Metaverse and education: the pioneering case of *Minecraft* in immersive digital learning

Iván Sánchez-López; **Rosabel Roig-Vila**; **Amor Pérez-Rodríguez**

Iván Sánchez-López ✉
https://orcid.org/0000-0002-5937-2904

Universidad de Alicante / Universidad de Huelva
Facultad de Educación
03080 Sant Vicent de Raspeig (Alicante), Spain
ivan.sanchez@ua.es

Rosabel Roig-Vila
https://orcid.org/0000-0002-9731-430X

Universidad de Alicante
Facultad de Educación
03080 Sant Vicent de Raspeig (Alicante), Spain
rosabel.roig@ua.es

Amor Pérez-Rodríguez
https://orcid.org/0000-0001-8312-5412

Universidad de Huelva
Facultad de Educación
Campus del Carmen
21071 Huelva, España
amor@uhu.es

Abstract

The metaverse is presented as a possible new technological iteration for the Internet. The generation of virtual universes in which the physical and the digital converge raises the question of how education will be addressed in these new systems. We find, however, pioneering exercises such as *Minecraft: Education Edition*. This platform is a version based on the popular sandbox video game, which was originally created by a community of teachers. The aim of this research is to analyze and describe the idiosyncratic characteristics of *Minecraft* as an educational platform, framing it as one of the pioneering exercises in the metaverse. To this end, we have employed a methodology that combines Multimodal Discourse Analysis with Grounded Theory and the Constant Comparative Method. As conclusions, we observe how the *Minecraft* Education platform reinforces from its approach pre-existing aspects from the physical world, resizing them to adapt them to its connected digital environment. These are key elements such as the identity of the participants, their ability to act within the system, creativity through lessons as a guide to the educational objectives and the community as the backbone of the process. At the same time, it presents differential components, such as the use of avatars, the transition from textual literacy to multimodal literacy, game mechanics that boost creativity or transhuman capabilities that defy physical space-time. All in all, the platform is designed for teachers, parents and managers, to whom it offers a series of benefits. Therefore, the pedagogical action will depend on their judgment and execution, especially through the elaboration of lessons and worlds, the management of the sessions and their interaction in community environments. It is their responsibility to ensure that the educational experience is truly empowering or, on the contrary, that it ends up being governed by reproductive criteria linked to symbolic violence.

Keywords

1. Introduction

1.1. The metaverse: a new possible iteration of the Internet

On October 28, 2021, Mark Zuckerberg made a global announcement about the restructuring of his technology company, which is now under the Meta brand. Beyond a simple rebranding, his presentation described a projection of the company into the metaverse: "I want to share what we imagine is possible, the experiences you'll have, the creative economy we'll all build, and the technology that needs to be invented" (*Meta*, 2021).

The origins of this concept can be found in science fiction, with the novel *Neuromancer* (**Gibson**, 1984) as a reference. The term "metaverse" was then taken up in *Snow Crash* (**Stephenson**, 1992). Etymologically, it combines the prefix "meta" (from the Greek μετά, meaning "after" or "beyond") and the word "universe." **Lee** *et al*. (2021) define it as a virtual environment that blends the physical and the digital, facilitated by the convergence of Internet and Web technologies and extended reality (XR). **Park** and **Kim** (2022) refer to a three-dimensional virtual world in which avatars participate in political, economic, social, and cultural activities. Other authors, such as **Jaynes** *et al*. (2003), focus on a new relationship of the human being with space–time through a simulation of the senses.

Dionisio, **Burns** and **Gilbert** (2013) state that the challenge for the metaverse is to identify a formula for moving from a set of sophisticated but completely independent immersive environments to a "massive integrated network of 3D virtual worlds or Metaverse thus establishing a parallel context for human interaction and culture" (p. 28). In their research, they highlight advances in four areas: realism, ubiquity, interoperability, and scalability. **Lee** *et al*. (2021) detail the pillars for building the most advanced state of the metaverse, which they call surreality, in which the physical and virtual worlds eventually merge, representing the final stage of the coexistence of physical–virtual reality. They divide this along two dimensions: technological enablers with the network, the cloud, artificial intelligence, computer vision, blockchain, robotics, user interactivity, and extended reality; and what they call the ecosystem, consisting of avatars, content creation, virtual economy, social acceptability, security and privacy, and trust and accountability.

Far from establishing itself as a franchise product of a single company, the metaverse as a business has attracted interest or suspicion from the world's leading technology companies, extending from the openness of Microsoft CEO Nadella, positioning his divisions dedicated to work environments and gaming, to the skepticism of Musk: "I think we're far from disappearing into the metaverse. This sounds just kind of buzzwordy" (in **Dillon**; **Mann**; **Nicolle**, 2021). There is, in any case, a predisposition on the part of a large fraction of the big digital industries for the metaverse to play a significant role in technological evolution. For Zuckerberg (in **Newton**, 2021), "The metaverse is a vision that spans many companies –the whole industry. You can think about it as the successor to the mobile internet. And it's certainly not something that any one company is going to build."

1.2. The metaverse and education: background

The 1960s and 1970s saw the development of virtual reality (VR) technology. Its origin had a pedagogical character in the form of flight simulation for the aerospace–military industry. In the 2000s, a new technological leap occurred with the incorporation of multi-user virtual environments (MUVEs) and augmented reality (AR), which harmonize, in real time and with the users' collaboration, digital information with physical information through different technological platforms (**Barroso** *et al*., 2019).

The power of immersion in the educational setting, following **Dede; Jacobson** and **Richards** (2017), depends on designs that use factors such as action, the social, and the symbolic/narrative, as well as sensory stimuli. Immersion through action involves allowing the participant in an experience to initiate actions that have novel and intriguing consequences. In the case of the social, immersion is related to reasoning processes between people who take advantage of their environment to make decisions and act in virtual spaces. With narrative/symbolic factors, it is possible to trigger semantic associations through the content of an experience. Finally, sensory immersion allows, through peripherals, an enhanced integration of the senses into the virtual space.

