Multimodal Technologies and Interaction

MDPI

Article

Connected Play in Virtual Worlds: Communication and Control Mechanisms in Virtual Worlds for Children and Adolescents

Yao Du [1,*], Thomas D. Grace [2], Krithika Jagannath [2] and Katie Salen-Tekinbas [2]

[1] Department of Speech Language Pathology, Monmouth University, West Long Branch, NJ 07764, USA
[2] Department of Informatics, University of California, Irvine, CA 92697, USA; tgrace@uci.edu (T.D.G.); kjaganna@uci.edu (K.J.); ksalen@uci.edu (K.S.-T.)
* Correspondence: yadu@monmouth.edu

Abstract: Technology plays an essential role in shaping youth's communication and social interactions in online multiplayer games. Due to physical distancing restrictions during the COVID-19 global pandemic, online multiplayer games like *Minecraft* and *Roblox* are well-positioned to amplify healthy communication/social connections and mitigate the impact of social isolation. Research so far has been focused on how these gaming environments support youth development from the perspectives of individual stakeholders (e.g., caregivers, educators, designers, and developers). However, features of these games, such as communication and parental controls, are often misaligned with the ways in which children develop communication and social skills. Using a series of case studies of popular virtual worlds and online games, this paper provides an analysis of critical design features that serve youth throughout different stages of childhood and early adolescence. We offer three main contributions: (a) a comparison matrix of similarities and differences in communication and control features between platforms; (b) an evaluation of design features in selected virtual world platforms that promote safe and positive social interactions; and (c) a method for cross-platform comparison aimed at helping researchers, designers, and practitioners examine specific dimensions of social communication and play experience in virtual worlds.

Keywords: virtual worlds; online multiplayer games; communication; children and adolescents; parental mediation and control

check for updates

Citation: Du, Y.; Grace, T.D.; Jagannath, K.; Salen-Tekinbas, K. Connected Play in Virtual Worlds: Communication and Control Mechanisms in Virtual Worlds for Children and Adolescents. *Multimodal Technol. Interact.* **2021**, *5*, 27. https://doi.org/10.3390/mti5050027

Academic Editors: Kiley Sobel and Emeline Brule

Received: 2 February 2021
Accepted: 14 April 2021
Published: 11 May 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

The COVID-19 pandemic has led to a surge of temporary closures in educational settings and outdoor playgrounds, resulting in an increased number of youth transitioning from in-person learning and play environments to online gaming platforms. Before the pandemic, virtual worlds (VWs), such as *Poptropica*, *Whyville*, *Roblox*, *Minecraft*, and *Habbo Hotel*, have been popular digital spaces that attract millions of youth to socialize and develop friendships using creative and imaginative play [1–6]. Online VWs offer different types of collaborative activities in which youth, including neurodiverse populations [7,8], can participate. Activities include engaging with gameplay narratives to solve problems and challenges, forming teams or "guilds" to collaborate and organize events, creating visual design such as making avatars and decorating assets, practicing digital literacy skills such as coding and writing, and developing scientific habits of mind through roleplay [9–13]. Playing in these online gaming platforms also fosters a sense of belonging and supports friendship development, which is essential for youth's socio-emotional development.

In order to maximize the aforementioned play experiences, players need to communicate while collaborating and socializing. Communication and control tools in online gaming platforms enable youth to not only participate in gameplay together but also engage in social and distributed learning through a network of interconnected people [14]. These communication and controls are typically designed differently based on individual platform features and available tools. For instance, communication tools may include

both text- and voice-based communication (e.g., in-game chat and forums, third-party servers such as Discord [15] for participating in other meta-gaming ecosystems beyond the gaming platforms themselves [16,17]; control tools include parent dashboards and customization features which determine specific content that could be enabled for young players. Investigating the different types of communication and controls in digital games can help researchers unpack the complexity of social interaction enabled by the game [18], such as how players collaborate to solve quests, build and create structures and worlds together, or compete against each other. Online virtual world platforms support rich multimodal social interactions among players, including text-chat, voice-chat, and/or video chat [19,20]. However, it remains uncertain how these platforms are being designed for age-appropriate development. A systematic analysis of platform design features and the various socio-behavioral outcomes associated with the platforms can help designers attend to child players' developmental needs and identify the features that promote prosocial behaviors.

It is unclear how age-appropriate socio-technical design features (e.g., parental control, communication moderation) are implemented for youth across different developmental stages [19,21]. Examining and evaluating different VW communication and control features allows researchers to understand how to design age-appropriate and engaging virtual learning spaces that minimize toxic communication and behaviors and promote positive communication and social-emotional development [18,22–25]. In this paper, we first evaluated platform information (e.g., player, developer, gameplay, communication and moderation, social interaction, parental controls) across 22 popular VWs ranging from 1994 to 2020. Drawing on this 23-year evaluation and review of VW platforms for children from pre-childhood (age five) to early adolescence/tweens (age 11 to 18), we then conducted an in-depth feature analysis. The analysis focused on 10 core platforms and compared the communication and control features that enable and/or restrict children's social interaction. Finally, we used three examples, namely *Whyville*, *Autcraft*, and *Roblox*, to illustrate how multimodal communication and control features influence youth's participation in gameplay and freedom to connect and socialize in VWs.

1.1. A Developmental Lens to Understand Online Virtual Worlds

Investigating the design of communication and control tools of different online VWs for children and adolescents is a complicated task. Children and adolescents need space to develop social competence across various settings in their offline and online lives as they prepare to become active, responsible participants in various communities [26,27]. VWs are online platforms that have the potential to mediate and facilitate interactional opportunities through which youth can learn social skills and develop social identities as they transition through several developmental stages into adolescence [4,28]. Consequently, the design of platform features needs to be aligned with various age-appropriate/developmentally appropriate communication and social interaction related needs of adolescents.

Neuroscientists and social psychologists contend that social play, a critical activity that facilitates social skills, is likely regulated and influenced by complex genetic manifestations, environmental experiences, and psychosocial milestones throughout human development [29,30]. Some researchers further hypothesize that play can be influenced by the social-emotional experiences specific to an individual's learning, behavior, and development of knowledge and skills [31]. Beals and Bers [32] describe six critical components of virtual worlds: (1) purpose, (2) communication, (3) participation, (4) play, (5) artifacts, and (6) rules, all of which are used differently across various stages of development for young children (under five years old), children (between six and 10 years old), tweens (10 to 12 years old), and teens (13 to 18 years old). Factors including player experience and preferences, motivation for play, interpersonal understanding, and knowledge about relationship building and friendship vary depending on the developmental phases from childhood to adolescence [33–35]. For example, during social play, younger children are driven by imaginative fantasy play and external rewards, whereas older children and

adolescents are driven by competition and challenges [36]. While preschoolers establish friendships and reciprocal exchanges, they may enjoy exchanges of concrete materials (e.g., gifts and rewards), whereas adolescents and adults emphasize mutual support, exchange of confidences, and trust [37]. When considering communication within the game, pre-literate preschoolers are unable to communicate via text-based communication channels and thus require alternate means of communication (e.g., symbols, icons, spoken messages), whereas older children can compose writings of extensive length on message boards and through in-game mails within the game [32].

While domain-specific knowledge (e.g., computer or information technology literacy) can be developed at any point in children's lives, research strongly suggests that social and emotional skills (e.g., the ability to emphasize and cooperate with other group members) developed in the early stages of life can significantly determine their own well-being later in life [31,38,39]. Research also suggests that games offer authentic opportunities for developing social and emotional skills through role playing within game narratives and social interactions [40–43]. In addition to designing gameplay mechanics, understanding social development in youth players allows design practitioners to create platform features that meet developmental needs. A thoughtfully designed environment gives youth freedom to communicate and play at younger ages and supports the development and growth of positive in-game relationships and the psychological well-being [44,45].

1.2. Multimodal Communication and Control Features

While online games designers often face challenges moderating toxic communications and behaviors [46], there has been limited research examining the relationship between communication channels, parent controls, and player's social interaction. Reich et al. [47] define the "technology of communication" as "ways for selecting, finding, playing, and communicating with friends." In VWs, there are different types (e.g., asynchronous and synchronous) and modes (e.g., text-based, voice-based) of communication [48]. Mechanisms that support in-game communication include private messaging and group chat, whereas outside game communications can happen elsewhere on the internet via text-based platforms (e.g., websites and blogs), as well as multimodal online communities (e.g., Discord and Instagram), where text, images, and videos are generated and exchanged synchronously and/or asynchronously [19,39].

As youth develop adequate literacy skills to read and type, they transition from controlled communication with restricted chat features (e.g., selecting platform-enabled bubble chat rather than free text entry) to a spectrum of possibilities that involve multimodal communication channels (e.g., text, images, emoji, and voice chat). Understanding these platform features can help not only platform designers and developers who create these communication and control systems, but also platform users (e.g., parents and teachers) who manage these systems for young players to safely communicate and socialize online. These communication features are critical design components as they may enable or restrict player communication. For example, Jiang et al. [49] interviewed moderators on *Discord* and found that, compared to text-based communications, moderating content and interaction (e.g., rule-breaking behaviors) in voice-based online communities is especially difficult. Voice-based communication is ephemeral unless specifically recorded by the platform or users; moderating online voice chat can be difficult due to technical difficulties in monitoring and filtering incidents of derision, harassment, and aggression during verbal communication [35,50]. This prompts parents and other caring adults to take on a restrictive approach to manage the communication and control systems on behalf of youth to ensure online safety for the latter [51]. Furthermore, even text-based communication platforms may not necessarily implement rigorous human moderators; instead, they tend to rely on customized controls by adult caregivers who frequently select more restrictive controls for younger players which may limit their online experience [51].

When children and adolescents engage in online play, toxic behaviors (e.g., online harassment, cyberbullying, sexting) can emanate from not only in-game actions, but also

from the communication between players within and outside of gameplay [52,53]. There is a significant gap in research regarding how designers should balance the various degree of communication control features for safety purposes while also creating avenues for parents and other stakeholders to guide and support youth's development and learning [46]. After interviewing parents in 25 European countries and surveying more than 20,000 youth aged 9 to 16, Livingstone et al. [54] found that only about 25% of parents reported that they blocked, filtered, and/or tracked websites visited by their child; one in eight parents do not appear to provide any mediation of their children's online activity. These multi-stakeholder challenges reveal a critical need to investigate how in-game and communication activities can be moderated, and toxic behaviors mitigated, through design interventions. Such investigation is vital for preventing the hindrance of youth's social-emotional development and identifying and promoting essential scaffolding of their social experiences during social interaction in VWs.

