# Connected Gaming: An Inclusive Perspective for Serious Gaming

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## *Abstract*

*Serious games should focus on connected gaming, which is combining the instructionist approach on having students play educational games for learning with the constructionist approach on having students make their own games for learning. Constructionist activities have always been part of the larger gaming ecology but have traditionally received far less attention than their instructionist counterparts. Future developments in serious gaming ought to promote this more inclusive perspective to better realize the full potential of gaming as a means for learning and for connecting children to technology and to each other. This potential for more meaningful connectivity can also address the persistent access and diversity issues long facing gaming cultures.*

**Keywords:** *Programming, Constructionist, Instructionist*

## *1. Introduction*

> *"Every educator must have felt some envy watching children playing video games: If only that energy could be mobilized in the service of learning something that the educator values. But the envy can take very different forms. Instructionists show their orientation by concretizing the wish as a desire for games that will teach math or spelling or geography or whatever. The Constructionist mind is revealed when the wish leads to imagining children making the games instead of just playing them. Rather than wanting games to instruct children they yearn to see children construct games."*

Papert's [38, p. ii] assessment was remarkably prescient of developments that would follow just a decade later when the serious games movement started. Despite video games having become a multi-billion dollar business equaling—if not surpassing—the movie industry, gaming is still regularly dismissed by some educators as a waste of time, or even worse, an instigator of stereotypes and violence. In response to such critics, some theorists [15] have wondered that if video games are, in fact, such effective inculcators of stereotypes and violence, why can't their influence be harnessed for good and serve as powerful tools to support children's learning? This was the question that Gee [14] answered in his book "What Video Games Can Teach Us about Learning and Literacy" arguing that many good educational principles could be found in the design and play of video games.

The launch of serious gaming realized the yearning for instructionist games, those games that are designed to teach academic content to students. While hundreds, if not thousands, of educational games have been designed, there is obviously great variety in the ways in which game play can support learning of concepts, skills, and creativity [23][43][44][48][51]. Playing serious games for learning can run the whole gamut from tightly constrained "drill and skill" and tutorial-based software to very open-ended simulations. Accompanying these efforts were the launch of several conferences and journals, and the funding of numerous research initiatives. Following a report by the National Research Council [37], several reviews have recently been published examining the learning benefits of instructionist games. The verdict reached by these meta-analyses is decidedly mixed: while some meta-analyses found significant impact [5][55], others were more hesitant in their assessment of impact [16][53], and still others were downright dismissive of the motivation and cognitive benefits claimed by serious gaming [57].

There has however been one notable absence in all of these reviews: the inclusion of constructionist gaming approaches—namely those approaches in which games are designed by students rather than professionals for their learning benefits [31][33]. And this absence is surprising given the successes of constructionist gaming for not only learning programming but also academic content and other skills [25]. It is worth reflecting for a moment on what might have caused this omission. The first and most obvious reason stems back to what Papert [38] aptly described as the instructionist desire of having a finished, downloadable, teaching product—namely, the game itself—as the party responsible (rather than the instructor) for teaching the child. A second reason may be that constructionist gaming has been less popular simply because educators have viewed the endeavor as far too technical given its association with learning programming. At last, a third reason may be that until recently, the gaming industry did not want players to engage in any design or modification of the games they produced for the marketplace. However, whatever the reasons—educational, technical, or cultural—the situation is clearly changing.

We're witnessing an increased interest in constructionist gaming [23] that is propelled by several developments, including the initiative to promote computational thinking [18][27], a need to broaden participation in computing [36], and the emergence of a DIY culture [31]. But the central impetus for a shift comes from the industry itself. After all, some of the most popular games on the market today include level and character modding as a central feature [10][21] and encourage such modding as part of game play until the next version becomes available. A closer examination of gaming cultures reveals that many rich learning activities happen in the context of what Gee [14] refers to as "metagaming" in which play extends beyond the game and includes participating in online discussion forums [48] and even accessing cheat sites [28] to help players more effectively navigate the game. Perhaps though the clearest indicator that constructionist gaming has arrived is signaled by the remarkable popularity of Minecraft [9], a virtual sandbox whose tremendous popularity has garnered over 12 million paying designers and players.