Immersion in connected digital environments is one of the idiosyncratic potentialities of the metaverse that is most often emphasized by authors (**Jeon**; 2021; **Kye** *et al*., 2021; **Dede**; 2009). **Kye** *et al*. (2021) also highlight the generation of a new social communication space and the high degree of freedom, "expanding student autonomy in the learning process by providing experiences form content consumers to creators" (p. 11). Telepresence (**Gandolfi**; **Kosko**; **Ferdig**, 2020) and motivation through gamified formulas (**Park**; **Kim**, 2022) are also included in this.

In general, the wide variety of analyzed educational experiences integrated into these virtual spaces offer positive learning results (**Kanematsu** *et al*., 2014; **Sung** *et al*., 2021). In this regard, **Márquez-Díaz** (2020, p. 270) points out the particularities of virtual worlds that make them attractive for students and teachers, as they allow ubiquitous learning to be combined with other forms of digital learning such as mobile, hybrid, and microlearning, where the traditional pedagogical model goes from being static to dynamic, so that the student becomes the center of the process, as in the inverted and collaborative classroom. However, **Kye** *et al*. (2021) also reveal some shortcomings, such as the processing of personal data, vulnerability to crime under the cover of anonymity, or identity problems and complex adaptations to the real world for certain types of profiles. **Ortega-Rodríguez** (2022), on the other hand, points out the shortcomings in teacher training and a lack of interdisciplinary collaboration between technology and pedagogy.

1.3. *Minecraft Education*: from global phenomenon to community of educators

Beyond the aspirational part of the metaverse, there are already some projects in which several of the defining qualities described above converge. Among these is *Minecraft*, one of the most popular since its launch in 2011. This leading position is endorsed by the data provided by **Nadella** (2021), which place the video game as one of the main platforms in the sector, with almost 140 million monthly active users and an increase of 30% year-on-year. In economic terms, this means that the creators have generated more than $350 million thanks to the more than one billion downloads and experiences in *Minecraft*. Nadella himself, in *Bloomberg* (2021), positions the idea of *Minecraft* as metaverse. This is not a novel axiom. Several authors report a direct technological, conceptual, semiotic, and functional relationship, either as a pioneering project (**Sweeney**, 2019) as one of the platforms of the metaverse (**Jeon**, 2021; **Rospigliosi**, 2021; **Shin**; **Yun**, 2022), or as a type of metaverse in itself (**Yun** *et al.*, 2021).

Tessler *et al*. (2017, p. 1553) define it as "a popular video game whose objective is to build structures, travel in search of adventure, hunt for food, and avoid zombies", considering it to be "an open research problem since it is impossible to solve the entire game with a single AI technique". The solution to advance in *Minecraft*'s general mode is to acquire skills as subproblems are solved. These skills can then be employed again when the player encounters similar subproblems. In addition to the survival mode, *Minecraft* also has a creative mode that offers the player an unlimited amount of resources without danger of death. In both modes, players have demonstrated great originality and creativity in their gaming experience. **Lastowka** (2011) understands that the purpose of playing *Minecraft* is to use the game as a creative tool. This creative action is augmented primarily by the participation and involvement of the community, which has generated a large amount of documentation, wikis, forums, tutorials, and shared diegetic worlds. Its initial partnership with *YouTube* and now with live streaming platforms such as *Twitch* has led to its being used, rather unexpectedly, as a platform for the creation of audiovisual stories. In this way, the creative possibilities of the game have exceeded the expectations for and functionalities of the program itself.

The original version of *Minecraft Education* arose from the interest of groups of teachers who saw the comprehensive potential for integrating this sandbox into educational purposes. They organized themselves through wikis and forums, and it was from this collaborative nucleus that the first pedagogical experiences and guides emerged. In 2016, Mojang Studios, together with Microsoft Studios, the owners of the license, presented the official version of *Minecraft*: *Education Edition*, integrating or deleting the content created by that initial community.

The use of video games as a learning tool in schools has increased in recent years (**Marín-Díaz**; **Morales-Díaz**; **Reche-Urbano**, 2019). On its website, *Minecraft*: *Education Edition* explicitly states that it "prepares students for the future by building skills such as creativity, problem solving, and systems thinking, fueling a passion for play" ["*prepara a los alumnos para el futuro, construyendo habilidades como la creatividad, la resolución de problemas y el pensamiento sistémico, alimentando la pasión por el juego*"] (*Microsoft*, 2022). In addition, meaningful learning, digital futures, and social–emotional skills are directly mentioned. **Alawajee** and **Delafield-Butt** (2021) report the benefits of the proposal in terms of increased motivation, language development and academic learning in subjects such as science or history. In **Sánchez-López**, **Bonilla-del-Río** and **Soares** (2021), it is specified that *Minecraft* is a versatile and open platform, and that its vision is linked to cooperation, problem-posing, and the search for solutions and cyber citizenship through project-based learning (PBL). In this regard, **Kuhn** (2018, p. 221) advocates that, when grounded in constructivist principles of learning, "the open-ended nature of play and collaborative approaches encourage student communication and context-based language use". In an analysis on the results of the project's integration into the classroom, **Callaghan** (2016) highlights that the ability to collaborate, as well as the role of the teacher, contribute to the creation of a more participatory and engaged learning environment for students with their own learning, while also obtaining concrete results. As discussed by **Hill** (2015, p. 380), such cooperation in combination with critical thinking and construction in a virtual world game environment also allows students to successfully integrate digital citizenship into an immersive learning space. **Niemeyer** (2015, p. 10), in turn, focuses on non-formal learning environments linked to Minecraft, in which participants collabora-

te, learning from each other and working together to achieve common goals. The issue of increased motivation and engagement is recurrent in the results of a large body of research (**Alawajee**; **Delafield-Butt**, 2021; **Callaghan**, 2016; **Baek**; **Min**; **Yun**, 2020). However, for **Ames** and **Burrel** (2017), the predominant culture in *Minecraft* has largely been defined by the Euro–American middle-class interaction norms established by early users, suggesting that the platform tends to marginalize later arrivals with other cultural norms and expectations. The platform also raises some suspicions regarding age appropriateness, safety, technology use, and the generalization of learning (**Alawajee**; **Delafield-Butt**, 2021).