2. Methods

2.1. Develop Platform Search Procedure and Inclusion Criteria

To examine communication and control features across a wide range of online platforms, we applied a 3-step search approach to develop a historical review of popular platforms representating the existing digital landscape for both children and adolescents. First, using two conceptual categories—gaming platforms (e.g., "sandbox games", "virtual worlds", "multiplayer games") and youth (e.g., "children", "kids", "teens"), we conducted a keyword search using ACM Digital Library and Google Scholar, social media websites (e.g., reddit.com), and game review and recommendation sites (e.g., gamstat.com, mmogames.com). Next, to include prior publications that have investigated existing VWs for youth, we conducted a literature review search of the platforms that were identified using the keyword search and generated a list of additional platforms based on academic publications [21,32,47,55,56] and industry and government reports [57–59]. Last, we conducted a focused search of a subset of platforms branded as "child-friendly" and "family-friendly" using ratings and reviews from multiple youth media and digital game sites (e.g., Common Sense, ESRB, kidssafeseal.com). These search terms and procedures helped us ensure that our platform selection includes a wide range of age groups of players.

The initial search generated a list of 35 platforms, with the oldest platform *JumpStart 3D* launched in 1994 and the newest platform *Fortnite* launched in 2017. These platforms offered a 23-year historical overview of some of the most popular VWs for youth. Popular platforms such as *Fortnite, Minecraft,* and *Habbo Hotel* have a registered user base of more than 250 million players in over 150 countries globally. Educational technology (ed-tech) companies own five platforms, namely *Whyville*, *Poptropica*, *Animal Jam*, *JumpStart 3D, and Secret Builders*, whereas entertainment companies own the other 17 reviewed platforms. In order to conduct an in-depth analysis of each platform, 22 virtual platforms were selected based on the following inclusion criteria:

- An active web platform where players can play and communicate with others.
- Public records of at least one million registered users by November 2019 as the lowest threshold to indicate the popularity and broad adoption of the platforms.
- Pre-existing online reviews and ratings for the appropriate age of players.
- Recommended player age(s) that include youth and/or adolescents on platform self-disclosure, Common Sense, and/or ESRB.

We purposely excluded platforms that are no longer active such as *Club Penguin* [27,60,61], as well as mobile-only platforms, so that we could focus on a comprehensive review of platforms that initially started in the web-based era. Platforms that primarily operate on family-oriented game consoles were also excluded, as the nature of these platforms are more versatile and purposely designed for offline group play. These criteria ensure our selected platforms are consistent with web-based platforms, as new gaming platforms may have features that take advantage of newer technology that prior web-based platforms may be unable to offer.

2.2. Coding, Evaluation, and Representation of Platforms

To evaluate the 22 selected platforms, we analyzed multiple sources of data (e.g., individual platform websites, third-party media sites, forum discussions, online posts) and created a codebook using both deductive and inductive approaches [62]. The codebook consisted of a variety of subcategories developed to cover six major thematic categories illustrating player, developer, and gameplay information, as well as communication and moderation, social interaction, and parental controls (Table 1). Such coding enables the evaluation of a diverse pool of platforms and analysis of features that impact youth's communication and control during online play.

Table 1. Themes and subcategories for the 22 platforms.

Thematic Categories	Subcategories
Player Information	Product listing of user age, reviewer site recommended user age, age range, platform user size
Developer Information	Developer name, type, product launch date, compatible platform, business model
Gameplay Information	Game environment, game genre, player type, gameplay mechanics and modes
Communication and Moderation	Modes of communication, types of moderation, content to be filtered/moderated, degree of freedom for communication
Social Interaction	Structures for team formation, event organization, friendship building, reputation building, and community participation
Parental Controls	Safety and privacy controls, community rules, and compliance to policies (e.g., COPPA [1])

[1] COPPA stands for "Children's Online Privacy Protection Act".

We used multiple sources (platform websites, Common Sense Media, and ESRB ratings) to triangulate the recommended player age range (Figure 1). It is important to note that age recommendations for players, one of the most important metrics of our analysis, vary across these three data sources. For example, on its platform website, the popular game *Habbo Hotel* is designed for players 13 years old and above; however, Common Sense Media rated it an 18+ game, and it has no ESRB rating. Another example is *Roblox*, which has no specific age groups for players listed; however, both Common Sense and ESRB rated it as appropriate for youth aged 10+. Instead of specifying a target player range, *Roblox* highlights its customized parental controls and delegates parents to "limit or disable online chat capabilities and restrict access to a curated list of age-appropriate games" [63]. We utilized the lowest age ratings from three data sources for the platforms that did not have consensus in age specification.

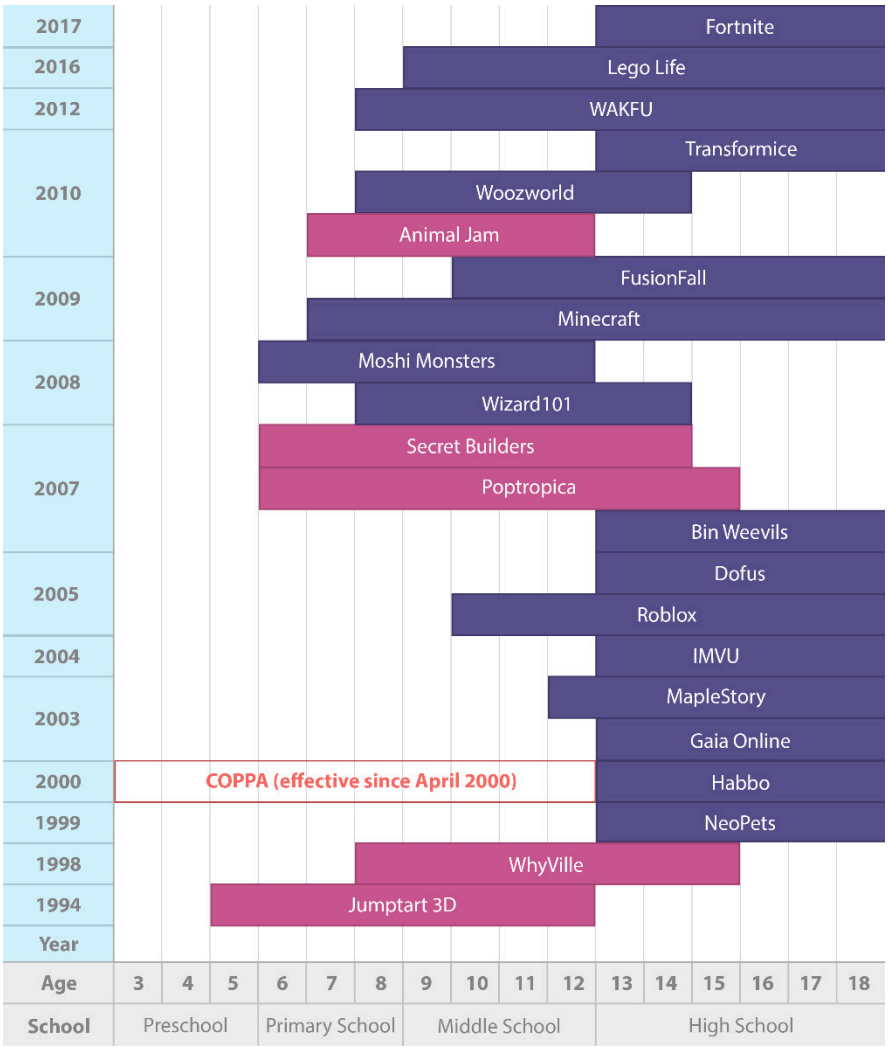


Figure 1. Historical overview of selected platforms by target player age range and platform initial launch year. Pink denotes platforms developed by ed-tech technology companies, and purple denotes entertainment technology companies.

2.3. An Analysis of 10 Representative VW Platforms

Reflecting on the core features that emerged from the initial round of analysis and building upon prior research, we selected a total of 10 platforms (Table 2) for a detailed analysis of social design features. These 10 platforms included five platforms developed by entertainment companies (*Fortnite, Habbo Hotel, Neopets, Roblox, and Minecraft*) and five platforms developed by ed-tech companies (*Whyville*, *Poptropica*, *Animal Jam*, *JumpStart 3D*, and *Secret Builders*). These 10 popular platforms were selected based on a rubric that we developed to cover a wide variety of genres that are popular across different developmental age groups and have been discussed in prior literature and industry research. As our study is focused on prosocial behaviors, we drew player profiles from prior literature that are shown to support collaborative, social, and creative play. We also included three broad developer groups to cover platforms developed by users as well as corporations and smaller title owners. Based on these rationales, the inclusion criteria for the 10 core VW platforms include:

- Diverse youth across age groups based on developmental age groups [32,64]: young children (3 to 5 years), children (6 to 10 years), and tweens and teens (11 to 18 years)
- A diverse range of game genres as described by Heintz & Law [65]: action, adventure, simulation, building, puzzle-strategy, role play, open world, etc.

- A diverse range of player profiles described by da Costa et al. [66]: explorer, builder, socializer, nurturer, fighter, etc.
- A mixture of developer backgrounds: parents and fans (e.g., *Autcraft* server of *Minecraft*), educational technology companies (e.g., National Geographic Society), and entertainment companies (e.g., Epic Games)
- A mixture of platforms that have been previously investigated by researchers, such as industry reports and research articles.

Table 2. Ten core VWs selected for detailed analysis.

Entertainment Companies			Ed-Tech Companies		
Platform & Year	**Recommended Age**	**Developer**	**Platform & Year**	**Recommended Age**	**Developer**
Fortnite (2017)	13+	Epic Games	Animal Jam (2010)	7–12	WildWorks
Minecraft (2009) [1]	7+	Mojang	Secret Builders (2007)	6–14	Rocket Paper Scissors LLC
Roblox (2005)	10+	Roblox Corporation	Poptropica (2007)	6–15	Pearson Education/Sandbox and Co
Habbo Hotel (2000)	13+	Sulake Corporation	Whyville (1999)	8–15	Numedeon, Inc
NeoPets (1999)	13+	Jumpstart Games [2]	JumpStart 3D (1994)	5–12	Jumpstart Games

[1] Since there are multiple servers for *Minecraft*, the analysis focuses on a specific server named *Autcraft* for children with autism. [2] *NeoPets* initially started as an entertainment company with several owners: Independent (1999 to 2005), Viacom (2005 to 2014), Jumpstart Games (2014 to present).

