Science HUNTERS Lancaster Environment Centre | Lancaster University

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ENVIRONMENTAL EDUCATION AND ENGAGEMENT USING A CONSTRUCTION PLAY COMPUTER GAME

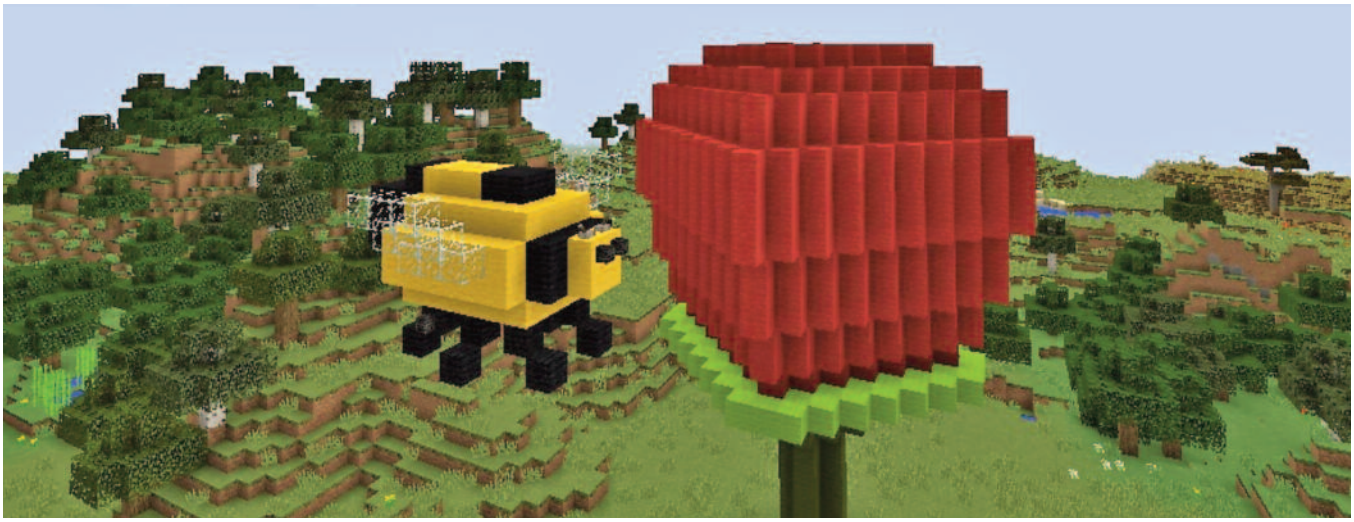
Science Hunters is a university outreach project which engages children of all ages with learning about science and the environment using the popular computer game, Minecraft. A learner-centred constructivist approach using anchored instruction and constructionism and an immersive experience in the Minecraft virtual world all allow children to direct and consolidate their learning. As they learn, they gain a sense of expertise and ownership and an appreciation that science, ecology and botanical topics are 'for them'.

THE SCIENCE HUNTERS OUTREACH PROJECT

Science Hunters is an outreach project, based at Lancaster Environment Centre (LEC) and initiated in 2014, which engages children with learning about environmental science. A key tool is the computer game Minecraft, a "game about placing blocks and going on adventures" (Mojang and Microsoft, 2018). Players can move freely around its virtual world, placing and breaking a wide range of blocks which have a variety of properties and can be used in a range of physical and ecological settings. Ecologically representative biomes and systems can be modified by the players, enabling them to interact with and alter the environment (Nebel *et al*., 2016). For example, it is possible to prepare ground, sow and grow seeds, and modify the features of the surrounding environment, for example by adding a water supply.

↑ *Minecraft offers opportunities for collaboration and peer support, seen here as children at The Park Primary School in Bristol design and build a plant growth environment together ©Science Hunters, Lancaster University*

Children can find and maintain interest in and understanding of scientific topics, and feel a sense of ownership and that science is 'for them'



For Science Hunters we use an educational version of the game developed specifically for classroom use, operating it in a mode which allows players unlimited access to the building blocks. Aside from the features mentioned above, Minecraft is a highly effective platform for engaging children with scientific topics because of its popularity and ability to capture their interest: it has been described as one of the most widely used and important games of the current generation (Lane and Yi, 2017).