The purpose of this paper is to analyze and describe the idiosyncratic characteristics of *Minecraft: Education Edition* as an education-oriented platform, framing it as one of the pioneering developments in the metaverse..

2. Methodology

For the extraction of the data in a first phase, multimodal discourse analysis (MDA) was applied, taking as a reference framework the model of **Pauwels** (2012, p. 247), which provides "the foundations of a multimodal framework for analyzing websites from both a medium-specific and sociocultural perspective" . MDA deals with the theory and analysis of semiotic resources and semantic expansions that occur in multimodal phenomena, taking into account the different media options and combinations available. This technique allows us to specifically address resources that are different from language, inter-semiotic expansions of meaning, and the resemantization of multimodal phenomena as social practices develop (**O'Halloran**, 2011, p. 120). This responds specifically to the multimodal nature of the *Minecraft Education* project and also facilitates the observation of intermodal relationships and their possible resemantization in the framework of the metaverse.

Following that author's criteria regarding the possibility of adapting the model to select and coding the most significant parameters according to the research objectives (**Pauwels**, 2012), section 1 of this proposal was removed. Moreover, sections 4 and 6 were integrated into a descriptive sheet, whi-

Table 1. Pauwels' (2012) multimodal discourse analysis proposal

le section 5 was incorporated into the inventory to provide greater clarity. To deepen the processing and grounding of the analysis with respect to the aim of the current work, grounded theory was applied in a second phase to arrive at an inductive theory on a substantive area (**Glaser**, 1992, p. 30), as well as the constant comparative method (CCM), which combines "the inductive coding of categories with a simultaneous comparison of all the units of meaning obtained" (**Glaser**; **Strauss**, 1967).

In this way, the information obtained was codified, while highlighting the most significant elements and a synthesis of the key points through memos. The codebook was defined following **Roberts**, **Dowell** and **Nie** (2019) on the basis of the results of the first phase of the analysis together with key elements extracted from a review of the scientific literature on the metaverse in education and analyses performed on the *Minecraft: Education Edition* platform (**Sánchez-López**, 2020). The *Atlas.ti* software was used for data analysis. Before the final processing, the final version of the coding was confirmed and validated by two external experts in the educommunication field. Returning to **Roberts**, **Dowell** and **Nie** (2019), we define codes and topics on the basis of detailed descriptions and restrictions on what can be included in each code:

Table 2. Codebook for the development of grounded theory and CCM

Code	Subcode	Definition
TE, technological enablers (**Lee** *et al.*, 2021)		Integration of technological potentials for the improvement of teaching–learning processes in digital environments
	HM, hypermedia (**Sánchez-López**, 2020)	Use and integration of hypermedia, understood as the sum of hypertext plus multimedia, for the improvement of teaching–learning processes
	IT, interactivity (**Sánchez-López**, 2020)	Use and integration of interactivity, understood as the possibility of the user to be active in a world (and social environment) and that this responds to their actions, for the improvement of the teaching–learning processes
	VT, virtuality (**Sánchez-López**, 2020)	Use and integration of virtuality, understood as the generation of binary time–spaces for the improvement of teaching–learning processes
	TM, Narrative transmedia (**Sánchez-López**, 2020)	Use and integration of the expansion of narrative elements on multiple platforms for the improvement of teaching–learning processes
	CN, connectivity (**Sánchez-López**, 2020)	Use and integration of the connection between human nodes and algorithmic nodes for the improvement of teaching–learning processes
IL, immersive learning (**Dede**; **Jacobson**; **Richards**, 2017)		Use and integration of immersion for the improvement of teaching–learning processes
	AC, Actional Factor (**Dede**; **Jacobson**; **Richards**, 2017)	Formulas to allow the user to perform actions that have consequences in the system
	SC, Social Factors (**Dede**; **Jacobson**; **Richards**, 2017)	Formulas to generate relevant social interactions among users
	NF, Narrative Factors (**Dede**; **Jacobson**; **Richards**, 2017)	Formulas to promote associations of meaning on the basis of history and the content of the experience
	SF Sense Factors (**Dede**; **Jacobson**; **Richards**, 2017)	Formulas for the integration of the senses into a virtual space

Data collection for the sample and analysis were performed during the month of May 2022.

3. Results

3.1. F1. Multimodal discourse analysis

3.1.1. Main project data

Table 3. Main identifying data of *Minecraft: Education Edition*

Project name	*Minecraft: Education Edition*
Launch year	2016
Production company	*Mojang AB*, *4J Studios*, *Microsoft Studios*
Slogans	- Stories in the classroom - Reimagine education - Anyone can teach and learn with *Minecraft: Education Edition* - Learning twenty-first-century skills
Target audience	3-18+ years
Information and context	The project contains the core of the experience, which is an adapted version of the video game *Minecraft*, along with a whole construction around a Web platform in which the educational components are enhanced. *Minecraft: Education Edition* has just released a new organization of the website, which is based on four pillars: "Discover," "Get Started," "Resources," and "Connect." The origin of the Web platform lies in work carried out by a community of teachers who also had a *Mojang AB* license for the video game through the company Teacher Gaming.

3.1.2. Inventory of main characteristics

We now present a description of the elements that make up the main sections of the project.

