

Engaging children from under-represented groups with STEM using Minecraft to link with the UN SDGs

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Laura Hobbs and Sarah Behenna use Minecraft to support STEM development with clear links to the SDGs

Minecraft as a STEM engagement tool

The virtual Minecraft world allows children to create almost unlimited constructions, using a wide range of blocks with various properties, textures and appearances. As parallels can be drawn with real-world processes and settings, the game is useful for supporting children to explore science, technology, engineering and maths (STEM) concepts (e.g. Hobbs et al., 2019a). For example, flooding can be simulated in the game, as well as solutions to prevent this (Figure 1).

Minecraft is an extremely popular game, widely used in educational contexts (e.g. Nebel, Schneider and Rey, 2016; Martinez, Gimenes and Lambert, 2022), and appeals to children as a learning tool (Hobbs et al., 2019b). There is no specific end-goal, and there are embedded opportunities for trial and error; these features led Kuhn (2018) to describe Minecraft as an instance of Papert's (1980) 'object-to-think-with', while Lane and Yi (2017) deem it one of the most important games of the current generation. It can act as a 'hook' to draw children into STEM engagement activities (Hobbs et al., 2019b).

Science Hunters – engaging children with STEM

In our 'Science Hunters' suite of projects, we use the computer game Minecraft to engage children, particularly those from under-represented groups, with STEM. Since 2014, the Science Hunters team has developed an approach that promotes learning about a specific topic, providing a defined framework while encouraging children to explore the elements of it that most interest them. Thus, sessions take a constructive approach: the Minecraft activity is child-led, and exploration, experimentation and construction within the game are anchored to interactive topic introductions that reference real-world settings and examples (e.g. Hobbs et al., 2019c).

Delivered by environmental scientists, Science Hunters projects link to the United Nations' Sustainable Development Goals (SDGs) through offering inclusive education and lifelong learning opportunities (SDG 4). We also consciously represent and advocate for under-represented groups in STEM careers, both actively and simply by being visible ourselves, which can be linked to SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all) and SDG 10 (Reduce inequality within and among countries).

Below, we outline how the SDGs naturally embedded into our recent 'Building to Break Barriers' project.

Building to Break Barriers

Building to Break Barriers (2020–2022) was a Science Hunters project, funded through the Royal Academy of Engineering Ingenious Awards scheme to engage children from under-represented groups, particularly girls, children with special educational needs and disabilities (SEND), looked after children (LAC), and those from areas of multiple deprivation or low progression to higher education, with science and engineering. A core aim was to engage participants with aspects and applications that they may not typically associate with engineering. We used Minecraft and resources developed throughout the project, including environmental and sustainability elements and in collaboration with a diverse group of engineers. Specifically targeting girls and ensuring clear representation (60%) of women within the participating engineer cohort linked to the SDG of empowering all women and girls (SDG 5).

Delivery took place within schools and specific children's groups and was based around a selection of topics, determined collaboratively with engineers, and where appropriate, participating children. There was no charge to participate. Topics varied, but often provided opportunities to facilitate awareness of real-world problems and to engage with engineering and environmental solutions to them. They were not specifically discussing the SDGs, but contained content relevant to them. Fifteen legacy resources (comprising a topic introduction, and related Minecraft challenge, with alternative non-digital options suggested) were produced and are freely available on the project website (see end).

How Minecraft sessions linked to the SDGs

We reviewed (Hobbs et al., 2022) the 'engineering in Minecraft' topics produced as part of the project by April 2022, and found that between them, they linked to eight of the SDGs:

SDG 2: Zero hunger (End hunger, achieve food security and improved nutrition and promote sustainable agriculture). We addressed this through looking at sustainable crop processing, and food security.

SDG 3: Good health and wellbeing (Ensure healthy lives and promote well-being for all at all ages). Addressed through exploring sustainable crop processing, food security, entertainment and leisure topics such as engineering at the Olympics, biochemical engineering and hazard-resistant construction topics.

SDG 6: Clean water and sanitation (Ensure availability and sustainable management of water and sanitation for all). We worked with an engineer to develop a session on river and flood management.

SDG 7: Affordable and clean energy (Ensure access to affordable, reliable, sustainable and modern energy for all). A session on nuclear waste storage was developed collaboratively with engineers.

SDG 9: Industry, innovation and infrastructure (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation). Addressed through looking at sustainable crop processing, food security, river management, transport systems, hazard-resistant construction topics, tunnels, and fire-fighting drones (e.g. Figure 2) and other robotics topics.

SDG 11: Sustainable cities and communities (Make cities and human settlements inclusive, safe, resilient and sustainable). Explored through food security, sustainable crop processing, nuclear waste storage, transport systems, tunnels and hazard-resistant construction topics.

SDG 12: Responsible consumption and production (Ensure sustainable consumption and production patterns). Addressed through sessions on sustainable crop processing, food security, transport systems and nuclear waste storage.

SDG 15: Life on land (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss). This was linked to in sessions on food security, sustainable crop processing, and tunnels.