To investigate the specific design characteristics of communication and control features, the comparison of the 10 selected platforms focused on two specific dimensions: communication and moderation, and parental control. Three levels of ratings were developed to investigate the overall degree of freedom for these two evaluation components: low, moderate (or scaffolded), and high. The degree of freedom refers to the extent to which a player can act and interact with other players. Features supporting communication and moderation were evaluated based on the types of communication channels that were enabled in the game and how player-generated communication content (e.g., text and voice chat) was filtered and moderated. The evaluation of the types of available parent controls was based on three levels of complexity for customized features (e.g., enabling and disabling different modes of chat, purchasing, adding friends) that were available to parents. Amongst these three levels, the low level represents retroactive reporting systems and pre-scripted filters; the moderate level represents a mixture of automatic filtering and human monitoring for at least one type of communication system; the high level represents a hybrid of system/algorithm filters and human monitoring for all communication systems.

3. Results

3.1. Design Features for Communication and Controls

A comparative analysis of the 10 core platforms (Figure 2) revealed that, depending on the player age and genre of platforms (e.g., commercial vs. educational), design features of VWs for children and adolescents have different levels of freedom and/or restrictions for communication and control, and, accordingly, enable and/or disable different communicative and social opportunities during play. One influential factor that impacts the design of communication and control features is the Children's Online Privacy Protection Act (COPPA) of 1998, a policy launched in 2000 to protect the privacy of players under 13 years old online. It has become a specific measure that guides communication, moderation, and parent control features across many platforms [67–69]. Ed-tech platforms, including platforms developed pre-COPPA (e.g., *Whyville* and *JumpStart3D*) and post-COPPA (e.g.,

Animal Jam, *Poptropica*), have worked closely with entities such as Children's Advertising Review Council (CARU) and participated in FTC-approved COPPA-certified Safe Harbor Seal programs [70]. Entertainment companies that primarily target players aged 13+ have, nonetheless, also listed statements and/or developed compliance measures for COPPA to ensure online safety and privacy. For example, *Roblox* and *Neopets* have utilized different communication and parental control features (e.g., enabling chat messages and in-game mails with friends only, for example) for players younger than 13 years old [63,71–73]. Additionally, many platforms operate on a free-to-play model, with different membership options, price ranges, and pricing tiers to purchase virtual currencies, such as "Robux" in *Roblox*, "Minecoin" in *Minecraft*, and "Pearl" in *Whyville*. However, as illustrated in Figure 2, children younger than 13 years old were unable to purchase and redeem membership and virtual currencies without parental consent across several platforms (e.g., *Habbo Hotel*, *Animal Jam*, *Poptropica*).

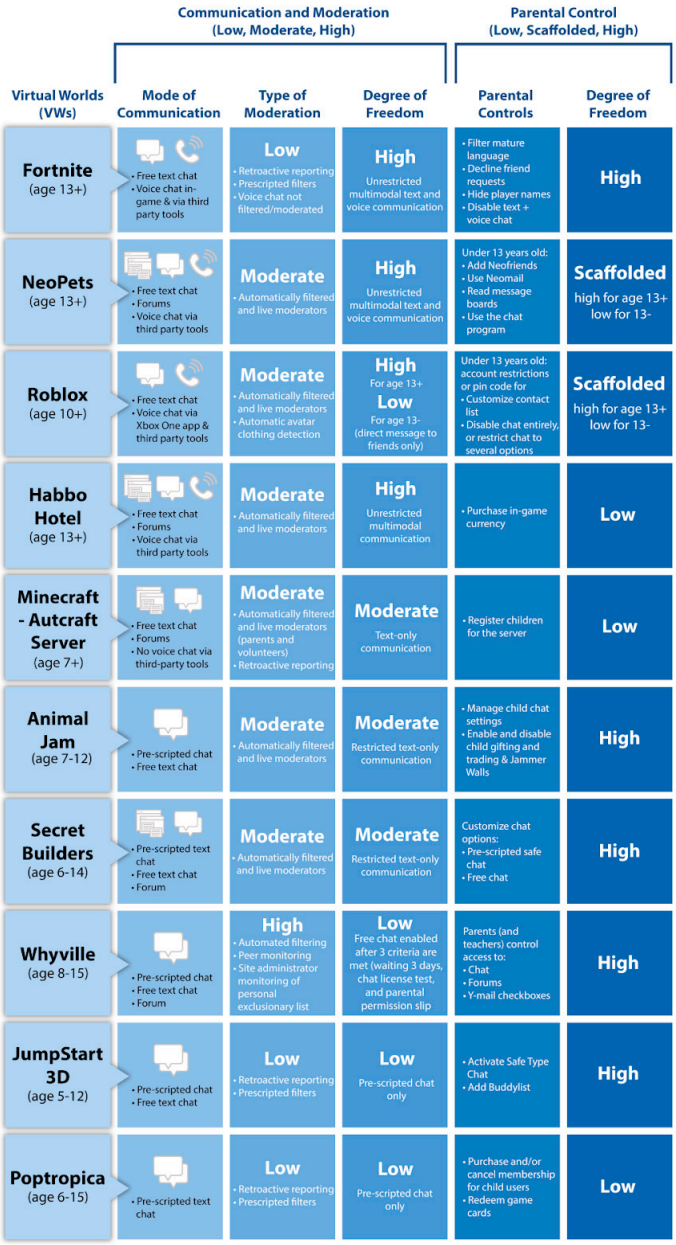


Figure 2. Degree of freedom for communication and moderation and parental control across 10 platforms (ordered by the degree of freedom for "communication and moderation" from high to low).

We also found differences in the types of game mechanics and communication channels used by the players to socialize across the platforms. Ed-tech platforms that primarily target younger players (e.g., *Whyville*, *Poptropica*) were generally found to provide environments consisting of many individually focused "mini-games" (e.g., puzzles, quizzes), where players engage in independent and solo play by themselves with limited interaction with other players. As a result, these ed-tech platforms primarily have relatively restricted communication (e.g., pre-scripted text) which are easier to moderate and monitor than unrestricted text chat and/or voice chat features found in many of the more entertainment-based VWs. Ed-tech platforms *Secret Builder*, *JumpStart 3D*, and *Animal Jam* all granted parents customization of controls to enable and disable different chat options. These three platforms also named the text chat option with pre-scripted and/or staff-picked phrases as "Safe Chat," implying that "Free Chat" may not be as safe as the restricted text chat. This contrasts with commercial games developed by entertainment companies, which typically utilize free chat and even voice chat via third-party platforms.

There is a range of chat moderation approaches across these platforms to ensure the safety and privacy of communication. Not all platforms explicitly listed what specific types of content are being filtered, and typically, platform developers make individual decisions about moderation and controls. Platforms such as *Habbo Hotel* use a combination of system filters and a team of human moderators to monitor players who do not comply with platform rules and regulations set out in the Habbo Way (Figure 3) [74].

Figure 3. A screenshot of *Habbo*'s Code of Conduct. There are six main rules under the title "Don't"—troll, scam or script, trick or cheat, sell for real money, place or accept bets, and cyber.

Youth's ability to play in online space is supplemented by the numerous communication opportunities to interact with other players. For example, in *Fortnite*, the "Party Hub" allows players to chat with friends before jumping into the game to compete with other player groups; *Habbo Hotel* has numerous mechanisms for players to make friends via planning and hosting parties, finding jobs and making earnings, trading, and obtaining Habbo Citizenship; *NeoPets* offers numerous community contests in areas such as art and design, writing, collection, and home customization, as well as social exchanges at the marketplace. In summary, in contrast to ed-tech companies, platforms created by entertainment companies offered more multimodal communication opportunities, further enabling players to engage in collaborative play with each other.

To highlight some of the differences in ways that VWs support or restrict multimodal social interaction, we now explore three of our selected platforms in detail. These three

platforms were selected to represent a range of sectors, including *Whyville* from the educational technology sector, *Autcraft*—an "in-the-wild" community server merged from *Minecraft* that is run by parents of children with autism, and *Roblox* from the commercial game sector. We discuss gameplay structures and environments, parental control features, and moderation and filtering of inappropriate communication and gameplay behaviors in each case.

3.2. Communication and Control Features in WhyVille, Autcraft, and Roblox

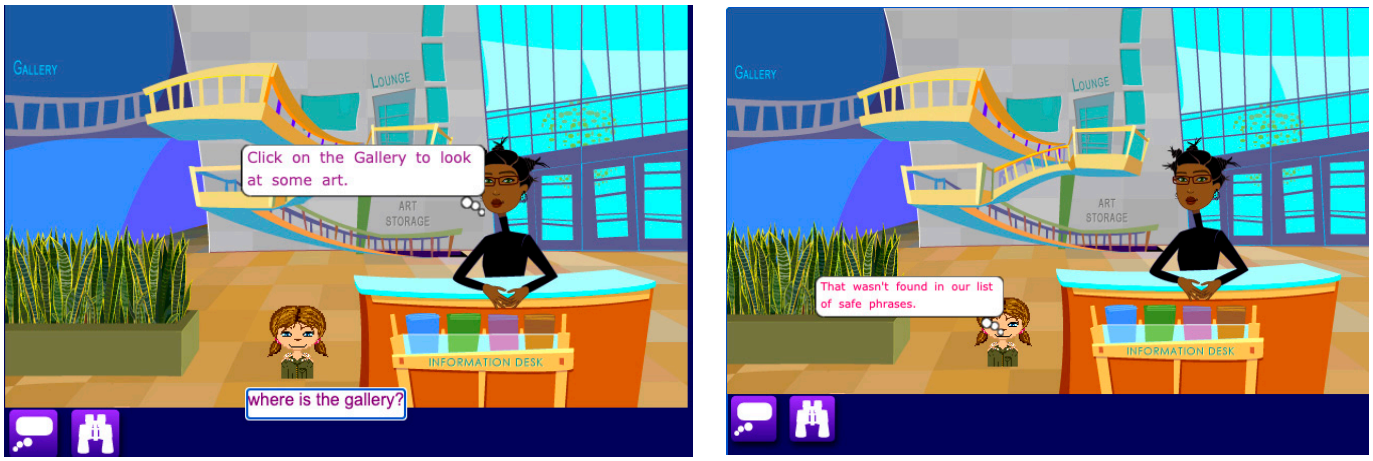
3.2.1. Whyville

Developed in 1999 by ed-tech developer Numedeon, Inc., *Whyville* is a virtual city that has attracted 7 million youth and adolescents between 8 and 15 years old worldwide. Players inside *Whyville* are referred to as "citizens of *Whyville*," and they interact with each other by participating in various social and educational activities. These activities include those that are civically focused (e.g., running the *Whyville* Senate and player-run City Hall, writing for town newspaper "The Whyville Times"), math and science simulations, art activities (e.g., avatar design, museum visits), and multiplayer games (e.g., checkers treasure hunts). Currency inside *Whyville* is called "clams," which are rewarded by being a good citizen in the community, earned through obtaining a job and/or starting a business in the game, and gained through selling and trades [75].