3.1.2.1. *Minecraft: Education Edition*

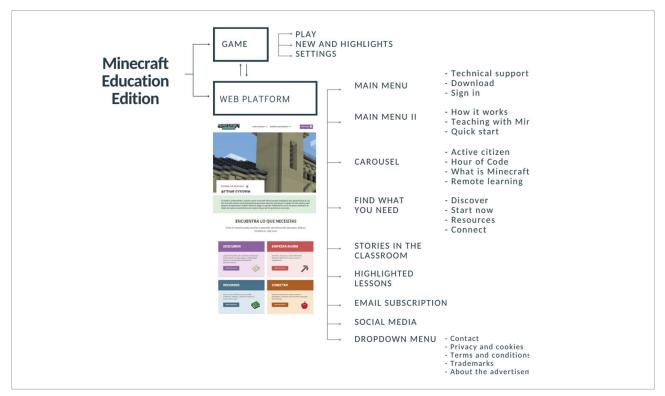Figure 1. Structure of the *Minecraft: Education Edition* platform (*Microsoft*, 2022).
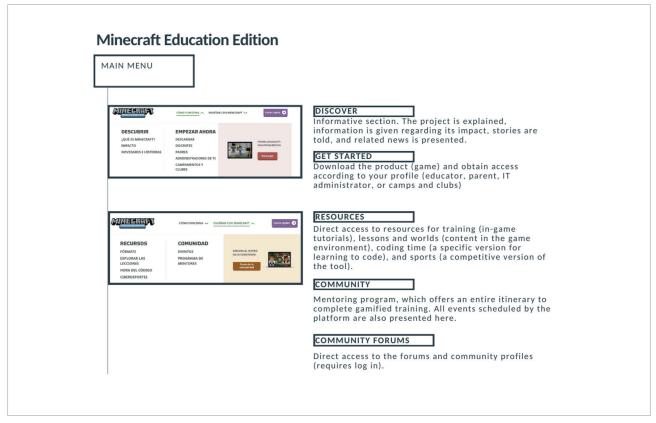
3.1.2.2. Web platform: main menu

Figure 2. Elements that make up the main menu of the Web (*Microsoft*, 2022).
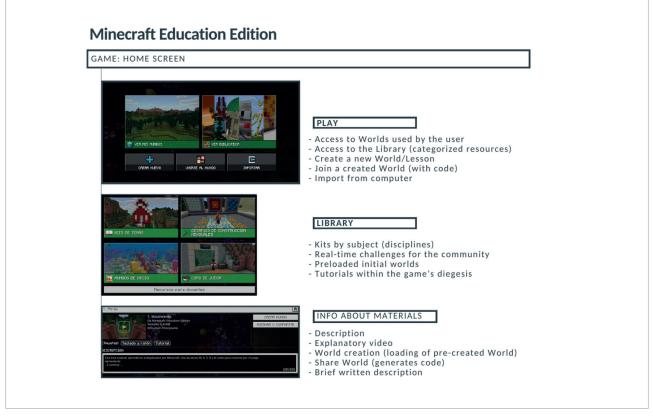
3.1.2.3. Game

Figure 3. Main elements of the initial interface of the game (*Minecraft Education Edition*, 2022).
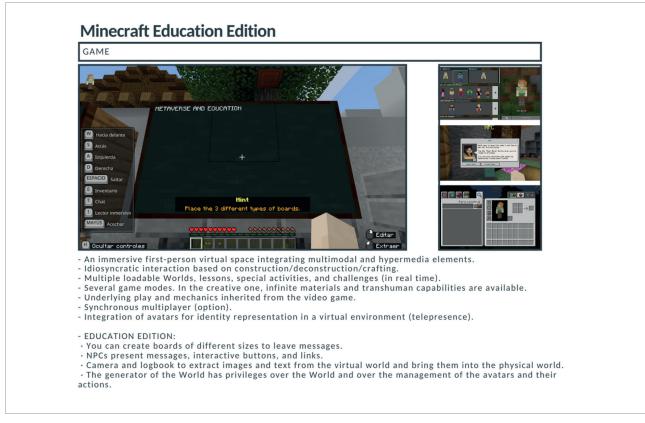

Figure 4. *Minecraft: Education Edition* game descriptors (diegesis) (*Microsoft*, 2022).

3.1.3. Intermodal analysis

This section describes the main characteristics of the signifiers that make up the content of the proposal, paying special attention to the game's diegetic universe.

Table 4. A synthesis of the signifiers, symbols, and metaphors in *Minecraft: Education Edition*

Verbal/written signifiers	The educational version introduces these into the game.

	A digital representation is used through:
	  - Boards
	  - Logbooks/portfolios
	  - Non-playable characters (NPCs)

	They are editable.
	  - The boards are informative/descriptive in nature.
	  - NPCs incorporate a dramatic nuance.
	  - Logbooks/portfolios allow the user to include their own writing.

	However, in the diegetic world, this loses importance in the face of the digital audiovisual representation.
	It continues to have significant weight specifically on the Web platform (in all its sections) and in the lesson descriptions.
Typographic signifiers	In the virtual environment of the game, the graphics exhibits its own (pixelated) esthetics.
	The Web platform uses a single representative typography, except for the logo.
Signifiers of visual representation	The game starts from an imitation of the reference world but introduces elements from the (already iconic) imagination of, and constructions by, the users.
	Pixelated blocks are its most defining feature. The objects have the same esthetic representation. These blocks are the raw material of the representations.
	The mimesis extends to biomes, day/night cycles, climatic changes, etc.
	It is dynamic: it changes depending on the World/lesson loaded and can be altered in real time. New signifiers can be created.
	The default perspective is first-person.
	The Web platform and game follow the same esthetic lines, albeit in different environments.
	The multimodal elements of the Web (videos, graphics, and images) share an esthetic universe.
Audio signifiers	The game has its own soundtrack. Minimalist music accompanies the player (depending on the world).
	A whole series of effects can be activated by the user through the avatar or the World in an independent manner.
Design signifiers	A universe with a shared graphic design on the Web and in the game.
	Elements representative of the real world in the game usually respect color analogies.
Metaphors	The universe and the actions in *Minecraft: Education Edition* could be considered metaphorical, although one might wonder about the meaning of this figure of speech in virtual contexts.
Symbols	The objects "imitated" in the virtual context have a symbolic value from the virtual–referential analogy.
	In the virtual environment, the symbol acquires the value of diegetic reality.
	The same symbolic representation is used on the Web platform, offering continuity.

