of humanity’s big ideas, *Teaching Geography*, 37(3), 120-121.

British Geological Survey. 2014-2022. *GB geology with Minecraft world*. <https://www.bgs.ac.uk/discovering-geology/maps-and-resources/maps/gb-geology-minecraft-world/>

Catling, S. and Martin, F. 2011. Contesting Powerful Knowledge: The primary geography curriculum as an articulation between academic and children’s (ethno-) geographies. *The Curriculum Journal*, 22, 317-335.

CCEA. 2022. *Vikings Minecraft.* <https://www.nicurriculum.org.uk/STEMWorks/minecraft/>

Centre for Ecology and Hydrology. 2018. *ASSIST science and Minecraft brought to Cereals 2018*. <https://www.ceh.ac.uk/news-and-media/blogs/ceh-bring-assist-science-and-minecraft-cereals-2018>

Corvo, S. 2020. *Minecraft version of South Australian school created by students, to run virtual tours amid COVID-19*. <https://www.abc.net.au/news/2020-07-08/minecraft-version-of-wallaroo-primary-school/12426874>

de Andrade B, Poplin A, Sousa de Sena Í. 2020. Minecraft as a Tool for Engaging Children in Urban Planning: A Case Study in Tirol Town, Brazil. ISPRS International Journal of Geo-Information, 9(3): 170. <https://doi.org/10.3390/ijgi9030170>.

Ekaputra, G., Lim, C. and Eng, K.I. 2013. Minecraft: A game as an education and scientific learning tool. In: Information Systems International Conference (ISICO) 2013, 237-242.

Ferretti, J. (2013) Whatever happened to the enquiry approach in geography?, in Lambert, D. and Jones, M. (2013) *Debates in Geography Education*. Abingdon: Routledge, pp. 103-115.

Hobbs, L., Stevens, C. and Hartley, J. (2018a). Environmental education and engagement using a construction play computer game *Roots Education Review*, 15(1), 20-23

Hobbs, LK., Stevens, CJ., Hartley, J. (2018b). ‘Digging deep into geosciences with Minecraft’. EOS, 99 (11), pp. 24-29. <https://doi.org/10.1029/2018eo108577>

Hobbs, L., Stevens, C., Hartley, J., Ashby, M., Jackson, BW., Bowden, L., Bibby, J., and Bentley, S. (2019a). ‘Science Hunters: Teaching science concepts in schools using Minecraft’. *Action Research and Innovation in Science Education,* 2(2), pp. 13-21. <https://arisejournal.com/index.php/arise/article/view/23>

Hobbs 2019b. SciComm Southwest, June 2019, Bristol UK.

Hobbs, LK., Stevens, CJ., Hartley, J. and Hartley, CK. (2019c). ‘Science Hunters: an inclusive approach to engaging with science through Minecraft’. *Journal of Science Communication,* 18 (02). <https://doi.org/10.22323/2.18020801>.

Hobbs, L., Stevens, C., Hartley, J., Ashby, M., Lea, I., Bowden, L., Bibby, J., Jackson, BW., McLaughlin, R. and Burke, T. (2019d). ‘Using Minecraft to engage children with science at public events’. *Research for All* 3 (2), pp. 142-160. https://doi.org/10.18546/RFA.03.2.03

Hobbs, L., Hartley, C., Bentley, S., Bibby, J., Bowden, L., Hartley, J., & Stevens, C. (2020a). Shared special interest play in a specific extra-curricular group setting: A Minecraft Club for children with Special Educational Needs. Educational and Child Psychology, 37(4), 81-95

Hobbs, L., Bentley, S., Hartley, J., Stevens, C., & Bolton, T. (2020b). Exploring coral reef conservation in Minecraft. Primary Science, 162, 21-23

Hobbs, L., Bentley, S., Stevens, C. and Hartley, J. (2020c). Exploring space using Minecraft. *Space Science in Context, virtual conference.*

Hobbs, L., Bentley, S., Behenna, S., and Stevens, C.: Exploring engineering solutions to environmental hazards through Minecraft, EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-7435, <https://doi.org/10.5194/egusphere-egu22-7435>