In this paper, we rated *Whyville* with a "low" degree of freedom for player communication and moderation, since the game offers pre-scripted text chat, and free chat can only be enabled after users complete three tasks: wait three days, earn a Chat License test, and submit a parental permission slip (for players younger than 13 years old). Before taking the Chat License test, *Whyville* citizens have to take a tutorial to learn the rules of chat safety and etiquette. *Whyville* uses this structured community management system to model and teach users how to participate in activities on the internet safely. As illustrated in Figure 2, we found that parents have a "high" degree of freedom to control their children's play. *Whyville* is an ed-tech platform in which parents andteachers have the options to control three types of access for communications: Chat, Forums, and/or Y-mail. Specifically, before their children of under 13 years old can start chatting and playing with others, parents must sign a *Whyville* Permission Slip. For teachers, the default setting for students is chatting among their classmates, not with the rest of the *Whyville* community. Therefore, players younger than 13 years old need to demonstrate knowledge for safe communication and cooperate with adult stakeholders to configure communication features.

In *Whyville*'s pre-scripted chat mode, communication is restricted to clicking pre-scripted bubble chat options rather than allowing users to author their communication. Figure 4a illustrates a pre-scripted chat condition in which the researcher's avatar (on the left) attempts to ask the system avatar (on the right) to locate the Getty Gallery, a virtual museum designed based on the Getty Museum in Los Angeles. Since the pre-scripted chat mode restricts free-text communication, even non-offensive questions such as "Where is the gallery?" is nonfunctional, as it is not on the list of safe phrases (Figure 4b). While the feature allows children an opportunity to communicate in-game, this very restricted language filter can hinder a player's naturalistic and reciprocal text-based communication.

In *Whyville*, player communication is moderated by automated chat filtering (for inappropriate language and information including web links) through which users (primarily parents) can add a "personal exclusionary list" to filter words and phrases, such as those that contain personal information. Besides the automatic filtering feature, *Whyville* is also monitored by site administrators through a variety of tools (e.g., priority listing, automatic notification, pre-set buttons, and other special provisions). The site administrators reinforce several types of penalties for violations: financial punishments (via virtual possessions), restrictions on communication, public censure, suspension of internal email privileges, alterations in physical appearances, and account banishment.



(**a**) (**b**)

Figure 4. (**a**) An in-game character at the information desk suggests in response with a message that reads, "Click on the Gallery to look at some art." In response, a player (the first author) asks an open-ended question "Where is the Gallery" in *Whyville*; (**b**) a system-generated response to the player's question "Where is the gallery?" The chat bubble in the restricted chat mode in *Whyville* reads "That wasn't found in our list of safe phrases".

In addition to moderation by adult guardians and/or site administrators, *Whyville* also establishes organizational structures that encourage peer monitoring systems amongst the players themselves. For example, good *Whyville* citizens are eligible to become "official community helpers" and serve on the patrol team to report inappropriate behavior to site administrators. Reported offensive communication and behaviors can lead to several actions that impact the player experience: (1) silence from chatting, (2) vaporization of the face (of the avatar), and (3) a 911 Report to alert city workers for further investigations, with consequences as severe as losing chat privileges for one week [76]. These three consequences to ensure community safety also influence the different visual and textual information available for communication. For example, being silenced from chatting restricts the freedom for text-based written communication via text, whereas vaporization restricts the visual imagery of a user during gameplay. These in-game actions mimic real-life scenarios, actions such as calling 9-1-1 within *Whyville* also enable transferring of similar actions outside *Whyville*, allowing youth to connect their online play with offline safety training in daily interactions [27,77].

3.2.2. Autcraft

Autcraft is a parent-owned server of *Minecraft*, a sandbox game in which players use different 3D blocks to create, destroy, rebuild, and explore structures in a user-generated open world. Since its release by Mojang Studios in 2011, *Minecraft* has been played by over 126 million users worldwide (as of 2020). Differing from the web-based virtual world platform *Whyville*, *Minecraft* can be played via different software platforms (e.g., mobile and desktop) on various hardware equipment (e.g., computers, tablets, as well as game consoles—Nintendo Switch and Xbox). The generic *Minecraft* account follows COPPA regulations, in which parental consent is required (through payment charged via credit card for a child under age 13 account [78]. *Minecraft* also has a token economy where in-game add-ons (e.g., Skin Packs, Character Packs), and community user-generated content can be purchased using Minecoins.

Additionally, *Minecraft* has thousands of individual servers which allows users to play with a local area network based on IP address (e.g., *Mineplex*, the largest server), gameplay styles (e.g., *Hypixel*, a server with mini-games), or with players from a specific social group (e.g., *Autcraft*, a server for children and adolescents with autism). Most *Minecraft* servers are managed by moderators who oversee the text-chats to catch any offensive text that may have escaped the technical filters. *Minecraft* servers that support voice-chat use automated

bots to scan and detect banned words in the text-chat and rely on human moderators to manage communication via voice-chat. Moderators can mute players or configure players in specific teams to manage voice-chat communication. If an argument or conflict between two players emerges, for example, moderators can punish or ban the players or invite the players to specific channels in *TeamSpeak* and *Discord* to address the problem, depending on the server. In summary, these different types and levels of moderation for in-game communication (e.g., bubble chats, text entry, voice chat) require designers to consider play behaviors and rely on both algorithm monitoring and mediation from adult stakeholders. In *Minecraft*, players can communicate via in-game text-chat and forum discussions, and some servers (e.g., Hypixel) enable multimodal chat tools, such as *Discord* and *TeamSpeak,* that have both voice chat and text chat features. The text chat is mostly moderated using chat filters that *Minecraft* moderators can configure to ban certain communication (e.g., abusive words or spam messages, etc.). Since *Minecraft* servers and realms can be set up by individuals, moderator rules differ across servers. Child players typically learn server-specific rules from Community Agreements [79–81], internalize these rules through mediating conflicts, and report inappropriate behaviors during the game.

In this paper, as illustrated in Figure 2, we rated *Autcraft* with a "moderate" degree of freedom for communication and moderation. The server allows in-game free text chat and forum discussions outside of the game and utilizes two types of chat moderation mechanisms: automatic text filters and in-game moderators by parents and server volunteers who proactively and synchronously monitor gameplay. There is also an option for retroactive reporting to the server administrators. *Autcraft* does not allow the integration of voice chat tools due to the lack of a 24/7 moderation mechanism on this server for neurodiverse players with autism. Given the nature of this sandbox-style game, which is intentionally designed with openness for play and communication, the primary parent control feature for *Autcraft* is the initial onboarding process. In Figure 2, we rated *Autcraft* with a "low" degree of freedom in parental controls, as the server asks parents to register their children as a gatekeeping procedure. After young players are registered and obtain server administrator approval to play, *Autcraft* becomes a virtual environment meant to be a safe playground with reduced levels of parental control.

Many recent research studies have indicated that *Autcraft* offers neurodiverse players a safe space to participate in positive and meaningful play that integrates social and sensory experiences [82–87]. Some specifically reported that the use of speech during the reciprocal conversation (e.g., request, command, initiation) to build friendship and share game experiences further extends positive learning and intervention outcomes [85–87]. Social communication is one of the hallmark deficits for neurodiverse individuals. Being able to interpret nonverbal communication signs, such as conceptualizing appropriate social proximity, is particularly challenging for children with autism [88]. Prior research has investigated the use of wearables [89]; however, limited studies have examined how users with autism learn social skills interventions in VW multiplayer environments such as *Autcraft*. During the global pandemic of coronavirus, to maintain safety, individuals were taught to keep 6-feet apart from each other. Such intervention can be challenging to implement for children with autism due to the limited physical interaction in the real world. However, in *Autcraft*, the server owner and supporting members in the community have successfully utilized the 3D gameplay environment to develop strategies to support neurodiverse players' health literacy. Figure 5 illustrates an Instagram screenshot posted by the server owner, known as the "autism father," showing how players learned to use blocks to "create spheres of particles around themselves to help visualize, demonstrate, and practice social distancing" [90]. In this virtual environment, players can manipulate particles with different shapes, sizes, and densities to visualize the abstract concept of "social distancing," which can be difficult and risky to teach in a real-world learning environment (e.g., public spaces such as school, museums, and libraries) during a global pandemic. This example demonstrated how an adult stakeholder leveraged the *Autcraft* platform, reappropriated the conventional play interaction of "building with particles,"

and offered direct supports to create embedded learning and inclusive play opportunities for neurodiverse players [82–86,91].

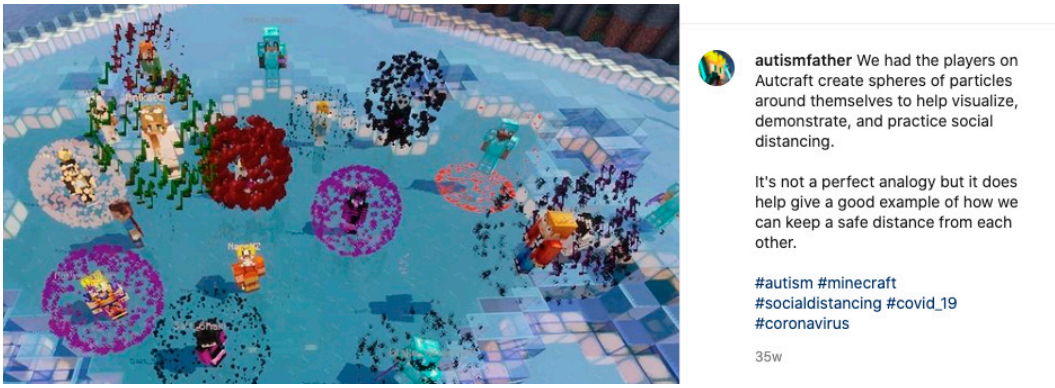


Figure 5. An Instagram post shared by the *Autcraft* server owner, "autism father" (avatar on the low left, surrounded by purple particles) who created spheres of particles with other *Autcraft* players to visualize social distancing.