3.1.4. Cross-media analysis

The following table presents a synthesis of the relationships between the multimodal components.

Table 5. Relationships between multimodal elements in *Minecraft: Education Edition*

Relationships between image/text and typography	- On the Web platform, there is an effort to reduce the importance of text, presenting very brief descriptions accompanied by images or videos. - The text still operates as a hyperlink. - These hyperlinks connect the Web platform and the game as well as the Web and game to the outside. - In the game, the text is integrated into the virtual environment, being substantiated in the diegesis. - In the presentation of lessons on the Web, more text is used.
Relationships between sound/image	- Minimalist music and images operate together in the construction of the universe. - Effects respond to the interactions of the avatars or the actions of the represented objects. - Fictional sound is generated for elements that do not exist in the reference world. - In the general navigation on the Web platform, no sound is used. - In the videos, overdubbed music and fake live vocals are used on most occasions.
General design/interactions between image, audio, and text	- The representations of virtual worlds are generated from the interaction between image, audio, and text, the latter being the least used. - Mechanics and interaction are incorporated into this triad for the generation of the experience. - In the loaded worlds, interactions occur beyond the action of the player/user. - On the Web platform, text has greater importance, but there is a trend toward reduction. - In the lessons, the proportions are reversed, with text gaining in importance.

3.2. Results of grounded theory and the constant comparative method

3.2.1. Technological enablers

3.2.1.1. Hypermedia

In the diegesis, the start menu offers limited options for direct access to the experience and settings (accessibility search). In the game experience, the hypermedia structure replicates the way the game works, with the addition of connectivity through NPC. The incorporation of predesigned experiences provides code-driven stepwise trajectories.

The hypermedia structure of the Web fulfills several key functions: positioning the products that make up the experience (Hour of Code, Active Citizen, and *Minecraft Education*), functions and services (Discover, Get Started, Resources, and Community), and facilitating accessibility and usability by presenting possible itineraries to users. It also splits the experience by profile: teachers, parents, IT administrators, and camps and clubs.

At the center of the hypermedia structure are the resources and the community. Each has its own space, but they are directly interrelated. The resources do not just present the lessons: they provide a roadmap for getting started, support, and tools to enhance teacher creativity. The community focuses on members, but also on gamified training.

Table 6. Key data about the hypermedia (HM) technology enablers code

HM code
Use and integration of hypermedia, understood as the sum of hypertext plus multimedia, for the improvement of teaching–learning processes
The Web platform fulfills the functions of accessibility (focusing on support for new users) and usability (getting the most out of everything it has to offer). The game is accompanied by resources and the community. There is a combination of codes, prioritizing the combination of text and image and video with explanatory/informative uses. Esthetically, it is governed by the design of the game. The experiences predesigned by the platform's managers are a priority, and renewed on a seasonal basis. In the game's diegesis, it is worth highlighting the strategic use of NPCs as elements to hyperlink the experience with the outside world. In addition, this educational version incorporates its own mechanics to connect the experience between the physical and virtual worlds (camera, notepad, and panels).

3.2.1.2. Interactivity

Interactivity becomes a central axis of the platform. Without this, experiences do not develop. *Minecraft: Education Edition* offers multilayered and multilevel interactivity. On the Web platform, in addition to the conventional "click and go" interactions, there is a comprehensive reinforcement of the interconnection with the community, with a tracking system between profiles, comments, etc. (social). In the game, and from the center of the avatar as an identity representation, one can interact with objects (construction/deconstruction and crafting), with other players, and with NPC. The World Generator also enjoys a whole series of privileges for the construction of lessons and the administration of the other profiles. The educational version includes various tools that are specific to the project, viz. the camera, the logbook, and the panels. The former two provide a means of interaction between the virtual world and the physical world by enabling the transfer of images and comments from one environment to another.

Table 7. Key data about the interactivity technology (IT) enablers code

IT code Use and integration of interactivity, understood as the possibility of the user to be active in a world (and social environment) and that this responds to their actions, for the improvement of the teaching–learning processes

From its recreational base, the tool expands the possibilities of interactivity in the virtual environment of the game and the Web. One can note:
 	
    - Community enhancer. System to enhance interaction between administrator profiles.
    - Narrative enhancer. Tools are incorporated to create a narrative to accompany the lessons.
    - Creative enhancer. Ability to build, destroy, and craft.
    - Agency enhancer. Protagonism through the avatar and the power to act and transform the Worlds (with separation of status).
    - Entertainment enhancer. Origin in the video game and its mechanics, although it will depend on the use of the Administrator.
    - Immersive social enhancer. Tools to encourage interaction between profiles in the virtual environment.

3.2.1.3. Virtuality

Minecraft: Education Edition combines two types of virtuality: a typical multimodal desktop interface (Web 2.0) and one close to virtual reality (immersive environments with telepresence and interactivity). The virtual Web generates a community space and a repository of resources with identity (with registration as a starting point).

In the case of the game, there are multiple worlds with a common base of physics, esthetics, and mechanics, although configurable and, above all, editable. The worlds are created by the administrators and can be modified by the students. Once the playable tutorials are completed, the platform is oriented toward synchronous lessons in a multiplayer environment with real-time interaction.

