

Minecrafting Virtual Education

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Abstract. Minecraft is an innovative video game that combines a simplistic, flexible, childlike interface with an open-ended, non-deterministic, playing environment that allows for a wide assortment of tasks and skills building while providing a platform for innovative game play, collaboration, and new formats for interaction and cultural creation.

In this paper, we explore the dynamics of Minecraft and we discuss their implications in the context of virtual education.

Keywords: Minecraft · Education · E-learning

1 Introduction

In the recent years, Minecraft has exploded from an indie game to a best-seller platform with over 100 million copies distributed. Nowadays, the software invites creative participation from a total of 55 million monthly active players, programmers, and designers worldwide. Unlike point and shoot, sports, and specific strategy games (e.g., Doom, Call of Duty, The Sims, or Civilization), Minecraft comes with no official agenda, and once there, users can decide what end they wish to follow, similarly to real life. It offers an unarticulated schema when a player enters, and it is up to the user to transform the partial environment of the base game into something more personal. This leads to a culture of customization and innovation that has created massive communities that explore and create new aspects to the growing and continuously expanding virtual platform. Few proprietary gaming systems have allowed or encouraged this level of interactivity, expandability, and diversity. Most importantly, Minecraft demonstrated that unleashing individuals' creativity is even more important than providing users with adrenaline and compelling visual experience. On the contrary, pixel art succeeded as a democratization tool for user generated content.

The launch of Minecraft education edition represents a natural but important step in which programming, gaming, design, and educational resources have converged with the purpose of creating new technologies that seamlessly blend gaming and education. However, beyond this initiative, worldwide communities of educators independently created and keep generating new use cases for using this platform for teaching and engaging learners in exploring subjects in non-conventional ways. In this paper, we present a literature review of the most prominent applications of Minecraft for virtual education. To this end, we analyze scholarly articles and unpublished yet

relevant best practices. In addition, we categorize currently available tools into education level and subject, with the objective of providing educators with both an entry point and a reference to integrating virtual experiences in their teaching activities. Moreover, we analyze factors, such as, gamification, creative and spatial thinking, and integration between interaction between physical and virtual classroom, that might play a role in revitalizing education. Also, we identify directions for education research using gaming platforms and we present novel opportunities for designing learning environments.

By viewing Minecraft as a larger entity, and by analyzing how users are leveraging its potential to shape new products, to create communities, to engage with audiences, and to deliver experiences, other software houses could understand how to invest the resources spent in developing their game titles to generate an impact in other sectors, with a specific regard to education. Examples from Minecraft could lead to transforming games which are well-developed, mature, and adaptable to educational purposes, into cost-effective, collaborative, and expandable learning platforms.

2 Related work

Minecraft differs from most games in that it is wildly anarchic in its construction and aims. Developer, Markus Persson wrote that the game is constantly under development [1], which, in turn, helped to keep the game a subject of interest. What is the subject of Minecraft, and indeed is there a single subject or objective in this game? It is more than a mere game and has morphed into an infotainment educational portal that has invaded classrooms across the globe. In [2] Minecraft was referred to as “an alluringly moving target to try to pin down, and so in order to assess how it is well-played, well-designed, and iteratively well-redesigned, we need to think more broadly about the approach Persson has taken toward the development of the game”. That process has been circuitous and this has prompted some hesitation about the game and its implementation in the educational and scientific community.

The authors of [3] commented that introducing the game to a novice can be a difficult task due to the lack of instructions. A belief in rational processes presumes the game and its subsequent play needs to be directed towards a definitive goal. Minecraft’s lack of destination can be worrying to a community that perceives a game design as requiring a requisite end goal.

Yet, it is precisely the open-ended nature of Minecraft that makes it a touchstone for innovative scientific and creative accomplishment. In structured gaming, goals and insight are limited. Minecraft is often associated with the burgeoning maker movement that is flourishing in communities and schools across the nation to teach innovation and entrepreneurship to a group of young creators that can empower them to be creatives rather than drones of an industrial oligarchy in the hands of a few corporations. In [4], the authors commented that Minecraft has participated in the building of makerspaces in libraries that provide students with hands-on skills. The perspective presented in [4] is that diverse forms of learning encouraged in an open environment

provide the best educational opportunity. Authors of [4] write that, “whether the learning takes place through being a part of a team, building a robot, using maker kits, designing in 3D, or through individuals reading or group discussion”. Minecraft offers this sort of generalized workspace where students can build without specified end goals.

