

## Utilising the various modes of Minecraft modes in teaching

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It is hugely important that we find and develop effective ways to encourage young people to engage with science<sup>1</sup> - children's interests in science tend to decline from 10 years of age<sup>2</sup> and are usually established by 14 years<sup>3</sup>. This can be mitigated by engaging children in practical, investigative, activities associated with science<sup>4</sup>; computer games, being played by 69% of 6–10 year olds and 81% of 11–14 year olds in the UK<sup>5</sup>, provide a way to do this.

Minecraft is both an extremely popular<sup>6</sup> game and ideal for communicating concepts<sup>7,8</sup>, as it contains a range of features which relate to real-world processes and environments and can be used to engage children with various topics. It is a construction-based game which allows players to build a huge range of structures and items with a variety of blocks of different properties and textures. Players can play individually in single virtual worlds, or collaboratively in shared worlds on secure servers. Commands can be entered, offering opportunities to practise basic coding skills. There are multiple opportunities for scaffolding learning, employing collaborative learning approaches<sup>9,10</sup> and supporting children to construct meaning with each other through dialogue during learning and play<sup>11</sup>. Children often feel a sense of expertise and ownership in using a game that they are familiar and experienced with for learning<sup>12</sup>. Minecraft is used as a pedagogical tool around the world across a spectrum of subjects, from Science to English to Art<sup>11-13</sup> and has been described as one of the most important games of the current generation<sup>7</sup>.

There are two key modes of Minecraft, 'Survival' and 'Creative'. Both can be utilised in educational settings; it is important to understand the features of each mode in order to effectively select the most appropriate for the intended learning outcomes. There are also three other modes,

'Adventure', 'Hardcore' and 'Spectator', which are modifications of the two key modes. In all cases, students are supplied with virtual worlds that can range from containing no specific pre-built content, requiring players to construct relevant creations, to fully pre-constructed worlds relevant to the topic covered and students are able to explore.

These modes, and illustrations of how they can be used in educational settings through examples from Science Hunters, an outreach and research project based at the University of the West of England and Lancaster University which follows a constructivist pedagogy utilising anchored instruction and constructionism to engage children with science through Minecraft<sup>14</sup>, are explained below.

### **Survival mode**

In Survival mode, players must collect resources, build structures, fight off hostile mobile entities ('mobs'), explore the world they find themselves in and eat in order to survive and stay healthy. They have an inventory which they populate by gathering items. These resources are finite; players can only gather what they come across, with specific blocks only found in particular places. As they obtain more of an item, its availability increases in their inventory and will then decrease again, and eventually run out unless replaced, as the item is used. Items can be used to create other items and tools through various processes (known as 'crafting').

Survival mode also features 'health' and 'hunger' bars, which affect players' progress. The hunger bar is represented by ten drumsticks (equivalent to 20 hunger points) which replenish as players consume food. If the hunger points are low, the player will lose abilities such as sprinting. If it is at zero, the health bar, represented by ten hearts, will deplete. When sufficient hunger points have been gained, the health bar regenerates.

Players can be damaged by the environment (e.g. lava flows) and mobs. The 20 hit points of the health bar can also be depleted through sustaining such damage, as well as by diminished hunger points. When health points run out, the player 'dies' and must respawn to continue playing; the items in the inventory will be lost. These harmful entities can be disabled using the 'Peaceful' difficulty level when creating the world, which will also enable the hunger and health bars to replenish automatically; other difficulty levels are 'Easy', 'Normal' and 'Hard'.



*Minecraft operating in Survival mode. The health (hearts) and hunger (drumsticks) bars are visible at the bottom of the image. If the player gets hurt or hungry the hearts and drumsticks deplete. The row of squares beneath them is the hotbar, where players place the items they are currently using in the game.*

Survival mode can be used, for example, to introduce understanding of how to withstand extreme outdoor environments, and the body's physiological response to stressors such as lack of water, shelter and food. In the 'Science of Survival' Science Hunters session water filters, heat blankets and outdoor gear are shown and discussed as examples of items which support outdoor survival. No pre-

built content is provided; a virtual Minecraft wilderness is generated at random, and students must plan, craft and forage in order to build a shelter and find food to thrive in the environment in which they find themselves. The parameters of the world are set to 'Peaceful' difficulty allowing players to concentrate on the session tasks; this can be altered for experienced players, or to provide an extra challenge. Students are tasked with crafting an item to support their survival in the wilderness, such as a wood-cutting tool. The activity can be extended by asking children to describe – verbally or in writing – what they did, what the outcomes were and what they learnt or would do differently.



Survival mode can also be used to explore other themes such as sustainability; understanding the concept of surviving on what you have available and maintaining your resources - i.e. if you eat all your animals or cut down all your trees, you cannot create new ones. This can be differentiated to

ability and experience with Minecraft by providing maps containing differing levels of resource availability or by deliberately providing caches of resources in strategic locations.

### **Creative mode**

Creative mode eliminates the survival elements of the game; players always have access to unlimited numbers of blocks in their inventory and do not need to search for or gather them. There is no health or hunger bar to interfere with progress, and single-use items are not consumed and do not run out. It is also possible to instantly destroy block types such as bedrock, unlike in Survival mode.