3.2.3. Roblox

As one of the most popular online gaming platforms with more than 90 million monthly active users [92], *Roblox* is a multiplayer, user-generated, 3D world launched in 2005 by the entertainment company Roblox Corporation. Roblox can be accessed from various devices such as Microsoft Windows, Android, Xbox One, iOS, macOS, and Fire OS. Marketed to players who are 10 years old and above, this platform allows players to play free games designed by other users and/or use tools to build and create their own games. Without prior programming skills, *Roblox* users can contribute their own creations (e.g., games, items, sounds, ads) via Roblox Studio for free. Roblox Studio offers various templates of virtual environments and has been utilized as a video game development engine in prior research in order to teach language to students with hearing impairments [93] and teach cultural heritage [94]. Differing from *Whyville* and *Autcraft*, *Roblox* makes profits from micro-transactions of in-game purchases [95]. Users can purchase the virtual currency known as "Robux" to buy upgrades and/or virtual items (e.g., accessories for avatars) and membership options (e.g., "Builders Club") for premium items such as avatar customization, removal of screen advertisements, and item purchase and trading within games.

In this paper, we rated *Roblox* with a "scaffolded" degree of freedom for parental controls, given the diverse range of customizable options (e.g., account restriction, account PIN) available to parents to limit or disable online chat communication and restrict access to age-appropriate games on *Roblox*. As illustrated in Figure 2, for players above 13 years old, *Roblox* offers a high degree of freedom in which players can communicate with each other via direct and small group text chat and can also customize chat histories to be seen between only friends and/or friends of friends, whereas players younger than 13 years old can only send direct messages to their friends. Additionally, voice chat is available via the Xbox One app [96], and via external third-party voice chat tools (e.g., *Discord*), neither of which are moderated by *Roblox*. To comply with COPPA regulations, users under 13 years old cannot change their age setting [97]. *Roblox* allows parents to limit their children's access to only a curated list of age-appropriate games for these young players.

Roblox uses a combination of human moderators and software moderation for proactive chat filtering before users communicate with each other [98]. The chat filtering system for these users also restricts direct messages with only players who are accepted as friends [71,72,97]. Additionally, players can independently report inappropriate chat messages or content via the Report Abuse system throughout the site and in-game. Parents can use account restriction and/or an account PIN code feature to disable direct messaging

with other players entirely (Figure 6) or customize chat control with a selection of chat options: no chat, chat with friends, chat with everyone [71]. One distinct feature that sets *Roblox* apart from *Whyville* and *Autcraft* is "avatar clothing detection," an automated feature that examines whether player avatars were shown as wearing appropriate attire. Having such an automatic detection of avatar design brings additional monitoring of the safety and appropriateness of visual information displayed to players.

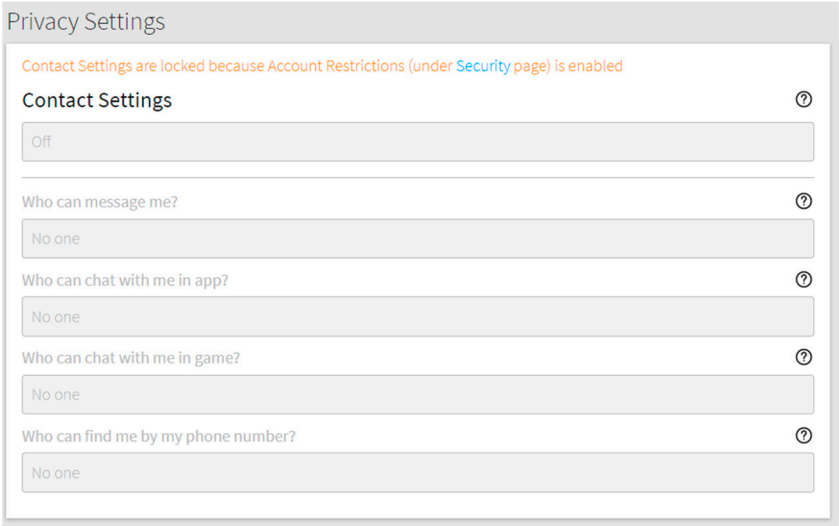


Figure 6. A screenshot of the most restricted option of contact settings from the *Roblox* Privacy Setting Page.

In contrast to *Whyville* and *Autcraft*, *Roblox* has different types of gameplay and community structures, such as "Roblox Groups," that support players to network and build friendships. On the *Roblox* website, players can join to play different games in a small group of 15 people and/or join *Roblox* groups to meet players who are interested in playing similar games as well as creating objects and constructing virtual play environments by working together. It is crucial to discuss these structures, as new opportunities for communication and social interaction typically emerge in these *Roblox groups* that *Roblox* users are affiliated with. Within these established groups, players can take on new roles and receive rewards by earning points and/or game badges. For example, in combat games (Natural Disaster Survival, Zombie Strike), players can team up and join combat to earn badges based on achievement accomplished (e.g., number of disasters survived, type of defeated Zombies) [99,100]. In the social game "Work at a Pizza Place," players can take on different roles at a restaurant to fulfill food orders and use work earnings to upgrade houses and buy furniture [101]. In a *Roblox* Group called "Paragon"—a group for simulation games with more than 859k+ members, players can communicate (e.g., leave comments) and trade (e.g., buy from the store) with other players, and can also receive badges associated with different roles [102]. For instance, players with a manager status can give a bonus check to 15 other players as managers.

Some games emerged from these *Roblox* groups that have invented new gameplay interaction and mechanics. Figure 7 illustrates a screenshot from a *Roblox* game called "Shouting Simulator" [103] in which a player (in this case, the researcher displayed as an avatar with red hair) can click on an icon to shout "oof" in communication with other players within the free chat. This game builds upon a game mechanic of "shouting to other players" and offers a multimodal communication in which audio/voice can be created and integrated directly into the play experience. As depicted in Figure 7, the researcher has only one sound, "oof," from the freemium sound library but could gain points by using the sounds more and/or purchasing more sounds from the store to play with other players. Using only one sound or purchasing "shouts" may not convey the same type of

information compared to text chat (which is available via the second icon on the top left). However, using different types of "shouts" can become a way of calling others' attention to another distant player; in the context of this game, it helps to create a new form of verbal communications (e.g., mimic animal sounds) that is different from conventional voice chat compared to gameplay in other VW platforms.

Figure 7. Screenshot of a *Roblox* game "Shouting Simulator" in which the first author (the avatar with red hair) can click on an icon to shout, "oof," to communicate with other players, in addition to using the free chat.

4. Discussion

In this study, we established a method for evaluating large-scale VW platforms concerning features that enable and/or restrict communication and play in online virtual environments for players ranging from young children to adolescents. We applied a three-step analysis to offer a comprehensive assessment of existing platforms and in-depth feature analysis for selected platforms. In the first step, we used six major thematic categories of information (player, developer, gameplay, communication and moderation, social interaction, parental controls) to provide a historical evaluation review of popular VW platforms for youth across different stages of childhood and early adolescence. In the second step, we used three levels (low, moderate/scaffolded, high) to evaluate two specific types of features—communication and moderation and parental control—and provided an analysis of 10 core platforms to compare and contrast three degrees of freedom for young players to communicate and play. These categories address the complexity of customized parental control features. Analysis of in-game player communication and parent control features revealed complex design considerations regarding how developmental age, game genre, and developer background can all influence the ways player communication and parental controls are customized across platforms. Lastly, we represented examples from three specific VWs—namely *Whyville*, *Autcraft*, and *Roblox*—to understand differences in communication and control features enabling or limiting multimodal social interaction. This multi-step evaluation framework can be used to support future user evaluation studies that examine specific dimensions of social communication and play experience in VWs using the following three critical considerations.

4.1. A Developmental Lens for Examining VWs

First, our findings suggest that, to examine youth's connected play in virtual worlds, it is imperative to apply a developmental lens for evaluating the age-appropriateness of design features. For example, platforms such as *Whyville* supplement age-specific

constraints with training and assessment for students to learn chat etiquette and safe online activities in a preventative, rather than a reactive, manner [104]. Having such training resources in place could allow platforms to educate all children as they grow across the lifespan of different developmental stages. It is highly recommended that platform developers on these VWs continue to learn from educational platforms (e.g., educational VWs such as *Whyville*) to implement training that can be educational for players. Additionally, because all platforms reviewed in this study were played by a range of age groups, these virtual environments allowed youth to interact with others of their own age but also learn from mixed-age groups. Many multiplayer games (e.g., *Minecraft* and *Roblox*) that value maker cultures offer rich opportunities for players to actively create objects and play environments [82–84]. The transition from passively playing games on the platform to actively making games is also part of development. It further enables platform developers to examine user-generated content to re-conceptualize age-appropriate and child-centered design features.

4.2. Multimodal Communication and Scaffolded Controls

Second, as we traced the footsteps of youth's connected play experiences through analysis of these VW platforms, we recognized that having access to multimodal communications (e.g., text chat, voice chat) and different modes of play (e.g., solo play, cooperative play) within a game is a critical component for maximizing youth's experience during online play. In this study, we reviewed how communication and parental control were designed, and different types and levels of moderation mechanisms provided by different platforms. During our review, we noticed that many communication and control features are not easy to locate and visualize, and often require additional exploration and extended engagement with the platform through play. It is important to acknowledge the possibility that these important features related to communication and controls may not be easily available to parents. Parents or adult caregivers may not have the time, knowledge, and resources to update customizable platform features and/or mediate their children's online interactions [54]. When parents initially create accounts for their children, they may select the default and/or most restricted communication and control features for their children to protect them from potential bully and harassment from other strangers; however, as children develop, this limitation and control may hinder opportunities for them to freely play and maximize learning in these VWs. For younger players who are pre-literate, social interactions during online platforms may be limited, especially when players are getting familiar with the game content through independent play, as illustrated in the example from *Whyville.* As they learn to acquire computer proficiency with mouse control for complex customizations (e.g., avatar decoration) and the ability to type and chat via text, players transition from solo to cooperative play and communication becomes an essential tool for youth learning to confront difficult content by teaming up, forming bonds, organizing play, solving complex tasks, and learning to socialize and compete with others through play [27,105–107]. Overly restrictive parental controls are typically designed based on a restrictive parental mediation style in order to limit and regulate children's access to online game content and features [108]. However, this type of parental control may reduce children's freedom to engage in a variety of social communication and play interaction, disabling valuable situated learning opportunities these VW platforms offer [109]. A more restricted and controlled environment (e.g., prescripted chat, lack of connection to other players though accepted friend lists) may lead to not only negative attitudes towards parents but also less multimodal communication and interaction with peers, preventing children from capitalizing on the vast number of players that they can connect with through these VWs.