DELIVERY AND AIMS

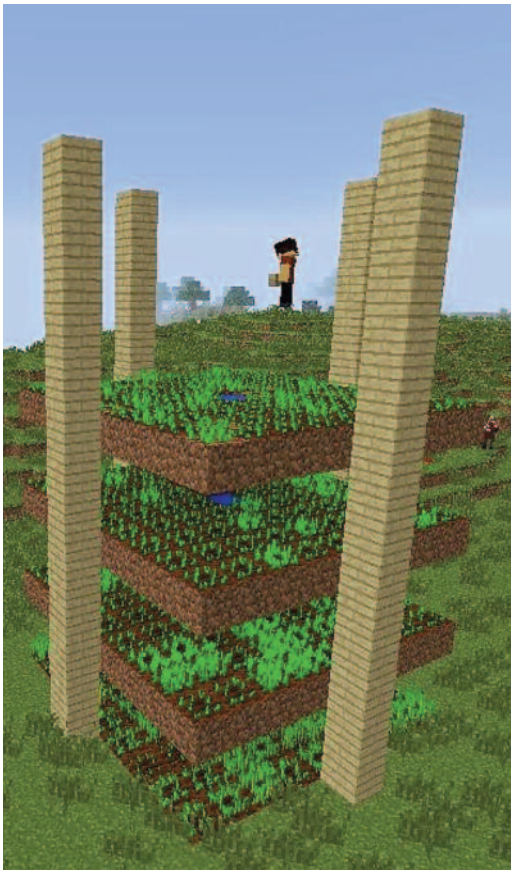
The Science Hunters project has a strong 'widening participation' focus, reaching children who may face barriers to accessing higher education such as low family income, special educational needs and disabilities (SEND) or being in care (Office for Fair Access, 2017). It was set up with funding from the British Ecological Society and now receives the majority of its funding from Lancaster University. Sessions are designed to both raise aspirations and inspire an interest in science, presenting a different experience to traditional school science lessons. Project activities include visits to primary, secondary and specialist schools, public events such as festivals, and a fortnightly on-campus Minecraft Club for children with autism spectrum disorder (ASD). Minecraft Club is run in association with the National Autistic Society. Children of all ages and abilities are included, with the project team adapting delivery to suit the needs of the group involved.

PEDAGOGICAL APPROACH

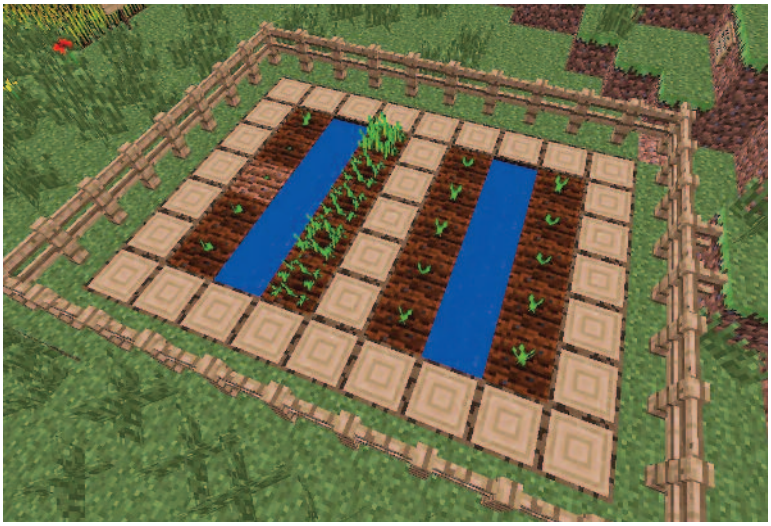
All Science Hunters delivery follows a *learner-centred constructivist* approach (Brooks and Brooks, 2001; Rovai, 2004). This means that the students direct their own learning and problem solving through use of Minecraft, with a clear emphasis on constructing understanding and meaning from the information they've been given. The approach was chosen to ensure that children can find and maintain interest in and understanding of scientific topics, and feel a sense of ownership and that science is 'for them'.

Making use of *anchored instruction* (The Cognition & Technology Group at Vanderbilt, Bransford et al., 1990), staff briefly introduce a scientific topic, with a practical hands-on demonstration. Students can refer back to this introduction and it provides a shared learning experience. *Applying constructionism* theory (Papert and Harel, 1991), topic-related Minecraft building challenges are then set as a way of deepening and consolidating learning. Minecraft worlds are physically and ecologically representative of reality, so these challenges situate the topic in a 'real-world' situation.