Such open-ended constructions might seem less than optimal to produce significant results. Certainly, one subject area that has fascinated Minecraft scholars is the game’s application to the fine arts and architecture. In [5], the authors postulate that the game’s style of art creation, this open-ended free ranging design is precisely the format that Minecraft assails most capably: “rather than form a stable body, the immanent data-set moves as a flow of information through systems” [5]. Therefore, the authors imply that students are more challenged by such environments and this energizes the creative process, and they argue that this computer replication process merges the creative instinct of the creator with hard core data, describing the process as, “these operations include in general: generating a point cloud; building a mesh; creating a UV map, also called a skin or a texture”. Thus, such operations foster more creativity than operations that do not have to reference real spaces in a real plane. What is built in Minecraft must be buildable and must conform to the rules, the geometry, and space of the Minecraft virtual world.

While many in the educational realm see production as proceeding through a series of concrete steps, in [5] authors argue that digital production need not follow this time-based progression sequential model derived from film and prior narrative structures, explained as “3D imaging is characterized by simultaneity – a function of parallel processing rather than cinematic succession” [5]. This form of creation violates some of the honored traditions of temporality, and therefore can be both embraced and questioned by academic institutions that are regulated through sequential processes and thus are wary of simultaneity, a factor of fast computer and machine processes.

City Building Games (CBGs) are described in [6], as changing the thinking models and methods of young scientists and artists and urges them to consider the whole topic of cityscapes earlier in their development thus providing a better entre for future city planners. The authors of [6] describe the games as, “highly successful cultural products that for millions of gamers have constituted their initial formative experience with urban planning and development”. The authors of [6] are less concerned with the formal pedagogical models underpinning such games and prefers to view them as “social or cultural” devices. A central concept to the games’ value is the ability of such games to urge players to think in terms of definite spatial dimensions [6]. They may not be working in a real world, but they must follow the rules of engineering in a real world even if their world is make-believe: “CBGs and other simulation/strategy games encourage the player to exercise adaptive critical reasoning while continually critiquing different theories and strategies” [6]. So, in this sense, Minecraft creators are dealing both with theoretical issues and practical problems. The only thing that is imaginary is the plane of creation that is a digital construct. In other regards their simulation contains elements of a real-world simulation.

3 Human dimensions of Minecraft in education

In the striving to make computers, gaming and education synonymous, much effort has been expended in finding games that are age appropriate. A delightful aspect of the Minecraft experience is that the game and its open-ended playing mechanism is that the game is age appropriate at almost any level, due to its innate capacity to be modified and the broad ranging community that engage in continually modifications of the game. Because of its complexity and online community, Minecraft is recommended for kids aged 8+. However, even younger children can enjoy the game with little adverse reactions, and therefore several suggest that the title is already suitable for kids at a very young level. Furthermore, a variety of games with similar game play and set of objectives that can occupy younger children and would not necessitate constant monitoring for students that desire to play Minecraft at a younger age. Essentially, the dynamics of Minecraft can be described as a sandbox game, which means that players are given a virtual construct with which they can build things, though survival mode and adventure mode offer more challenges and more dangers and even potential death for characters. As a result, the best approach is for parents who are concerned about younger children is to keep a watchful eye when they are involved in game play. If properly harnessed, Minecraft enables children to express their creativity in a 3D environment: they can create massive buildings, elaborate villages and cities, train systems, or even other creative objects and projects.

The wide disparity in age range for players and fans is one of the sources of inspiration for their players. As any product enjoyed and loved by children, parents need to feel comfortable and secure with the product. It is easy for parents to be concerned when a new product begins to draw their children's attention and consumes massive amounts of a child's time, as several researchers associated smart phone usage can degrade memory function [7]. However, researchers argue that reliance on a technology can stunt real world growth experiences. If this is true for people engaged in using smart phones is it true of people that spend long hours in video game play.

A big question concerns whether programs like Minecraft can teach conducive computer skills or must it ratchet our brains to new levels of stress, excitement and engagement that destroys constructive thought, concentration and the ability to get things done. Minecraft is a strongly collaborative learning tool for youth and parents and children need to approach it in that fashion. New improved version of the game, and specifically the cross platform, Minecraft Better together sadly evolves the game towards the industry that constantly depends on upgrades and new thrills to sustain audience involvement. While there is no rush to update to the new version, the existing Minecraft games will not stop working. However, parents need to know that it is the new version of Minecraft that children will want to play. However, while Minecraft can be obsessive as a hobby, it unlikely to be addictive and harmful the way shooting games are to mental development. The authors describe it as a "an amazingly creative experience", which has intrinsic educational value from problem-solving, storytelling and team building skills. According to its creator, the better together version allows kids to play together on console on tablet for the first time it also opens up services which of been unavailable on the console version.

