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Template for Roots articles

Title (10 words MAX):

Environmental education and engagement using a construction play computer game

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Article summary (100 words MAX) (remember to make this a stand-alone summary of your article and NOT a repetition of the 1st paragraph.)

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 allow children to direct and consolidate their learning, while gaining a sense of expertise and ownership and that science, ecology and botanical topics are 'for them'.

Article (750- 1200 words MAX)

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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 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, such as adding a water supply. Science Hunters activities use an educational version of the game developed specifically for classroom use and operate it in a mode which allows players unlimited access to the blocks with which they can build. Aside from the above features, Minecraft is also a highly effective platform for engaging children with scientific topics because it is very popular and therefore captures 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 formats 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) and being in care (Office for Fair Access, 2017). It was initiated using funding from the British Ecological Society and is now receives its the majority of its funding from Lancaster University. Sessions are designed to both raise aspirations and inspire an interest in

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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 ages and needs of the group involved.

Pedagogical approach

All Science Hunters delivery follows a *learner-centred constructivist* approach (Brooks and Brooks, 1995; Rovai, 2004). This means that focus is on the students directing their own learning and solving problems through use of Minecraft, with a clear emphasis on constructing understanding and meaning from the information they've been given. This 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 And Technology Group At Vanderbilt, 1990), staff briefly introduce a scientific topic, including practical hands-on demonstration. This introduction can be referred back to and provides a shared learning experience. Applying *constructionism* theory (Papert and Harel, 1991) topic-related Minecraft building challenges are then set as a method of deepening and consolidating learning. As Minecraft worlds are physically and ecologically representative of reality, these challenges situate the topic in a 'real-world' situation. During the building phase, children are encouraged to use their imagination and

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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) and interaction and discussion with peers and staff further develops understanding of the topic. Whilst the session topic provides a framework for construction within the virtual world, the activity undertaken 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 not only allows children to test and explore concepts in a way that is not possible in reality, but also allows them to do this in line with their own interests by choosing the aspects of the topic which most engage them. Students are allowed input to the session direction to enhance their sense of student ownership and expertise.

Using Minecraft to engage children with botanical topics

Drawing on research experience in 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 used to enhance each other, 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 fertiliser. Engaging with such interactions in Minecraft and the opportunity to handle

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relevant samples also raises students' awareness of and interest in topics not usually covered within their formal education unless they choose to study relevant subjects at a higher level.

Information and engagement with the topic are delivered and encouraged using the pedagogical approach described above. The structure of the food security session, for example, is broadly:

*The topic of food security is introduced by the session leader, by finding out what the students think this means, and leading them by means of targeted questions and exploration and expansion of their own knowledge to work this out;

*Hands-on samples of foods found in Minecraft are used to support and elaborate on this, 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 increasingly less 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

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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 recognise that students are immersed in topics and retain what they've learnt as a result, and parents appreciate the social-communication skills which develop as a result of collaborative play in an environment of which children feel they have ownership and expertise.

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