↑ *A bee approaching a flower to pollinate it, built in the virtual world of Minecraft. Children learn to infer that insects act as pollinators in Minecraft, as flowers reproduce ©Science Hunters, Lancaster University*



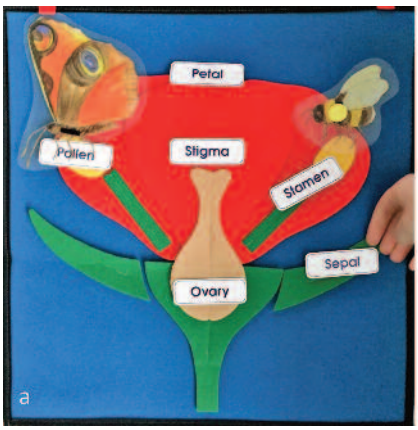
↑ *A 'space-saving farm' designed and built in Minecraft after learning about the challenge of food security ©Science Hunters, Lancaster University*



During the construction phase, children are encouraged to use their imagination and creativity, building on existing knowledge, exploring key concepts of the topic and deepening their understanding. Students usually work in pairs; Minecraft presents valuable opportunities for development of and benefit from peer collaboration and mentoring skills (Kervin *et al*., 2015), while interaction and discussion with peers and staff further develops understanding of the topic. Whilst the session topic provides a framework for construction in the virtual world, activity within the game is directed by the children playing. In practice, this means that the session leader sets a building task or challenge related to the session topic, which solves a real-world problem or demonstrates a real-world process, and it is then up to the children how they address this within the game. This means not only can children test and explore concepts in a way that is not possible in reality, it also allows them to choose the aspects of the topic which most engage them. Their input to the session direction is encouraged, to enhance the sense of student ownership and expertise.

USING MINECRAFT TO ENGAGE CHILDREN WITH BOTANICAL TOPICS

Drawing on research experience at LEC, areas of environmental science covered include a range of botanical topics, such as flower structure, pollination, germination, farming and food security. Topics can be interlinked and one can be used to enhance another. For example once the process of insect pollination is understood, it can be used to infer the presence of insects in the virtual world of Minecraft even though they are not seen (because flowers spread in Minecraft). The virtual world of Minecraft reflects real-world processes; for example, to grow crops, crop seeds must be provided with correctly prepared soil and adequate light. Growth rates then respond to sources of water and fertilizer.



← *Hands-on activities initiate exploration of a topic, which is then extended by child-directed building in Minecraft, for example by assembling a tactile flower cross-section (a) followed building a representative flower in Minecraft (b), consolidating the learning. ©Science Hunters, Lancaster University*

Feedback indicates that use of Minecraft in this way captures children's interest, engages them with the topic and facilitates and consolidates the learning gained through instruction.

← *Players can modify the Minecraft environment, applying scientific knowledge. For example, plant growth rates respond to presence of water, which has been applied in the image above ©Science Hunters, Lancaster University*

↑ *©Science Hunters, Lancaster University*

Engaging with such interactions in Minecraft and having the opportunity to handle relevant samples, also raises students' awareness of and interest in topics not usually covered within their formal education except where they pursue related subjects at a higher level.

Information is given and engagement with the topic promoted using the pedagogical approach described above. The structure of the food security session, for example, is broadly as follows:

- The topic of food security is introduced by the session leader, finding out what the students think it means, and leading them to better understanding by means of targeted questions and exploration and expansion of their own knowledge;
- Hands-on samples of foods found in Minecraft are used to support and elaborate on the topic, demonstrating the space needed to produce food and providing an opportunity for children to see food sources in unprocessed states (for example, carrots with uncut leaves, sugar cane, cocoa beans and wheat seeds). This links the real-world topic to the Minecraft world;
- The challenge of healthily feeding a growing population with ever dwindling space available for food production is thus raised. Students are set the task of designing a space-saving farm that could be used to resolve this difficulty in future.

Beyond this, it is up to the children how they approach the task and what form and function their farms take. Learning can be further reinforced over time by leaving them with an activity, such as growing seeds in a transparent bag which allows them to witness germination, and then plant development in a small space, such as on a windowsill.

IMPACT

Feedback indicates that use of Minecraft in this way captures children's interest, engages them with the topic and facilitates and consolidates the learning gained through instruction. Children report high levels of enjoyment and engagement with learning, teachers recognize that students are immersed in topics and retain what they've learnt as a result, and parents appreciate the social-communication skills developed as a result of collaborative play in an environment of which children feel they have ownership and expertise.

← Hands-on practical scientific demonstrations and activities provide an anchor underpinning constructive, learner-centred play in Minecraft ©Steve Pendrill/ Lancaster University

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