Players are able to fly around the world, and will not be damaged by other characters as they would in Survival (it is still possible for players to 'die' and respawn, should they enter empty space known as "the Void", but this is the only mechanism by which this is possible other than using a "kill" command to enact instant 'death').

Operating in Creative mode also enables players to use command blocks, structure blocks and spawn eggs. Command blocks are used to execute actions which are not otherwise available, such as teleporting the player to another location. They must be correctly set up to work and offer an introduction to coding. Structure blocks allow a structure that has been built into the world to be copied and recreated – essentially creating a template of that structure. Spawn eggs instantly place creatures, for example wolves and chickens, in the world. None of these functions are available in Survival mode. Without the need to seek and obtain specific blocks and items, players can focus on construction objectives; Creative is the mode with the greatest scope for building.

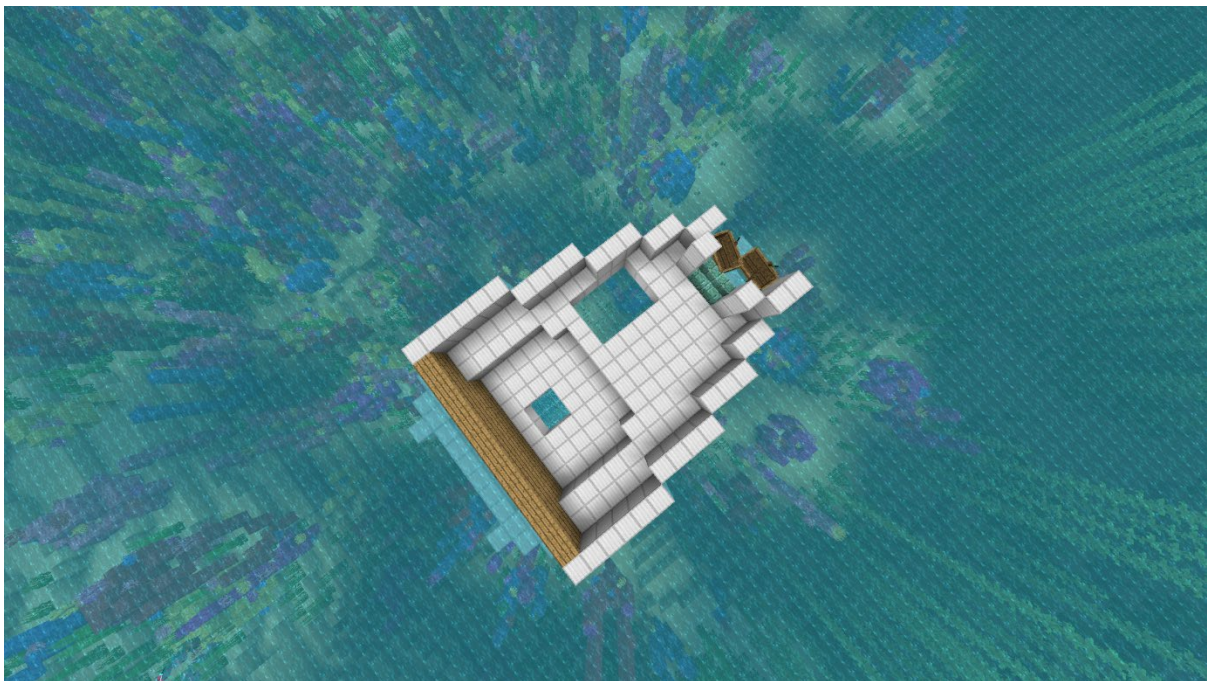


*Minecraft operating in Creative mode. The health and hunger bars are absent, and the game's inventory contains infinite blocks for the player to use.*

Spanning the full spectrum of pre-built world provision, the Science Hunters 'Coral reef ecosystems and conservation' topic has multiple options for engaging children through Minecraft. The session is based around the coral reef ecosystem, and potential threats to it, at the Chagos Archipelago, a group of tropical reef atolls and a key field study site in research at the project's host institution<sup>15</sup>. In all versions of the session, students are introduced to the topic using samples of corals and photographs of the real-life Chagos coral reefs<sup>16</sup>. At the fully pre-built content end of the range, it uses a pre-created Minecraft world to display a virtual coral reef ecosystem. The world is designed to resemble the Chagos Archipelago; replicating a real-world conservation example in Minecraft helps players link their in-game experiences in with reality and what they have learnt during the introduction. The Minecraft world is split into three distinct areas to which players can teleport from a central hub point: a healthy, untouched coral reef, an unhealthy, bleached coral reef and an island displaying anthropogenic threats to the longevity of coral reefs. Students enter the Minecraft world in Creative mode, and it is sufficiently detailed and educational, including strategically placed signs