Table 8. Key data about the hypermedia technology (HM) enablers code

VT code
Use and integration of virtuality understood as the generation of binary time–spaces for the improvement of teaching–learning processes
The recreation of an iconic (and, in this case, popular) virtual space is a marker of identity and affection for the project. From the centrality of the registry and the avatar, the participants assume a role in the experience (identity) and a presence in the environment. Their ability to create or transform the didactic experience brings them into the realm of agency and protagonism. Interactions with third parties in real time in the diegetic space give it a social character. *Minecraft*'s playable base, along with its open-ended nature, the quantity of doable actions and tools, and transhuman abilities (such as flying), offer an exponential creative base when it comes to approaching lessons. In addition, those responsible for the platform (*Minecraft: Education Edition*) also offer their own itineraries, usually generated in partnership with third parties, where the story (narrative) takes on special relevance.

3.2.1.4. Transmedia narrative

The construction of *Minecraft: Education Edition* starts from an appropriation of the fandom formed of the teachers who started using the game for didactic purposes. This offshoot was reacquired by the root company with Microsoft's purchase of Mojang.

Representing the vital center of *Minecraft*, the transmedia vectors have diversified with expansive development of the story (*Minecraft Realms*, *Minecraft Story Mode*, etc.), versions based on new hardware (VR, Hololens, etc.), and media reappropriations (*machinima* on *YouTube*, gameplay on *Twitch*, etc.).

In the *Education* version itself, a series of expansions have been introduced over time. The Hour of Code or Active Citizen versions of their Worlds offer major extensions with different purposes for the developing platform. In addition, each new world/lesson generated by the users can be considered to represent an expansion of the educational universe.

Table 9. Key data about the transmedia technology (TM) enablers code

TM code
Use and integration of the expansion of narrative elements on multiple platforms for the improvement of teaching–learning processes.
The fandom of the main product (the *Minecraft* video game) draws part of its community to this educational version. The adoption of worlds by using the World Generators creates a role that goes beyond prosumer, entering into the dynamics of content creators (didactic), with this aspect being the essence of the platform. The platform thus puts its expansion into the hands of users by offering an immersive virtual environment and a whole series of tools. Regarding such transmedia relations, it is worth mentioning the interest of the platform itself and its authors in updating and expanding its universe, both with technological innovations (the incorporation of new functions, tutorials, and versions) as well as in relation to content and its diversifying didactic purposes (thematic deepening, code learning, etc.). Connections to third parties (companies and institutions) are also interesting, pointing to collaborations at a macro level (beyond the internal relations of the users).

3.2.1.5. Connectivity/socialization

The platform offers a twofold approach to enhance the connective experience: the Web, with a social environment for teachers similar to that of a social network but based on projects, and the diegetic game, based on interaction between avatars (the learning community as a whole) with chat and interactivity as the main tool for intercommunication, plus hyperlinks to the outside world through integrated links via NPCs.

Social networks themselves would also imply a connective expansion, but it is via external appropriation (unofficial uses) that more content is produced, and with higher rates of impact and interaction.

Moreover, the digital experience is transferred to the physical space, integrating a calendar of face-to-face activities both on the Web platform and in the video game interface.

Table 10. Key data about the technology connectivity (CN) enablers code

CN code
Use and integration of the connection between human nodes and algorithmic nodes for the improvement of teaching–learning processes
The core of the development represents a connective basis in a meta-structure: On the first level, we find the connection between teachers on the basis of identity (registration) and projects. On the second level, that of the diegetic experience, the multiplayer environment, together with interactivity, enable a whole series of social relationships, with the avatar as a base. The platform and game make up a compact, integrating experience, operating without the need for third parties. The opening up to other Internet spaces occurs on a very ad hoc basis on the Web, and is made possible through the NPC links in the game (manageable by the World Generators). A physical layer is promoted over the virtual layer, with the programming and dissemination of events and community meetings.

3.2.2. Immersion for learning

We use the taxonomy of **Dede**, **Jacobson** & **Richards** (2017), to delve into the actantial, social, narrative and sensory factors presented by the Minecraft Education platform. The extracted data will allow us to identify its proposal as an immersive environment, one of the nuclear qualities of the metaverse and its associated phenomena.

3.2.2.1. AC code: actional

Agency is configured through identity. The introduction of the avatar enables what one could call a transreal identity and thus the nondirect translation of the physical subject to the virtual space.

Its prominence is reinforced by design options, such as the subjective plane, but above all through interactivity. In *Minecraft: Education Edition*, users are given the power to transform the diegetic universe and experiment with the ability to create, destroy, and craft. The pixelated blocks, in this sense, are not only esthetic elements that allow for recognition of and feelings in the world, but also behave as units of meaning. In their creation or destruction, they compose symbolic and metaphorical elements within the environment.

The platform offers skills that do not exist in the referential world, which can provide differentiated approaches to learning. In addition to transhuman abilities (flying, for example), there is a redimensioning of time (for skills such as building, cooking, farming, etc.) and space (teleportation).

Since it is the intervention of the users that ends up building the experience based on a world or lesson designed by the teacher, the design of the lessons or the establishment of objectives becomes especially importance, since these are the features that enable the participating community to operate in pursuit of an end.

3.2.2.2. SC code: social

Socialization in *Minecraft: Education Edition* operates on three interconnected levels: two official ones, along with a third aspect based on appropriation. The Web platform reinforces the community connection on the basis of projects through a system similar to that of social media (likes, shares, and comments). This sociability is based on an identity registry, and also offers a whole system of empowerment based on accompaniment and support (tutorials, forums, and technical help) and recognition (status through gamification).