Another aspect in Minecraft is the shelf-life of creative work as updates will happen as the game is developed in the coming years. While provisions for porting over previous constructions have been made for some versions of the game there is a potential that past creations, such as, old houses that are torn down in the redevelopment project of a town, may be swept away.

There are benefits to upgrades to new versions. Minecraft's transition to new gaming engines, such as, the Microsoft Bedrock engine, which happened after the acquisition of the platform, inspired a new look. Though the blocking sub-structure of the game remained, the visual textures and colors were enhanced by a gaming engine that rendered the colors and landscapes more vibrantly. Updates are also expected to improve game play. The Better Together update allows the Minecraft kernel to be loaded to the new Bedrock gaming engine which improves graphics and the look of Minecraft (famous for its blocking textures) and enhances cross platform play that allows users to play from one device to another device in seamless integration.

Recent articles explore the creation of a new novel that was produced by the Mojang company, the producing entity that has produced the Minecraft game and subsequent Minecraft forms of adventure. *Minecraft: The Island* is an adventure set in the Minecraft Universe. As reminded by the authors [8], the open-ended nature of the game is a big part of its appeal. Max Brooks, the author of the Minecraft novel is the son of Mel Brooks and Anne Bancroft and wrote the popular zombie novel *World War Z*. He combines a paranoid glee about end of the world apocalyptic visions with a Robinson Crusoe sense of adventure and innovation. In another sense, the expansion of Minecraft into the realm of fiction is appropriate for a game that has acquired a narrative sensibility and created its own adventure world.

Further change from conventional gaming is how Minecraft can steer students towards aesthetic adventures, and the creation of actual 3D objects. Many describe the potential of Minecraft to be more than a game, and to implement an aesthetic platform. Indeed, many game contributors are designing elegant landscapes and extreme architecture patterns out of the game's crude block construction. For instance, a company called Blockworks designs maps for the Minecraft platform and the company has even developed a coffee table book called *Beautiful Minecraft* which shows the most extreme game designs. The artistic community can thrive in the open gaming context of Minecraft, as are artistic opportunities flow from Minecraft's open structure, and by the fact that players, in addition to the classically video-game-like "Survival Mode", can also realize anything they want in the "Creative Mode", which removes any threats and turns Minecraft into a blank canvas.

Where Minecraft turns from a distraction to a device for learning is in the way the program is deployed and used at various schools across the nation. Gamification, the use of game strategies to increase learning has become a common practice in educational institutions. In a report [9] published by an educational firm discussing Minecraft's capability for teaching social and emotional learning through its platform. The company explained their research design, which involves meeting with teachers, school leaders, and students, and co-designing instructional resources. Testimonials

and contributions from the viewpoints and experiences of dozens of educators from 11 countries across four continents enable shaping new educational tools.

While the findings of the report suggest that the game can help students with intellectual, creative, and emotional development, the schools seem to have focused on kids with strong backgrounds, good parenting, and strong resources that also could account for their strong personal development. One places a good student in a healthy educational environment and remarkably they tend to grow into healthy adults. One cannot ascertain from this scenario if Minecraft encouraged healthy development or if the research simply confirmed the impact of a good nurturing environment, with or without Minecraft. Despite this caveat, the researchers may have found impressive correlations between Minecraft and student development. As discussed in [10] “when educators intentionally work on the classroom culture using a game like Minecraft as a vehicle for that learning - when students are already intrinsically motivated to play - it can serve as a powerful learning tool. Studies point to learning as a cultural process, including complex aspects of development representing a larger human experience regardless of age, gender, class status, racial or ethnic group membership. It has global impact. It can be entirely non-verbal, and yet, it provides opportunities for rich verbal dialogue, story prompts, history, contextual understanding, science, fine arts and even world languages”. So, the research suggests that the game can aid such developments in any children.