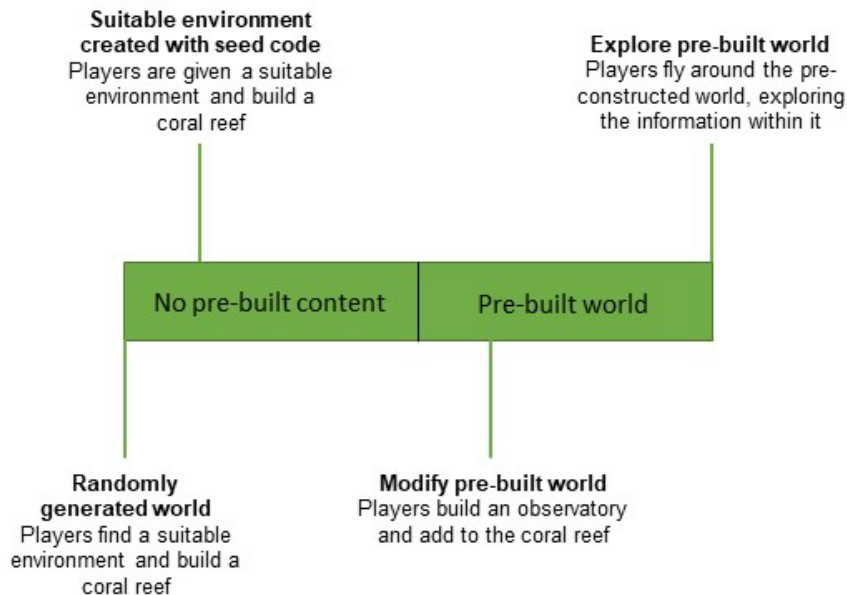
giving them information, directions and tasks, that they have the option to explore the coral reef areas without modifying the world. This is particularly helpful for students with less experience of Minecraft or ability to build, or where time is limited, for example.

Students can also actively build in the world. In some sessions, they are set the task of building an observatory that can be used to observe and study the health of surrounding coral reef. They are encouraged to use the information given to them in the session introduction when building their observatory, for example building a glass base through which to see the coral under the water. Students are not limited to one task, so those quick to build an observatory can move around the world regenerating areas of bleached coral reef or removing visible threats to the coral reef ecosystem.



At the other end of the pre-built provision spectrum, students are provided with worlds which do not contain pre-built coral reef. They are placed either in a world generated by Minecraft which places them in a coastal area (obtained by using a relevant seed code when opening up a new world), in which they can then build coral reef, or where an extra challenge is appropriate, they are

spawned into a randomly generated world and their first task is to fly through it searching for a suitable environment in which to create their coral reef.



*The spectrum of options for playing in randomly generated, environment specific or pre-built worlds in the Science Hunters 'Coral reef ecosystems and conservation' session.*

### **Other modes**

Spectator mode puts players into a state where they can explore a world, but not interact with it. They are invisible to other players in a shared world (other than those also in Spectator mode) and can view the world from the perspective of other entities present in it. They can go through blocks and other entities, and as in Creative, can't be damaged other than in the Void or using the 'kill' command. They always fly and cannot interact with the inventory. This mode can be useful for educators who wish to observe their students' progress and activity from within the world, without being seen or interacting with them.

Adventure mode is used to preserve pre-built maps. It restricts players' abilities to destroy or place blocks, so that they can't modify the existing world in the same way that they can in Survival or



Creative. Adventure is otherwise similar to Survival in that players must manage their hunger and can interact with other entities in the game, and can be damaged or be killed. This mode can be useful in an educational setting if it is important that a map remains intact, whilst still allowing players to interact with and explore the world.

Hardcore mode is a version of Survival mode in which the difficulty level is always set to 'Hard' (as such, it is not technically a mode in itself, but a modifier of Survival mode). If a player dies, the map must either be deleted, or in a shared world the player must enter Spectator mode, rather than respawning. It could be used, for example, to support students in considering the realities of hostile environments, or as an extension challenge for able and experienced players.

When 'cheats' are enabled in the game settings, it is possible to switch between the modes, using the `/gamemode` command followed by the name of the desired mode, so that users can, for example, play in Creative mode on a map created in Survival mode. An important consideration here is players cannot gain achievements in Survival mode if playing on a map created in Creative mode. Cheats can also be used to set weather, daylight and new spawn points. These functions are useful for aiding focus, as educators can ensure particular weather conditions, prevent the world from becoming dark and ensure that if players 'die' they will respawn close to the building area.

Single player worlds can be used to prevent issues occurring between players, such as destruction of each other's builds or transmission of disruptive messages, to aid focus and where a Minecraft server and sufficient internet connection is not available. Where it is possible to use a secure shared server, groups can play together in the same world, completely projects more quickly and learning co-operative play.

## **Conclusion**

The appeal of Minecraft makes it a viable choice for facilitating engagement with formal learning content. All modes of Minecraft can be utilised in classroom settings; the features of each mode determine which is most appropriate for a specific task or aim. There is scope to develop planning, teamwork, evaluation and problem-solving skills, as well as introducing subject-related concepts and competencies. Students can become immersed in their learning, being able to virtually experiment with ideas and importantly, have fun while they do so.

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