In the virtual world, the multiplayer component, interactivity, and chat are the enhancing elements (enhancers), allowing the whole participating educational community to congregate in the same virtual space–time. The relationships developed between the profiles will depend to a great extent on the previous preparation work and the educational project generated by the teacher, parent, or IT manager (the profiles defined by the platform). There are no preconceived social rules. The only rules are established by physical and mechanical rules. In this sense, administrators enjoy a series of privileges that make them hyper-empowered users (superusers), with capabilities such as limiting functions, "physically" controlling the student body, placing physical barriers in the world, or muting profiles during sessions. In a way, this represents a type of self-regulation in which the teacher has an *auctoritas* that is reinforced by their privileges in the system.

In terms of external socialization (outside the platform), the Web offers the option of configuring personal networks from one's account, although this dimension is not promoted. Indeed, *Minecraft: Education Edition* functions as a self-contained, integrative experience. However, this does not exempt it from containing the third aspect mentioned above, viz. the appropriation and creation of multichannel content by its users. A special confluence with external platforms such as YouTube, Twitch, and social networks is observed. Its use is often linked to mentoring (tutorials) or to the dissemination of personal creations and experiences.

The first differentiating factor of *Minecraft: Education Edition* that drives the generation of a community is the fandom surrounding the original video game. The popularity of the game and the recognition and empathy it generates thus extend toward the educational project.

3.2.2.3. NF code: narrative factors

Minecraft does not have a predetermined base story, but it does have a universe with its own laws and cycles (temporality, different spaces and biomes, etc.). Its audiovisual characteristics, together with its mechanics, make it an identifiable space–time, which favors the integration of the user into the diegetic space. The story is told through the users' interaction with this universe, through has its own rules of operation.

This extreme freedom offered by the game can lead to chaos, which is why in *Minecraft: Education Edition* the lessons and worlds take on special relevance. Lessons indicate objectives, processes, and goals. The influence of PBL is clear in this regard. The worlds are the ones that provide the environments and the mechanics (if any) in which the lessons will take place. With the design of the worlds, a narrative is also being constructed.

The administrator, through their lessons and the recreation of the worlds, is the one who decides how to incorporate the narrative (as well as the dramatic) component. In this regard, there is a second factor to take into account: participants may alter the proposed storyline through their own actions (for example, by ignoring the administrator's instructions).

In addition, the company responsible for *Minecraft: Education Edition* has continued to publish itineraries for worlds and construct lessons on very specific themes and objectives in which the story takes on a fundamental value ("Active Citizen," "Hour of Code," etc.).

3.2.2.4. SF code: sensory factors

The *Minecraft Education* experience introduces its participants to an immersive universe in which the protagonism resides mainly in an idiosyncratic, three-dimensional visual section (pixelated blocks), but which is also reinforced in a very significant way by the musical setting (with its own soundtrack) and effects. The experience does not so much pursue realism as recreate a universe of its own in which the avatars are introduced with a subjective perspective. When using virtual-reality peripherals, telepresence and the transition to a digital space are reinforced at the sensory (especially visual) level. However, this version has not achieved the same popularity as the screen-based version, suffering from various obstacles such as the price of the kit, the bulky nature of the hardware, or the prevailing feeling of dizziness during prolonged use.

Through peripherals (mouse, keyboard/control, screen, and speakers), a high level of immersion in the *Minecraft* universe is achieved, without any diegetic integration of the senses of touch, taste, and smell. This follows the dominant technological line of contemporary audiovisual developments. With certain peripherals, there is a representation of haptic experience through vibration. The evolution of devices and diegetic universes may lead us to ask whether, phenomenologically, there is a different sensory dimension in the digital–virtual realm.

4. Conclusions

Minecraft: Education Edition was one of the pioneering projects to integrate educational objectives into experiences before the introduction of the metaverse. **Nebel**; **Schneider** and **Rey** (2016, p. 362) point out that, originally, "the simple sharing of worlds, creations, modifications, lessons, and experimental setups between teachers and researchers around the world without strong software restrictions" was what boosted its unintended use as an educational tool.

The current analysis reveals some of the potential of *Minecraft Education* to drive learning in a connected immersive environment.

First, the suggestive force of its own universe is highlighted. In the diegesis, we find a recognizable world with the ability to attract the fandom of the original video game to an educational environment. The interactive multimodal composition of the space in which the action takes place is presented as a differentiated media layer with respect to traditional text, and what **Price** (2020) criticizes as "pedagogical practices and the assessment of students' work based on literary models common in educational structures". Literacy thus moves from textual literacy to three-dimensional multimodal mediation.

A connective layer is added through the Web to the diegetic universe, and in that connected structure, the developers highlight three of the elements that they intentionally aim to enhance via the platform: identity, agency, and community. The latter two coincide with the actional and social factors collected by **Dede**; **Jacobson** and **Richards** (2017) for a meaningful learning experience in an immersive environment.

The identity aspect is provided, firstly, by registration through the Web (with metadata from the personal account), and secondly, through the users' selection of a diegetic avatar. The avatar, as a representation of the individual in virtual space, acquires special relevance in their projection into the metaverse. **Park** and **Kim** (2022) point out that it is an ideal shape that projects an outward appearance and reflects the ego. They also explain that younger generations consider the social meaning of the virtual world as just as important as that of the real world, since they think that their identity in virtual space and in reality is the same. In the case of *Minecraft: Education Edition*, this may not be obvious. Indeed, it provides more of a fictionalized projection of the self in a divergent environment with respect to physical space, unlike what might happen with self-representation on social media.

This identification of the "I" is what facilitates agency in the first instance; moreover, it provides the capacity to act and modify the virtual world from a personal or personalized perspective. In this sense, the avatar has a whole series of abilities that allow it to transform the diegetic environment, such as building, destroying, crafting, etc. Here we see the importance of having the ability to transform the universe, i.e., to cause changes in the system, although this does not substantially imply a link with empowerment. Such power is strengthened or weakened through the design and implementation of lessons and worlds, as well as extra-diegetic interaction through the community and forums.