These developments in serious gaming present an opportunity to think about new directions, taking into account what we now know about instructionist and constructionist perspectives. Rather than treating playing and making games as two separate pedagogical activities, they should be considered as overlapping, mutually informing instructional strategies for learning—as connected gaming [25]. While researchers have previously used connected gaming to denote playing online games with others who are remotely located [e.g., 8], in this paper the term connected gaming is used to describe playing and making games as part of a larger gaming ecology in which the traditional roles of game player and game maker are no longer treated as distinct entities. To make the case for connected gaming, this review examines first the overlaps between instructionist and constructionist gaming before outlining mutual benefits for expansion and considering challenges for realizing connected gaming. It also discusses example platforms where connected gaming has been realized. The goal is to focus on how serious gaming can be more inclusive and informative for children by giving young players a greater hand in the design and production of video games and ultimately enhance their learning experiences and benefits.

## 2. Examining connections between playing and making games

When Gee [14] argued that playing video games could teach us about learning and literacy, he made the point that games embody many of the features that we should seek out in good educational designs. He also pointed out that while games embodied many of these aspects, this was not meant as an invitation to educators and learning designers to turn everything into a game. The serious gaming movement, expanding on Gee's main points, has consistently posited that the educational potential of games sits somewhere between commercial products and skill-and-drill exercises. With connected gaming the argument is however, that the real solution might not be situated between the commercial and the educational but rather between the practice of *playing* and *making* games, thus combining constructionist and instructionist efforts in serious gaming. Gee himself made this connection between playing and making when he reflected in a later paper that "[i]n fact, it is a crucial learning principle that people learn best when they have an opportunity to talk (and write) about what they are learning. I may well have learned more by writing this book than anyone has by reading it" [14]. While he was commenting on writing his books and papers, writing, like programming, is an activity where people construct an artifact and it doesn't matter whether the artifact is digital, material or a hybrid.

If we examine potential overlaps between instructionist and constructionist gaming, we can see that the two approaches have much in common. Making games embodies many of the very same learning features that Gee saw in playing games—namely, providing highly-responsive contexts for complex problem solving that motivate a learner's engagement with the game, content, and others. Learning in game making is situated in designing a public and shareable artifact [40]. Learners do not learn coding for the sake of coding but do so with the goal of creating applications—in this case, games—that can then be used and played by others. The focus on game design provides a context for their learning and the possible integration of other content that they need to master for their designs. And this is also true of game playing that is not the solitary activity often portrayed in the media but often results in fans creating discussion forums, their own game modifications and more.

First, programming games provides direct and immediate feedback on whether ideas work or not. Like in game playing, the computer plays a pivotal role in providing speedy responses to the design features that students implement in their code. Writing the program for a game often doesn't work; in fact, it rarely does the first time [39]. Translating one's ideas into the language of computers is a difficult task. Much like writing a paper, the author must match intention with reception and, like good writing, efficient coding requires many revisions before getting it right. Like in game playing, there usually are different ways to approach and solve problems and generate design ideas. Achieving an effect in game play typically can be accomplished by multiple coding sequences. A key aspect of game making is that there isn't one right answer but many possible solutions. The hard part is finding an optimal one. This of course has serious implications for teaching pedagogy and assessment, in which students are rewarded not for finding a single best answer but rather the range of potential solutions.

Second, making games requires time and practice, just like playing games. This motivating nature of game play has always fascinated many educators and parents; sometimes it is even called addictive. But it is also a powerful motivator for learning. Game makers also spend extensive time in figuring out how they want to make things work and look on the screen, as do game players as they are learning how to play a game. Perseverance in solving problems is a necessary skill set precisely because achieving competencies of any kind nearly always require considerable time commitment and overcoming initial setbacks and persistent constraints, both technical and personal. But it is not just the repeated practice of skills that is important here, it is also the completion of a project—a final artifact—that requires perseverance. Contextualizing motivation is key for both playing a game towards an end goal just as it is for making a game towards final completion of a project.

Finally, game making like game playing is a social activity. With the rise of massive multiplayer online role-playing games, game playing took on a whole new level of socialization. But game making has this element of socialization inherently by the very nature of creating content for others to experience in a meaningful way. Developing communities, online and offline, to share one's work is of paramount importance. Gee [14] and others have stressed again and again the crucial role that affinity groups play in gaming communities. Game playing the latest and most popular video games actually requires interaction and coordination with others in solving complex problems to advance playing. Making games very much involves being able to modify an avatar's appearance and controls to designing an entire game engine from the ground up. Players increasingly want to produce gaming content that is unique to their own personal interests. And such play is never a solitary activity.