4.3. Inclusive and Safe Play for Typically Developing and Neurodiverse Youth

Third, we argue that a diverse and equitable virtual environment should be inclusive to neurodiverse youth, as well as to their caregivers, who may have different needs and

preferences but equal desire to stay connected online through play. In the case of *Autcraft*, we learned that, as youth migrate from offline/physical to online play, online VWs such as *Minecraft* have empowered neurodiverse players with access to play in a safe server such as *Autcraft* that is initiated and moderated by parents and peers. These youth may be typically learning in a special education classroom and have challenges socializing through traditional face-to-face interactions. They also lack communities to stay connected with and opportunities to play with other neurodiverse peers outside traditional educational environments such as classrooms. When youth embrace play on virtual playgrounds, they also need to learn community rules and regulations which are not different from physical playgrounds [82,84]. As these neurodiverse children used online communities such as *Autcraft* to continue learning social communication, these youth also redefined their conceptualization of socialization through alternative virtual environments [84–86]. Neurodiverse youth have to rely on parents to complete an application in order to join the *Autcraft* server, yet such a dedicated server offers parents the peace of mind that this is an inclusive virtual play environment specifically created to connect a community of neurodiverse children. As represented in Figure 5, the open-to-play nature of the sandbox game *Minecraft* enabled players from the *Autcraft* server to play with other players by building color particles in 3D shapes to reinforce a social rule of physical distancing. This example indicates that once a community is built for neurodiverse children, with a greater level of collaboration and facilitation, supporting peers and adult stakeholders (e.g., parents and teachers) can create an inclusive play environment free of bullying and harassment. VW developers and designers should implement equitable practices and consider the adult–child interaction when designing inclusive and prosocial activities online [110,111].

It is important to acknowledge that youth are vulnerable to toxic and negative social interaction online, and therefore technologies and researchers need to carefully ensure a platform's safety and security against toxic behaviors. A recent study conducted at primary schools in Australia and Uruguay, Pangrazio & Gaibisso [112] examined the digital practice of social media apps among 276 pre-teens aged 7–12 years and found that many students socialize on game apps such as *Roblox, Minecraft,* and *Fortnite.* As the boundaries between games and social networks become blurry and more game creations and interactions are being shared through various virtual platforms such as YouTube and Twitter [84], youth need to be educated about the increased degree of freedom to connect with others in a setting with increased risks for a cyberattack, not only from within the gaming platforms themselves. Gratian et al. [113] conducted a corpus-based analysis of 2910 tweets of user-reported cyber victimization and found that *Roblox* was reported to have the highest incidence of content related to account victimization compared to other gaming platforms. *Roblox* gamers were desperate to recover their accounts, and many users reached out to *Roblox* game moderators and developers for help. Some users even shared both usernames and passwords publicly on *Twitter* to seek help for account recovery. These issues reveal the critical need to educate and support youth's online play in a non-toxic and safe VW community.

5. Limitations

Although this paper provides insights into understanding design feature analysis of existing popular VWs for youth, our study has several limitations to be acknowledged. First, this paper primarily reviewed platform design features using platform information and secondary sources online, rather than direct observation of user interaction or survey of user activities. Future research in this area could expand upon our study by investigating youth player gameplay via observations and learning about parent experiences through surveys and interviews. Doing so would allow researchers to better understand parent and child relationships to the VW communication to inform the design of parental controls, taking into account parental mediation strategies to scaffold age-appropriate player needs [109,114,115]. Second, since certain gaming platforms have servers with individualized rules for play and communication features, our study methodology limits our ability

to compare the idiosyncratic features within a specific platform. For example, *Minecraft* is a more complex ecosystem in which hundreds of thousands of different servers and/or realms can be created by any licensed user. These *Minecraft* servers vary in many different ways, often depending on server size, target audience, etc., with regard to how their game features are set up. Such platforms need more rigorous evaluation to understand gameplay dynamics across their own platform ecosystems. Third, as we were conducting our review study, a few VWs were experiencing shutdowns and moving to mobile-only platforms. As a matter of fact, shortly after our evaluation, *Moshi Monsters* announced its web platform shutdown in December 2019. Although our selection of gaming platforms excluded mobile and console games, these two forms of play, which are traditionally used for localized play within families, have become increasingly social with online players over the last few years.

6. Conclusions

In this study, we provided an overview of existing popular VW platforms for young children and adolescent players by providing insights into how gameplay mechanics, communication channels, and parent control features contribute to critical insights about design. We conducted a comparison across 10 specific platforms for players aged 5 to 18+ years old, examining gameplay mechanics using play and community structures, and social communication in the online environment using chat moderation and parent controls. Findings from this paper suggest that, over the past two decades, VWs have advanced from text-only chat features to multimodal social interaction during gameplay. However, critical sociotechnical design challenges remain, especially in areas of age-appropriate design features that allow child and adolescent players to interact and communicate freely while keeping them safe within the gaming systems, and customizable communication parental control features that are easily visible, supportive of youth's developmental needs. This work expanded the existing research about the virtual worlds for youth by offering an evaluation framework for analyzing existing VW platforms, particularly for young players, an area that is in critical need of more research by interdisciplinary scholars. As youth grow and learn in these VWs, ongoing research should take a longitudinal examination of VWs to monitor youth's learning and play trajectories and create features that foster positive, productive, and creative experiences.

Author Contributions: Conceptualization, K.S.-T. and Y.D.; Methodology, K.S.-T. and Y.D.; Analysis and Investigation, Y.D., T.D.G. and K.J.; Writing: Y.D., T.D.G., K.J. and K.S.-T. All authors have read and agreed to the published version of the manuscript.

Funding: This research did not receive any funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data sharing not applicable.

Acknowledgments: We would like to acknowledge Sruthi Vidya Ramabadran for help with the visual design and Keri Isara, Andre Adame, and Christie Abel for their generous feedback.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Salen–Tekinbas, K. *Raising Good Gamers: Envisioning an Agenda for Diversity, Inclusion, And Fair Play*; Connected Learning Alliance: Irvine, CA, USA, 2020.
2. Navarro, J. Fortnite: A context for child development during COVID–19 (and beyond) (USA). *J. Child. Media* **2021**, *15*, 13–16. [CrossRef]
3. Lenhart, A. Teens, online stranger contact & cyberbullying: What the research is telling us. In Proceedings of the Cyberethics Cybersafety Cybersecurity Conference, College Park, MD, USA, 2–3 October 2008.
4. Kafai, Y.B.; Fields, D.A. *Connected Play: Tweens in A Virtual World*; MIT Press: Cambridge, MA, USA, 2013.
5. Dawley, L.; Dede, C. Situated learning in virtual worlds and immersive simulations. In *Handbook of Research on Educational Communications and Technology*; Springer: Berlin/Heidelberg, Germany, 2014; pp. 723–734.