Another idiosyncratic feature of this capacity of an agent lies in the transhuman capabilities. These are actions such as flying or teleportation in space, which can add value regarding the physical limitations of the real world. This redefinition of the relationship with virtual space–time already offers interesting options today, such as time travel to a representation of past epochs within the virtual diegesis. Agency, considered strategically, translates the learner from the realm of reception to that of emirec or prosumer depending on the approach, in what **Hill** (2015, p. 380) determined as a participation "as prosumers in digital culture" since they contribute content themselves, in addition to consuming it, "which illustrates the constructivist theory applied to the concepts of information literacy". However, *Minecraft* currently limits this role by not proposing a base option for students to generate worlds or lessons.

The mechanics, capacity for advocacy, and social system define an approach oriented toward creativity in the very gene-sis of the platform itself. The association between gameplay in the field of video games and creativity is a phenomenon that has been researched by various authors (**Blanco-Herrera**; **Gentile**; **Rokkum** 2019; **Jackson** *et al.*, 2012). On the pla-tform, this is especially reinforced for administrators, who benefit from a whole armamentarium of virtual resources for the creation of Worlds. In this sense, the categorized hypermedia presentation of the community's work, the gamified social system of profiles, and the forum itself are presented as elements that value creative action, recognize the work done, and accompany individuals during their construction processes.

The general community in *Minecraft: Education Edition* is reinforced in the platform in three areas: identity and agency, projects (lessons and worlds), and accompaniment (support). In the beginning, the wiki and the forum reached a higher degree of interaction. Currently, the extra-diegetic priority space is given over to mentors (certified teachers), forums, lessons, and worlds. In the diegesis, an immersive MUVE is provided, together with the chat, thus enabling constant, real-time interaction between agents as well as between agents and the environment within the virtual space. However, this participatory environment does not imply, per se, that the learning process is effective. **Dede**; **Jacobson** & **Richards** (2017) specify that it is necessary to go a little further. In this case, they propose that, "by mastering complex knowledge and sophisticated skills, students learn well in a Plan, Act, Reflect (PAR) cycle" [*"al dominar conocimientos complejos y habilidades sofisticadas, los estudiantes aprenden bien en un ciclo a Planificar, Actuar, Reflexionar (PAR)"*]. They thus first prepare for an experience that involves doing something they want to master, then they attempt that performance, and finally, they evaluate what was actually achieved.

In this infinite procedural environment, and with the great capacity for individual users to interact with the universe, the option that has prevailed in *Minecraft: Education Edition* has been to grant privileges over the Worlds and over the participants to the senior profiles (IT, parents, and teachers), and to place the meaning of the experiences in the lessons. It is these, created by educators, that give meaning, objectives, and purpose; They set the rules to avoid chaos. The narrative of the lessons, along with their readiness in the reference world, is what establishes what **Lee**; **Zhou** (2021, p. 44) call "social acceptability" and "trust and accountability." In this sense, the figure of the administrator (IT, parents, and teachers) receives *potestas*, with the possibility of muting participants or moving them to certain points on the map. Depending on the administrator, a vertical and reproductive educational experience may be generated, or dialogic and horizontal criteria may be chosen for the sessions.

On the basis of this short reflection on our analysis, the criterion of immersion as an element that enhances learning, whose nuances are confirmed by nearly all the authors consulted (**Jeon**, 2021; **Kye** *et al.*, 2021; **Dede**, 2009), is seen to be relative. **Dede**; **Jacobson** & **Richards** (2017) present it as a core element for motivation and learning in some respects but are also aware of its limitations. From our point of view, no such environment is more immersive than the real thing yet. The added value of learning from the metaverse will have to be built on its differentiating functionalities with res-pect to physical reality (such as connectivity between global communities, the creation of universes inspired by worlds that no longer exist, or telepresence, diegetic teleportation, and the ability to fly in the approach of *Minecraft: Education Edition*), beyond immersion and simulation.

From a technological perspective, *Minecraft: Education Edition* offers a whole series of tools that, with thoughtful exe-cution, have the ability to drive well-defined objectives of the learning experience, especially if specifically designed to be executed within their ecosystem (to use the term used by **Lee** *et al.*, 2021). Virtually all articles investigating the sui-tability of integrating *Minecraft* into educational spaces put forward arguments in favor of it (**Niemeyer**; **Gerber**, 2015; **Dezuanni**, 2018; **Callaghan**, 2016). However, it is pertinent to recall at this point **Kaplún** (2002), who pointed out the strong permanence of "the communicational conception of sender/message/receiver", warning of the possibility that, "if digested ideas continue to be deposited in those who do not know, no matter how progressive the content may seem, we will continue to contribute to authoritarian, vertical and unidirectional communication" (p. 24).

Identity, agency, creativity, and community suggest a line of educational development applicable to both metaverse and physical world logics. In the transition to a digital immersive reality, *Minecraft: Education Edition* (with the exception of special lessons created by the platform itself) leaves the power and authority over the educational process in the hands of teachers, parents, and IT managers, thus repeating the preestablished patterns in the physical world. This will there-fore determine whether the teaching–learning dynamics are oriented toward what **Zimmerman** (2000, p. 43) calls "a different approach to develop interventions and create social change", or if, on the contrary, those same tools are used to maintain symbolic violence, understood as the imposition of meanings as legitimate in pedagogical action (**Bourdieu**; **Passeron**, 1979).

Regarding the limitations of this study, restricting the sample to a single platform is a disadvantage when it comes to extending the results to the metaverse. Moreover, MDA is not effective when it comes to gathering the opinions and ideas of a fundamental component such as that of the users (in this case, of the platform). Along these lines, a possible avenue for future research would be to expand the technique to include a questionnaire and a focus group to gather the opinions of users as well as to increase the sample to a greater number of platforms.

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