Gaming cultures already embody aspects of game playing and making: when players move outside the game to reflect on their experiences, share them with others, and start making their own worlds. For successful game play, there can be no playing without making. The boundaries that have been drawn between game playing and game making are largely academic, simply because different research communities study different topics. The realities of connected gaming are borne out by numbers: Millions of children are now making and programming their own games across a range of different platforms such as Scratch [27][41]. They often do so without even formally recognizing it, and only rarely do they do it because it is a school project. More likely, their reason for doing so—or at least their reason for persisting—stems back to a simple reason: namely, to join the digital public. Children see making games as a way to interact, socialize, and share with others.

## 3. Informing design and research in connected gaming

If one sees playing and making games as part of the same learning enterprise, how then can instructionist and constructionist gaming learn from each other? There is now ample evidence that it is possible to engage students in making games and learn about computational concepts, practices, and perspectives while also learning about academic content and metacognitve skills [25]. Like their instructionist counterpart, constructionist gaming provides students with social, motivational and contextual supports for learning and literacy. To expand the conversation about serious gaming, it might be worthwhile asking, what can constructionist and instructionist approaches learn from each other? The most obvious answer is to argue for connected gaming, to bring playing and making together. But before considering this proposition, it might be worthwhile to discuss what elements of each approach could be included in the other, thus expanding what either playing or making games for learning efforts can do. This would allow us to build on the substantial knowledge base hundreds of researchers have built over the last decade in designing and examining learning in playing or making games.

For instructionist gaming, one could see the most direct applications stemming from efforts to promote game modding, those activities that already add design to game playing. The level of design, obviously, can range from modifying characters and levels to actually building new games. Gaming researchers [20][21] have drawn on Wing's [54] view of computational thinking to build a bridge between game making and modding. The ability to manage complex systems, whether it is in designing or modifying them, is certainly one of the hallmarks of computational participation. Tools for game modding like tools for game making can offer *low floors* for facilitating beginnings and simple changes, *high ceilings* for allowing complex projects and manipulations, *wide walls* for addressing multiple interests in what can be modified and *open windows* for increasing social participation. In modding various aspects of the system, players learn technical skills that range from simple graphical manipulations to designing new levels and add-ons [4]. Game modding eventually leads players to turn from users into designers [51].

There is also equal benefit in engaging players intentionally in metagaming, those activities which are part of the larger gaming ecology including discussion forums, reviews, cheat sites, and extensive mods. These metagaming activities require players to move from an "in-the-play" stance to a more reflective stance that evaluates their own game play and that of others. Participating in discussion forums where players discuss strategies to overcome challenges or develop theories on how the game is developed lead players to examine the structures and dynamics of how the system is designed. Writing reviews is another approach that can lead players to evaluate the game and play for others and engages them in articulating and reviewing strategies and knowledge they have learned. From examining cheat sites, we know that players not only use them but also design them to share their understanding of the game with others. The design of games in which players just have to look for a right answer, and thus not require much of the cheat site designer other than posting information, is not a productive context for fostering inquiry [28]. But instructional games can also be designed in such a way that simple cheating is not possible. Here problems can have more than one right answer and would require cheat designers invest more efforts in providing solutions.

Likewise, what can one learn from instructionist counterparts to making games for learning a richer enterprise? One element that stands out is the performative aspect of game play that could benefit from more attention in game making. Games are not only made but also need to be played. Observations in various projects indicated how designers often served as play-testers of their own games and those of others. In past software design studies, we have always emphasized this use aspect by for instance bringing in younger students for whom the games were designed for usability sessions [32]. These usability sessions are part of professional software design, also called user-centered design, where designers want to make sure that the users actually can use the software. They are not only conducted at the end when the software is finished but throughout the process to capture any design mistakes before they become too deeply engrained in the software interface and architecture. Such user testing and playing sessions have been used with great success, often lasting no longer than 10-15 minutes where the aspiring designers get essential feedback on their designs and functions while the users learn how to engage in constructive criticism [26].

The role of instructional design for facilitating constructionist activities needs to be highlighted. While this seems like a contradiction, engaging students in constructionist gaming doesn't mean they have to start from scratch—no pun intended! When discussing game design beyond the screen, several examples illustrated how customized starter activities and controller designs can be designed in such a fashion that students with beginning engineering and programming skills can be successful in completing their designs [26]. Many of these projects require material knowledge and software skills that are beyond the scope of an instructional unit with limited number of hours, teacher expertise, and also cannot rely on students completing work outside of class, as it is the case with college students. Designing such scaffolds and making decisions on what to "black-box" and where to leave design open for students is a tricky business. It often requires multiple iterations of a project idea with different groups of students to understand progressions but also stumbling blocks both from the student as well as teacher side.