6. Yau, J.C.; Reich, S.M. Are the Qualities of Adolescents' Offline Friendships Present in Digital Interactions? *Adolesc. Res. Rev.* **2018**, *3*, 339–355. [CrossRef]
7. Spiel, K.; Frauenberger, C.; Keyes, O.; Fitzpatrick, G. Agency of autistic children in technology research—A critical literature review. *Acm Trans. Comput.-Hum. Interact. (Tochi)* **2019**, *26*, 1–40. [CrossRef]
8. Ringland, K.E.; Wolf, C.T.; Dombrowski, L.; Hayes, G.R. Making "safe" community–centered practices in a virtual world dedicated to children with autism. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, Vancouver, BC, Canada, 14–18 March 2015; pp. 1788–1800.
9. Steinkuehler, C.A. Massively Multiplayer Online Games as an Educational Technology: An Outline for Research. *Educ. Technol.* **2008**, *48*, 10–21.
10. Lim, S.S.; Clark, L.S. Virtual worlds as a site of convergence for children's play. *J. Virtual Worlds Res.* **2010**, *3*, 3–19. [CrossRef]
11. Liao, G.Y.; Pham, T.T.L.; Cheng, T.C.E.; Teng, C.I. How online gamers' participation fosters their team commitment: Perspective of social identity theory. *Int. J. Inf. Manag.* **2020**, *52*, 102095. [CrossRef]
12. Kirman, B. Tribal metaphors in social game design: Creating conflict and camaraderie through context. In Proceedings of the CHI 2013 Workshop on Designing and Evaluating Sociability in Online Video Games, SIGCHI Conference on Human Factors in Computer Systems, Como, Italy, 24–26 June 2013.
13. Griffiths, M.; Hussain, Z.; Grüsser, S.M.; Thalemann, R.; Cole, H.; Davies, M.N.; Chappell, D. Social interactions in online gaming. *Int. J. Game-Based Learn. (IJGBL)* **2011**, *1*, 20–36. [CrossRef]
14. Gee, J. *What Video Games Have to Teach Us about Literacy and Learning*; Palgrave Macmillan: London, UK, 2004.
15. Discord | Your Place to Talk and Hang Out. Available online: https://discord.com/ (accessed on 25 January 2021).
16. Ito, M.; Martin, C.; Pfister, R.C.; Rafalow, M.H.; Salen, K.; Wortman, A. *Affinity Online: How Connection and Shared Interest Fuel Learning*; NYU Press: New York, NY, USA, 2018.
17. Kow, Y.M.; Young, T.; Tekinbaş, K.S. *Crafting the Metagame: Digital Media and Learning Research Hub*; Digital Media and Learning Research Hub: Irvine, CA, USA, 2014.
18. Consalvo, M. Player one, playing with others virtually: what's next in game and player studies. *Crit. Stud. Media Commun.* **2017**, *34*, 84–87. [CrossRef]
19. Black, R.W.; Reich, S.M. Affordances and constraints of scaffolded learning in a virtual world for young children. In *Developments in Current Game-Based Learning Design and Deployment*; IGI Global: Hershey, PA, USA, 2013; pp. 61–73.
20. Iqbal, A.; Kankaanranta, M.; Neittaanmäki, P. Engaging learners through virtual worlds. *Procedia-Soc. Behav. Sci.* **2010**, *2*, 3198–3205. [CrossRef]
21. Reich, S.M.; Black, R.W. Missed opportunities on Webkinz when developmental abilities are not considered. *J. Appl. Dev. Psychol* **2012**, *33*, 136–145. [CrossRef]
22. Tekinbaş, K.S. Can Minecraft Help Raise a Generation of Good Gamers? 2018. Available online: https://medium.com/connected-parenting/can-minecraft-help-raise-a-generation-of-good-gamers-203112a1212e (accessed on 22 April 2019).
23. Mavoa, J.; Carter, M.; Gibbs, M. Beyond addiction: positive and negative parent perceptions of Minecraft play. In Proceedings of the Annual Symposium on Computer-Human Interaction in Play, Amsterdam, The Netherlands, 15–18 October 2017; pp. 171–181.
24. O'Keeffe, G.S.; Clarke–Pearson, K. Clinical report on the impact of social media on children. *Adolesc. Fam. Pediatrics* **2011**, *127*, 800–804.
25. Goltz, N. "ESRB Warning: Use of Virtual Worlds by Children May Result in Addiction and Blurring of Borders"–The Advisable Regulations in Light of Foreseeable Damages. *Advis. Regul. Light Damages Univ. Pittsburgh J. Technol. Law Policy* **2010**, *11*, 2. [CrossRef]
26. Subrahmanyam, K; Greenfield, P. Online Communication and Adolescent Relationships. *Future Child.* **2008**, *18*, 119–146. [CrossRef] [PubMed]
27. Marsh, J. Purposes for literacy in children's use of the online virtual world Club Penguin. *J. Res. Read.* **2014**, *37*, 179–195. [CrossRef]
28. Valentine, G.; Holloway, S.L. Cyberkids? Exploring Children's identities and social networks in On-line and Off-line worlds. *Ann. Assoc. Am. Geogr.* **2002**, *92*, 302–319. [CrossRef]
29. Sgro, M.; Mychasiuk, R. Playful genes: What do we know about the epigenetics of play behaviour? *Int. J. Play* **2020**, *9*, 25–38. [CrossRef]
30. Remschmidt, H. Psychosocial Milestones in Normal Puberty and Adolescence. *Horm. Res.* **1994**, *41*, 19–29. [CrossRef]
31. Immordino–Yang, M.H.; Damasio, A. We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education. *Mind Brain Educ.* **2007**, *1*, 8. [CrossRef]
32. Beals, L.; Bers, M.U. A Developmental Lens for Designing Virtual Worlds for Children and Youth. *Int. J. Learn. Media* **2009**, *1*, 51–65. [CrossRef]
33. Domahidi, E.; Festl, R.; Quandt, T. To dwell among gamers: Investigating the relationship between social online game use and gaming–related friendships. *Comput. Hum. Behav.* **2014**, *35*, 107–115. [CrossRef]
34. Zhang, T.; Frederick, C.M. Busting the Myth of the Non–Social Gamer: Comparing Friendship Quality between Gamers and Non–Gamers. *Proc. Hum. Factors Ergon. Soc. Annu. Meet.* **2018**, *62*, 746. [CrossRef]

35. McInroy, L.B.; Mishna, F. Cyberbullying on online gaming platforms for children and youth. *Child Adolesc. Soc. Work J.* **2017**, *34*, 597–607. [CrossRef]
36. Birk, M.V.; Friehs, M.A.; Mandryk, R.L. Age–based preferences and player experience: A crowdsourced cross–sectional study. In Proceedings of the Annual Symposium on Computer-Human Interaction in Play, Amsterdam, The Netherlands, 15–18 October 2017; pp. 157–170.
37. Laursen, B.; Hartup, W.W. The origins of reciprocity and social exchange in friendships. *New Dir. Child Adolesc. Dev.* **2002**, *95*, 27–40. [CrossRef]
38. Durlak, J.A.; Weissberg, R.P.; Dymnicki, A.B.; Taylor, R.D.; Schellinger, K.B. The impact of enhancing students' social and emotional learning: A meta–analysis of school–based universal interventions. *Child Dev.* **2011**, *82*, 405–432. [CrossRef]
39. Landy, S. *Pathways to Competence: Encouraging Healthy Social and Emotional Development in Young Children*; Paul H Brookes Publishing: Baltimore, MD, USA, 2009.
40. Craig, A.B.; Brown, E.R.; Upright, J.; DeRosier, M.E. Enhancing children's social emotional functioning through virtual game–based delivery of social skills training. *J. Child Fam. Stud.* **2016**, *25*, 959–968. [CrossRef]
41. Madni, A.; Griffin, N.; Delacruz, G.C. *Social and Emotional Learning in Games*; APA 121st Annual Convention: Honolulu, HI, USA, 2013.
42. Slovak, P.; Salen, K.; Ta, S.; Fitzpatrick, G. Mediating Conflicts in Minecraft: Empowering Learning in Online Multiplayer Games. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montreal, QC, Canada, 21–26 April 2018; pp. 1–13.
43. Stern, R.S.; Harding, T.B.; Holzer, A.A.; Elbertson, N.A. Current and potential uses of technology to enhance SEL. What's now and what's next. In *Handbook of Social and Emotional Learning: Research and Practice*; The Guilford Press: New York, NY, USA, 2015; pp. 516–531.
44. Depping, A.E.; Johanson, C.; Mandryk, R.L. Designing for friendship: Modeling properties of play, in–game social capital, and psychological well–being. In Proceedings of the 2018 Annual Symposium on Computer–Human Interaction in Play, Melbourne, Australia, 28–31 October 2018; pp. 87–100.
45. Scheepmaker, L.; Frauenberger, C.; Spiel, K. The Things We Play with Roles of Technology in Social Play. In Proceedings of the 2018 Annual Symposium on Computer–Human Interaction in Play, Melbourne, Australia, 28–31 October 2018; pp. 451–462.
46. Depping, A.E.; Mandryk, R.L. Cooperation and interdependence: How multiplayer games increase social closeness. In Proceedings of the Annual Symposium on Computer–Human Interaction in Play, Amsterdam, The Netherlands, 15–18 October 2017; pp. 449–461.
47. Reich, S.M.; Black, R.W.; Korobkova, K. Connections and communities in virtual worlds designed for children. *J. Community Psychol.* **2014**, *42*, 255–267. [CrossRef]
48. Boudreau, K.; Consalvo, M. The sociality of asynchronous gameplay: Social network games, dead–time and family bonding. In *Social, Casual and Mobile Games: The Changing Gaming Landscape*; Bloomsbury Collections: Msida, Malta, 2016; pp. 77–133.
49. Jiang, J.A.; Kiene, C.; Middler, S.; Brubaker, J.R.; Fiesler, C. In Moderation Challenges in Voice–Based Online Communities on Discord. *Proc. ACM Hum.-Comput. Interact.* **2019**, *3*, 1–23. [CrossRef]
50. McLean, L.; Griffiths, M.D. Female gamers' experience of online harassment and social support in online gaming: A qualitative study. *Int. J. Ment. Health Addict.* **2018**, *17*, 970–994. [CrossRef]
51. Livingstone, S.; Ólafsson, K.; Helsper, E.J.; Lupiáñez–Villanueva, F.; Veltri, G.A.; Folkvord, F. Maximizing opportunities and minimizing risks for children online: The role of digital skills in emerging strategies of parental mediation. *J. Commun.* **2017**, *67*, 82–105. [CrossRef]
52. Sridhar, S. 2001. Protecting Children in Cyberspace. *Media Asia* **2001**, *28*, 135–143. [CrossRef]
53. Lee, S.J.; Chae, Y.G. Children's Internet use in a family context: Influence on family relationships and parental mediation. *Cyberpsychol. Behav.* **2007**, *10*, 640–644. [CrossRef]
54. Livingstone, S.; Haddon, L.; Görzig, A.; Ólafsson, K. *Risks and Safety on the Internet: The Perspective of European Children: Full Findings and Policy Implications from the EU Kids Online Survey of 9–16 Year Olds and Their Parents in 25 Countries*; EU Kids Online Network: London, UK, 2011.
55. Willett, R.J. The discursive construction of 'good parenting' and digital media–the case of children's virtual world games. *Media Cult. Soc.* **2015**, *37*, 1060–1075. [CrossRef]
56. Seidman, R.H. *Serious Games: The Confluence of Virtual Reality, Simulation & Modeling, And Immersive Education*; Sabbatical Project Report; Southern New Hemisphere University: Manchester, NH, USA, 2009.
57. Pearce, C.; Blackburn, B.R.; Symborski, C. Virtual Worlds Survey Report: A Trans–World Study of Non–Game Virtual Worlds–Demographics, Attitudes, and Preferences. Corporate Report. 2015. Available online: https://jyx.jyu.fi/bitstream/handle/123456789/26862/URN:NBN:fi:jyu-2011050210720.pdf?sequence=1 (accessed on 22 April 2019).
58. Ciaramitaro, B.L. *The Blue Book: A Consumer Guide to Virtual Worlds*; Association of Virtual Worlds: Ponte Verda Beach, FL, USA, 2008.
59. Federal Trade Commission. *Virtual Worlds and Kids: Mapping the Risks. A Report to Congress*; ERIC Clearinghouse: Columbus, OH, USA, 2009.
60. Marsh, J. Young children's play in online virtual worlds. *J. Early Child. Res.* **2010**, *8*, 23–39. [CrossRef]
61. Burley, D. Penguin life: A case study of one tween's experiences inside Club Penguin. *J. Virtual Worlds Res.* **2010**, *3*, 2. [CrossRef]