Hobbs, L., Bentley, S., Fenney. J., Hartley, J. and Stevens. C. (in prep.) Engaging with a real-world place in Minecraft: the Amazon rainforest. *Primary Geography*

Hwb. 2022. *Minecraft*. <https://hwb.gov.wales/minecraft/>

Geological Survey of Sweden, 2020. *BetterGeo – Minecraft with more geology*. <https://www.sgu.se/en/geology-of-sweden/bettergeo--minecraft-with-more-geology2/>

Iwahashi, J., Nishioka, Y., Kawabata, D., Ando, A., Okada, S. and Shiraishi, T. 2020. Report on science classes and a workshop for teen students to learn geography and geology using Minecraft. *EGUSphere*, <https://doi.org/10.5194/egusphere-egu2020-12516>.

Kim, J., Hobbsand Hobbs2021. *Engagement through Minecraft: Available editions, a guide from practitioners*. UWE Bristol, 14 pp. <https://www.uwe.ac.uk/research/centres-and-groups/scu/projects/building-to-break-barriers>

Kindelan, K. 2020. *High school students build replica of their school in Minecraft to host prom, graduation virtually*. <https://www.goodmorningamerica.com/living/story/high-school-students-build-replica-school-minecraft-host-69684622>

Kuhn, J. 2018. Minecraft Education Edition. *Calico Journal*, 35(2), <http://dx.doi.org/10.1558/cj.34600>

Lane, H.C. and Yi, S. 2017. Chapter 7 – Playing with Virtual Blocks: *Minecraft* as a Learning Environment for Practice and Research. In F.C. Blumberg and P.J. Brooks (Ed.). *Cognitive Development in Digital Contexts* (pp. 145-166). Massachusetts, US: Academic Press.

Lee, C.-M. 2021. Let’s go: Hai-Shan Junior High School and Minecraft in Taiwan. <https://education.minecraft.net/en-us/blog/hai-shan-school-in-taiwan>

Local Learning. 2017. *Minecraft*. <http://www.locallearning.org.uk/minecraft/>

Martinez, L., Gimenes, M. and Lambert, E. 2022. Entertainment Video Games for Academic Learning: A Systematic Review. *Journal of Educational Computing Research*, <https://doi.org/10.1177/07356331211053848>.

Martz, C.J., Powell, R.L. and Wee, B S.-C. 2020. Engaging children to voice their sense of place through location-based story making with photo-story maps, Children's Geographies, 18:2, 148-161. <https://doi.org/10.1080/14733285.2019.1685073>.

Maude, A. 2016. What might powerful geographical knowledge look like? *Geography*, 101(2), 70-76. DOI: 10.1080/00167487.2016.12093987.

Microsoft New Zealand News Centre. 2019. *Recreating ancestral worlds with virtual blocks*. <https://news.microsoft.com/en-nz/2019/09/09/recreating-ancestral-worlds-with-virtual-blocks/>

Millei, Z. 2018. Distant places in children’s everyday activities: Multiple worlds in an Australian preschool. *Journal of Pedagogy*, 9(1), 133-153.

Miller, J. 2017. *Reimagining an ancient Chinese city.* <https://education.minecraft.net/en-us/blog/reimagining-an-ancient-chinese-city>

Mitchell, J. 2006. *The archaeology of Rathlin Island*. [https://www.culturenorthernireland.org/article/1249/the-archaeology-of-rathlin-island](https://www.culturenorthernireland.org/article/1249/the-archaeology-of-rathlin-island%20accessed%2012/2/22)

Mojang. 2015. *Recreating learning environments in Minecraft*. <https://education.minecraft.net/en-us/blog/recreating-learning-environments-in-minecraft>

Mojang. 2021a. *Minecraft: Education Edition: Resources*. <https://education.minecraft.net/en-us/resources>

Mojang. 2021b. *Five new lessons on volcanoes from Minecraft: Education Edition*. <https://education.minecraft.net/en-us/blog/five-new-lessons-volcanoes-minecraft--education-edition>

Mojang. 2021c. *Sift through the sands of time with new Egyptian history lessons*.  [https://education.minecraft.net/en-us/blog/sift-through-the-sands-of-time-with-new-egyptian-history-lessons](file:///C%3A%5CUsers%5Cl8-hobbs%5CAppData%5CRoaming%5CMicrosoft%5CWord%5CMinecraft%20Education%20Edition%20blog%2C%20https%3A%5Ceducation.minecraft.net%5Cen-us%5Cblog%5Csift-through-the-sands-of-time-with-new-egyptian-history-lessons)