We also reviewed written feedback given by participating children and their parents/carers and teaching staff, and identified links to:

SDG 3: Good health and wellbeing (Ensure healthy lives and promote well-being for all at all ages) Children enjoyed taking part and improved self-esteem, social communication and confidence were noted.

SDG 4: Quality education (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all). The sessions were accessible and benefits for children with special educational needs in particular were reported.

SDG 5: Gender equality (Achieve gender equality and empower all women and girls). Benefits for girls, including seeing 'so many females in STEM roles', were noted. Furthermore, positive reactions towards STEM, particularly in girls, can be increased by presenting such fields as socially conscious (Diekman et al., 2011; McGowan and Bell, 2020). Further association with SDG 10 (Reduce inequality within and among countries) can be made with reported enthusiasm for future engineering careers and learning that engineers keep 'people, plants and animals safe', which in turn relates to SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all). Finally, using Minecraft to explore real-world needs and demonstrating children's power to 'change their world for the better' links to SDGs 9, 11 and 12 by demonstrating sustainable communities, innovation and responsible consumption.

Insights gained: Embedding SDGs in STEM engagement for under-represented groups

SDGs can seem quite abstract concepts. However, they can be looked at through small-scale activities such as finding solutions to specific problems, rather than (or in addition to) being considered on larger, broader scales. This applies both when using Minecraft, and more generally.

Relevant examples can be really helpful in encouraging children to engage; for example, those relating to the local area.

The SDGs don't have to be specifically referenced in order for the concepts to be engaged with. Embedding them means that children will naturally think about issues that incorporate them, so that those issues and potential solutions become the focus, not the SDGs.

We have an underpinning ethos of prioritising children from underrepresented groups in STEM, making our sessions open and appealing to them, and offering representation of these groups within our delivery.

Exploring topics from the focus of a sustainable, environmental and ecological solution naturally relates to the SDGs and promotes an environment in which children can realise and explore their own roles in developing our world sustainably.

Minecraft is not an essential tool for embedding SDGs into engagement for under-represented groups. However, some elements are key to making our sessions appealing, flexible and adaptable, and therefore suitable for the children we aim to work with, and may be pertinent to consider when selecting tools, media and approaches:

its role in drawing children in;

being a popular and familiar medium;

offering open-ended opportunities for exploration in which mistakes can be freely made and learnt from.

Further information

Activity resources and practitioner guides are freely available on the Building to Break Barriers website: go.uwe.ac.uk/BuildingToBreakBarriers.

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References

Diekman, A. B., Clark, E. K., Johnston, A. M., Brown, E. R. and Steinberg, M. (2011) Malleability in communal goals and beliefs influences attraction to stem careers: evidence for a goal congruity perspective. *Journal of Personality and Social Psychology*, 101(5), 902–918.

Hobbs, L., Stevens, C., Hartley, J. and Hartley, C. (2019a) Science Hunters: an inclusive approach to engaging with science through Minecraft. *Journal of Science Communication*, 18(2) article 1.

Hobbs, L., Stevens, C., Hartley, J., Ashby, M., Lea, I., Bowden, L., Bibby, J., Jackson, B., McLaughlin, R. and Burke, T. (2019b) Using Minecraft to engage children with science at public events. *Research for All*, 3(2), 142–160.

Hobbs, L., Stevens, C., Hartley, J., Ashby, M., Jackson, B., Bowden, L., Bibby, J. and Bentley, S. (2019c) Science Hunters: teaching science concepts in schools using Minecraft. *Action Research and Innovation in Science Education*, 2(2), 13–21.

Hobbs, L., Bentley, S., Behenna, S. and Stevens, C. (2022, August) Inclusive exploration of sustainable goals and solutions through Minecraft. Presented at SEEDS 2022. International Conference for Sustainable Ecological Engineering Design for Society, University of the West of England.

<https://uwe-repository.worktribe.com/output/9995140/inclusive-exploration-of-sustainable-goals-and-solutions-through-minecraft>

Kuhn, J. (2018) Minecraft education edition. *Calico Journal*, 35(2), 214–223.

Lane, H. C. and Yi, S. (2017) Playing with virtual blocks: Minecraft as a learning environment for practice and research. In *Cognitive development in digital contexts*, ed. Blumberg, F. C. and Brooks, P. J. Chapter 7, pp. 145–166. Cambridge, MA: Academic Press.

Martinez, L., Gimenes, M. and Lambert, E. (2022) Entertainment video games for academic learning: a systematic review. *Journal of Educational Computing Research*, 60(5), 1083–1109.

McGowan, V. and Bell, P. (2020) Engineering education as the development of critical sociotechnical literacy. *Science & Education*, 29, 981–1005.

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.

Papert, S. (1980) *Mindstorms: Children, computers, and powerful ideas*. New York, NY: Basic Books

Figure 1 A wall protecting a building in case the adjacent river floods, developed in Minecraft, featured in Building to Break Barriers 'River management' resource (developed with Phoebe Clayson-Lavelle)

Figure 2 A base for firefighting drones constructed in Minecraft, featured in Building to Break Barriers 'Firefighting drones' resource (build by Jay Fenney)