62. Fereday, J.; Muir–Cochrane, E. Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *Int. J. Qual. Methods* **2006**, *5*, 80–92. [CrossRef]
63. Roblox. For Parents. Available online: https://corp.roblox.com/parents/ (accessed on 22 November 2020).
64. Kidron, B.; Rudkin, A.; Digital Childhood: Addressing Childhood Development Milestones in the Digital Environment. 5Rights. 2017. Available online: http://eprints.soton.ac.uk/id/eprint/416911 (accessed on 21 January 2021).
65. Heintz, S.; Law, E.L.C. The game genre map: A revised game classification. In Proceedings of the 2015 Annual Symposium on Computer–Human Interaction in Play, London, UK, 5–7 October 2015; pp. 175–184.
66. Da Costa, A.C.; Rebelo, F.; Teles, J.; Noriega, P. Child–persona: How to bring them to reality? *Procedia Manuf.* **2015**, *3*, 6520–6527. [CrossRef]
67. Sobel, K. *Immersive Media and Child Development: Synthesis of a Cross–Sectoral Meeting on Virtual, Augmented, and Mixed Reality and Young Children*; Joan Ganz Cooney Center at Sesame Workshop: New York, NY, USA, 2019.
68. Kerbs, R.W. Social and ethical considerations in virtual worlds. *Electron. Libr.* **2005**, *23*, 539–546. [CrossRef]
69. Barney, C.A. 100 Million Friends You Can Never Know: Adding COPPA Compliant Social Networking to Poptropica. In Proceedings of the Game Developers Conference, San Francisco, CA, USA, 7–11 March 2013; pp. 25–29.
70. Federal Trade Commission. COPPA Safe Harbor Program. Available online: https://www.ftc.gov/safe-harbor-program (accessed on 22 November 2020).
71. Roblox. Safety Features: Chat, Privacy & Filtering. Available online: https://en.help.roblox.com/hc/en-us/articles/203313120-Safety-Features-Chat-Privacy-Filtering/ (accessed on 22 November 2020).
72. Roblox. Playing on Roblox. Available online: https://en.help.roblox.com/hc/en-us/categories/200217954-Playing-on-Roblox (accessed on 22 November 2020).
73. Lu, S.L. Growing up with Neopets: A personal case–study. *J. Virtual Worlds Res.* **2010**, *3*, 2. [CrossRef]
74. Habbo. Habbo Way. Available online: https://www.habbo.com/playing-habbo/habbo-way (accessed on 22 November 2020).
75. Whyville. So, You Want to Earn Some Clams. Available online: http://www.whyville.net/smmk/whyHouse/salary (accessed on 22 November 2020).
76. Whyville. Whyville Watch Call Box: Help Keep Our Community Safe. Available online: http://b.whyville.net/smmk/callbox/callbox?noSkin=1 (accessed on 22 November 2020).
77. Meyers, E.M.; Nathan, L.P.; Unsworth, K. Who's watching your kids? Safety and surveillance in virtual worlds for children. *J. Virtual Worlds Res.* **2010**, *3*, 2. [CrossRef]
78. Mojang. Mojang Account Users under 13. Available online: https://help.minecraft.net/hc/en-us/articles/360034753912-Mojang--account-users-under-13 (accessed on 22 November 2020).
79. AutCraft. Wiki: Rules. Available online: https://www.autcraft.com/wiki/m/34575523/page/Rules (accessed on 22 November 2020).
80. Minecraft. Community Standards. Available online: https://www.minecraft.net/en-us/community-standards/ (accessed on 22 November 2020).
81. Minecraft. Gameplay. Available online: https://minecraft.gamepedia.com/Gameplay (accessed on 22 November 2020).
82. Ringland, K.E. "Autsome": Fostering an Autistic Identity in an Online Minecraft Community for Youth with Autism. In Proceedings of the International Conference on Information, Munich, Germany, 15–18 December 2019; pp. 132–143.
83. Ringland, K.E.; Boyd, L.; Faucett, H.; Cullen, A.L.; Hayes, G.R. Making in Minecraft. In Proceedings of the 2017 Conference on Interaction Design and Children, Stanford, CA, USA, 27–30 June 2017; pp. 340–345.
84. Ringland, K.E.; Wolf, C.T.; Faucett, H.; Dombrowski, L.; Hayes, G.R. "Will I always be not social?" Re–Conceptualizing Sociality in the Context of a Minecraft Community for Autism. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, San Jose, CA, USA, 7–12 May 2016; pp. 1256–1269.
85. Stone, B.; Mills, K.; Saggers, B. Multiplayer Games: Multimodal Features That Support Friendships of Students with Autism Spectrum Disorder. *Australas. J. Spec. Incl. Educ.* **2019**, *43*, 69–82. [CrossRef]
86. Stone, B.G.; Mills, K.A.; Saggers, B. Online multiplayer games for the social interactions of children with autism spectrum disorder: A resource for inclusive education. *Int. J. Incl. Educ.* **2019**, *23*, 209–228. [CrossRef]
87. MacCormack, J.; Freeman, J. The virtual environment social program for youths with autism spectrum disorder. *Int. J. Play Ther.* **2019**, *28*, 218–237. [CrossRef]
88. Conroy, M.A.; Asmus, J.M.; Ladwig, C.N.; Sellers, J.A.; Valcante, G. The effects of proximity on the classroom behaviors of students with autism in general education settings. *Behav. Disord.* **2004**, *29*, 119–129. [CrossRef]
89. Boyd, L.E.; Jiang, X.; Hayes, G.R. ProCom: Designing and evaluating a mobile and wearable system to support proximity Awareness for People with Autism. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, CO, USA, 6–11 May 2017; pp. 2865–2877.
90. Duncan, S. Instagram Post. 2020. Available online: www.instagram.com/autismfather (accessed on 22 November 2020).
91. Sobel, K.; O'Leary, K.; Kientz, J.A. Maximizing children's opportunities with inclusive play: Considerations for interactive technology design. In Proceedings of the 14th International Conference on Interaction Design and Children, Medford, MA, USA, 21–25 June 2015; pp. 39–48.
92. Long, R.U. Roblox and Effect on Education. Master's Thesis, Drury University, Springfield, MO, USA, November 2019.

93. Fernández, M.J.; Jaramillo–Alcázar, A.; Galarza–Castillo, M.; Luján–Mora, S. A Serious Game to Learn Basic English for People with Hearing Impairments. In Proceedings of the International Conference on Information Technology & Systems, Quito, Ecuador, 6–8 February 2019; pp. 671–679.
94. Meier, C.; Saorín, J.; de León, A.B.; Cobos, A.G. Using the Roblox Video Game Engine for Creating Virtual tours and Learning about the Sculptural Heritage. *Int. J. Emerg. Technol. Learn.* **2020**, *15*, 268–280. [CrossRef]
95. Palmeira, M. The interplay of micro–transaction type and amount of playing in video game evaluations. *Comput. Hum. Behav.* **2021**, *115*, 106609. [CrossRef]
96. Roblox. Xbox One App Voice Chat. Available online: https://en.help.roblox.com/hc/en-us/articles/205355430-Xbox-One-App-Voice-Chat (accessed on 22 November 2020).
97. Roblox. Roblox Community Rules. Available online: https://en.help.roblox.com/hc/en-us/articles/203313410-Roblox-Community-Rules (accessed on 22 November 2020).
98. Goldman, E.; Miers, J. Why Internet Companies Can't Stop Awful Content. Available online: https://ssrn.com/abstract=3518970 (accessed on 22 November 2020).
99. Natural Disaster Survival. Available online: https://web.roblox.com/games/189707/Natural-Disaster-Survival (accessed on 22 November 2020).
100. Zombie Strike. Available online: https://web.roblox.com/games/3759927663/DUAL-WIELD-Zombie-Strike-BETA (accessed on 22 November 2020).
101. Work at a Pizza Place. Available online: https://web.roblox.com/games/192800/Christmas-Work-at-a-Pizza-Place (accessed on 22 November 2020).
102. Paragon. Available online: https://www.roblox.com/groups/3352473/P-r-g-n#!/about (accessed on 22 November 2020).
103. Shouting Simulator. Available online: https://web.roblox.com/games/1304603528/Shouting-Simulator#!/about (accessed on 22 November 2020).
104. Wisniewski, P.; Jia, H.; Xu, H.; Rosson, M.B.; Carroll, J.M. "Preventative" vs. "Reactive" How Parental Mediation Influences Teens' Social Media Privacy Behaviors. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, Vancouver, BC, Canada, 14–18 March 2015; pp. 302–316.
105. Ducheneaut, N.; Yee, N.; Nickell, E.; Moore, R.J. "Alone together?" Exploring the social dynamics of massively multiplayer online games. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Montréal, QC, Canada, 22–27 April 2006; pp. 407–416.
106. Braithwaite, A. WoWing Alone: The Evolution of "Multiplayer" in *World of Warcraft*. *Games Cult.* **2018**, *13*, 119–135. [CrossRef]
107. Cole, H.; Griffiths, M.D. Social Interactions in Massively Multiplayer Online Role–Playing Gamers. *Cyber Psychol. Behav.* **2007**, *10*, 575–583. [CrossRef]
108. Abel, C.A.; Grace, T.D. Designing dyadic caregiver–child personas for interactive digital media use. In Proceedings of the Interaction Design and Children Conference, London, UK, 17–24 June 2020; pp. 198–204.
109. Clark, L.S. Parental mediation theory for the digital age. *Commun. Theory* **2011**, *21*, 323–343. [CrossRef]
110. Yip, J.C.; Sobel, K.; Pitt, C.; Lee, K.J.; Chen, S.; Nasu, K.; Pina, L.R. Examining adult–child interactions in intergenerational participatory design. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, CO, USA, 6–11 May 2017; pp. 5742–5754.
111. Richard, G.T.; Gray, K.L. Gendered play, racialized reality: Black cyberfeminism, inclusive communities of practice, and the intersections of learning, socialization, and resilience in online gaming. *Front. J. Women Stud.* **2018**, *39*, 112–148. [CrossRef]
112. Pangrazio, L.; Cardozo-Gaibisso, L. Beyond cybersafety: The need to develop social media literacies in pre–teens. *Digit. Educ. Rev.* **2020**, *37*, 49–63. [CrossRef]
113. Gratian, M.; Bhansali, D.; Cukier, M.; Dykstra, J. "Help, I've Been Hacked!": Insights from a Corpus of User–Reported Cyber Victimization Cases on Twitter. *Proc. Hum. Factors Ergon. Soc. Annu. Meet.* **2019**, *63*, 432–436. [CrossRef]
114. Livingstone, S.; Bober, M. *UK Children Go Online: Final Report of Key Project Findings*; London School of Economics and Political Science: London, UK, 2005. Available online: http://eprints.lse.ac.uk/399/ (accessed on 21 January 2021).
115. Giang, M.T.; Kafai, Y.B.; Fields, D.A.; Searle, K.A. Social interactions in virtual worlds: Patterns and profiles of tween relationship play. In *Computer Games and New Media Cultures*; Springer: Dordrecht, The Netherlands, 2012; pp. 543–555.