Mojang. 2021d. *Explore indigenous history and culture with Manito Ahbee Aki*. <https://education.minecraft.net/en-us/blog/explore-indigenous-history-and-culture-with-manito-ahbee-aki>

Mojang. 2022a. *Mapping our world*. <https://education.minecraft.net/en-us/challenges/mapping-our-world>

Mojang, 2022b. Explore Ukraine’s incredible capital city, Kyiv. <https://education.minecraft.net/en-us/blog/kyiv-world>

Murphy, C. and Beggs, J. 2005. *Primary science in the UK: a scoping report. Final report to the Wellcome Trust*. London, UK: Wellcome. https://wellcomecollection.org/works/hs55sq6j/items

Nebel, S., Schneider, S., and Rey, G. D. 2016. Mining Learning and Crafting Scientific Experiments: A Literature Review on the Use of Minecraft in Education and Research. *Educational Technology & Society*, 19(2), 355–366.

Ng, J.-H.. 2017. *Minecraft: Is it truly a global education phenomenon? A Malaysian and Asian perspective*. <https://education.minecraft.net/en-us/blog/minecraft-is-it-truly-a-global-education-phenomenon-a-malaysian-and-asian-perspective>

Nojiri, Ms. 2022. Creaction as an act of memory: Preserving a closing school in Minecraft. <https://education.minecraft.net/en-us/blog/preserving-a-school-in-japan>

O’Leary, M. 2015. *Minecraft* Antarctica. <http://www.martinoleary.com/minecraft/>

Ordnance Survey. 2015. *Minecraft maps continue to grow*. <https://www.ordnancesurvey.co.uk/newsroom/blog/minecraft-maps-continue-to-grow>

Papert, S. 1980. *Mindstorms: Children, computers, and powerful ideas.* Basic Books Inc., New York, USA. 230 pp.

Pearson, C. 2019. *Around the world in 80 builds*. <https://www.minecraft.net/en-us/article/around-world-80-builds>

Quiring, T. 2015. From Voxel Vistas: Place-Making in Minecraft. *Journal of Virtual Worlds Research*, 8(1), 1-17.  <https://doi.org/10.4101/jvwr.v8i1.7122>

Ringland, K.E., Wolf, C.T., Faucett, H., Dombrowski, L. and Hayes, G.R. 2016. “Will I always be not social?”: Re-Conceptualizing Sociality in the Context of a Minecraft Community for Autism. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 1256-1269.

Roberts, M. 2017. Geographical education is powerful if... *Teaching Geography*, 42(1), 6-9.

Šajben, J., Klimová, N. and Lovászová, G. 2020. Minecraft: Education edition as a game-based learning in Slovakia. *EDULEARN20 Proceedings*, 7686–7693 <https://doi.org/10.21125/edulearn.2020.1946>

Short, D. 2012. Teaching scientific concepts using a virtual world – Minecraft. Teaching Science*, 58*(3), 55-58.

Victoria State Government, 2019. *Immersing students in Minecraft’s Mini Melbourne*. <https://www.education.vic.gov.au/about/news/Pages/stories/2019/stories-miniminecraft.aspx>

Wang, Q. and Abbas, M. 2018. Designing web-games for transportation engineering education. *Computer Applications in Engineering Eduation*, 26, 1699–1710.

Westerberg, P. and Rana, S. 2016. *Using Minecraft for Community Participation*. UN Habitat, 24 pp. <https://unhabitat.org/manual-using-minecraft-for-community-participation>

Wieman, C.E., Adams, W.K. and Perkins, K.K. 2008. PhET: Simulations That Enhance Learning. *Science*, 322(5902), 682-683.

Williams, B. 1990. The Archaeology of Rathlin Island. *Archaeology Ireland*, 4(2), 47-51.

Young, M. 2011. The return to subjects: a sociological perspective on the UK Coalition government's approach to the 14–19 curriculum. *The Curriculum Journal*, 22:2, pp. 265–278.