The education and therapy community have been interested in Minecraft’s ability to engage students. So successful has the game been that therapists are now looking to the game design as a model for approaches to therapy. The authors of [11] explained that Minecraft’s game design emphasizing an essential experience principle provided users with an emotive or cognitive connecting point that other games and other forms of therapy might not emphasize. The authors postulated that if therapeutic approaches could emulate the game’s connectivity with audiences, the game and the therapy might be more effective. They quote [12] on video game design and explain that their notion of an essential experience principle of playing a game is comparable to the idea of “systems thinking” [12] or as the authors describe it, “the emergent, holistic, and immersive experience of the player that occurs when the tangible game elements are combined with the player’s actual participation.” [11] They believe that the experience comes before the playing and the winning and any other reward involved with the gaming mindset. The authors of [11] believe that one of the main concept in [12] is that the true purpose of playing a game is not to complete it or to win but rather to participate in its essential experience. Not all game authors adhere to this principle. Some work on building a world or making active game play, but Minecraft adheres to the heavy engagement model by providing a sandbox environment where concrete goals and specific problems are not dictated, raw materials must be manipulated and molded into tools and structures, and players can visit other worlds, build in them, allowing building and creating that can be spread and shared. Thus, Minecraft works on the psyche of the player in a much less fatalistic manner but at times in a more profound fashion the player’s thought process is supported and aided by the interface, ambitions, and outcomes of the game, itself.

Still others have explored learning objectives and how gaming, and particularly Minecraft leverages gaming structures to participate in crafting learning environments. An article [13] mentioned a clear connection between the procedures and objectives of the technical communication field and the roles and missions of gaming structures, and they stated that the field already works at the intersection of the technical and the symbolic and games are both". The authors envision games as rule systems and frameworks for interaction and they see a very natural evolution from that process to the process of writing and thus interacting in that game world. Moreover, the authors speculate that creating manuals and communication materials to aid players in their gaming pursuits may draw on the writers' humanistic training to design systems that prioritize human/player experiences. The work of [13] suggests that not only can technical communication engage with traditional game play, it can also involve itself in game subversion by helping create technical writing that can disrupt play. As an example, Minecraft griefing guides teach aspiring grievers how to enter social situations, gain trust, and then make people angry and disrupt game play for the spectacle and benefit of the person doing the griefing. Such insight into technical communication, the game Minecraft and gaming in general suggests a highly developed community of learners that study the game, discover the intents and concepts of the game, and find means to disrupt the game. This is a complicated series of interactions in a game world in which little is pre-destined or ordained as conventional game play or outcomes and suggests that even the practice of griefing demands a high level of originality to produce optimal disruption outcomes.

Owing to its expansive game play, Minecraft has evolved more complex audiences. People with disabilities and with special needs, and adult-non-gamers have engaged with the game to seek worlds that don't exist in a non-game environment but do exist very easily in the Minecraft environment. According to [14], limited budgets are driving individuals and small teams to experiment with minimalistic styles and explore themes and taboos that would normally be considered beyond the purview of mere games, such as mortality, morality, economics, and abuse. In their work, [14] explore how games like Minecraft cultivate an interest in exploration, creation, world-building, and the production of safe and attractive habitats: positive society building may be an outgrowth of non-confrontational non-aggressive game play. Society building on the scale of new civilizations could be one of the practices and outcomes of Minecraft's method of play as an act of creation.

But the alternative to deeply directed game play in videogames like Minecraft may be a form of human colonization of cyber worlds. Not horrific dystopias that offer a destiny of murder and dissolution in competitive violent worlds, such as, *Grand Theft Auto*, where situational ethics dominates our thinking, but perhaps the creation of utopian places where people congregate and set up an alternative existence. The authors of [14] introduce recent patterns of Minecraft consumption involving less of creating and having more of a focus on a minimalist existence a sense where more time is simply spent exploring and appreciating the landscape. Maybe the result of Minecraft's virtual world is a land of leisure and a sense of accomplishment, making a perfect world where none existed. However, what keeps audiences generating more worlds and more spaces in Minecraft is the incredible ability to simulate large chunks

of the conventional world. According to the authors of [14], the simulation technology underlying the game is sophisticated enough to allow a recapitulation of the entire history of technological civilization, from primitive wood and stone tools, through agriculture, right up to factory-sized computers capable of running algorithms and displaying animated outputs on giant screens.

But apart from the ability of the game to synthesize and simulate our world, it has evolved, as we have, into a place where people can exist, something that is becoming far more difficult in the conventional non-cyber world: the game has become about finding, creating and fostering sacred spaces that evoke a sense of wonder, beauty and dramatic naturalism. Maybe Minecraft should be renamed MIND-craft, and maybe that world perfecting mindset is its greatest contribution to our desire to make better virtual worlds.

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