Finally, the audience dimension can be further strengthened in constructionist gaming by adding other events in which the game designs are not only played but also evaluated. National online and local competitions like the STEM National Video Game Challenge provide a possible authentic context for game designers to share their games and learn from each other [36]. Such challenges can serve as an outside audience and motivator for students to complete their designs. Experimentations have focused on various formats such as challenges and camps to remove the competitive streak and emphasize the collaborative nature of such public events. We found here that providing feedback even in the middle of the design process, rather than just highlighting winners in the end, led to the most profound changes and improvements in software designs [29]. These are suggestions for bridging the divide between instructionist and constructionist gaming approaches, drawing on the strengths of each approach to broaden learning and teaching opportunities for students. In the final designs, it is the particular learning and teaching needs that should direct the design of instructional features, leveraging what works best in particular contexts and for the particular audience.

## 4. Realizing connected gaming

Ultimately platforms that combine playing and making games under one umbrella should become the focus of new developments. Nowhere is the merging of constructionist and instructionist approaches more evident than in the success of the gaming platform Minecraft in which playing is making and making is playing. If there is any doubt that connected gaming is a reality, the tremendous popularity of Minecraft well demonstrates that the divide between playing and making games is essentially gone, and has resulted in merging of instructionist and constructionist gaming. Over 100 million copies of the game have been sold, making it one of the third highest-selling video game of all time [17]. Gameplay is not what one would expect from the typical video games. Referred to as a "sandbox" game, Minecraft is not driven by a single mission but rather exists as a vast virtual world in which players have free reign to build and sample a world of their own liking. Unlike typical video games, where the action sequences are typically highly linear and directed in a carefully orchestrated sequence by the game engine, Minecraft allows it players to roam free and at their own leisure. While there are no imperatives in terms of who to fight, who to save, or how to win, Minecraft has a single impetus for the player, and this is to make.

Creation in Minecraft starts on the small scale however. At the start of the game, the goal is essentially to build shelter, a home base. At the center of the game are blocks (3D cubes), reminiscent of Lego bricks that can be snapped together and apart. A player may stack or break these blocks in order to construct a wide range of objects and also assign them behaviors. Depending on the block type (dirt, stone, ore, water, among others), a player can construct vast oceans, mountainous vistas, dense forests, or expansive cities. Minecraft's expansive world mimics this diversity in what can be created. Divided into a series of biomes including deserts, snowfields, plains, and jungles, players visit these various spaces specifically to retrieve certain blocks for future building. Two modes exist for gameplay. In the basic *creative* or *construction* mode, the player may explore, build, and destroy structures at his or her leisure. In *survival* or *play* mode however, this drive to build shelter is predicated on surviving the elements of rain and snow, alleviating hunger, and thwarting outside players who might want to steal or destroy one's content [9]. The multi-player mode allows for players from around the globe to work with or against each other as they devised their own micro-worlds, establishing, quite literally, in the spirit of Gee's notion of affinity spaces.

The educational community have followed suit with various instructionist examples documenting and/or presenting the potential to the use Minecraft in a variety of subjects, including language arts, and a range of middle and high school science courses. Schifter and Cipollone [44] provide examples for language arts activities while Short [46] and Breitweg [2] illustrate the actual implementation of Minecraft activities in a high school physics classroom. Dikkers [7] has published a collection of classroom activities for teachers involving Minecraft. But their constructionist counterparts are equally present in Minecraft which is also being tapped as a way to teach the fundamentals of coding—not unlike stacking bricks of code in Scratch and Alice—through a virtual summer camp [24] and customized add-ons that allow players to stack Minecraft bricks to enact certain behaviors within gameplay. Minecraft's new current owner Microsoft has certainly recognized the tremendous educational potential of the game, having launched an education site based upon the custom mod of the original game entitled MinecraftEdu, which includes lesson plans and sample projects for integrating Minecraft into the classroom.

Educational researchers and designers have also adopted a connected gaming stance by conceiving of *sandbox games* that integrate the worlds of game making with designing and playing microworlds [21]. In these sandbox games, learners are provided with a microworld that lets them make and play their games around focused concepts. For instance in the car racing sandbox game, Holbert and Wilensky leverage a widely popular sports game mechanic and provide the designers with a sandbox and tools that allow them to build a racing track and cars and then color different parts of the track to represent different velocities. Playing the car racing game then becomes like running and participating in a real-life experiment where student designers can examine the outcomes and modifying constraints in order to test their hypotheses. Working with a small group of students, they found that engaging in sandbox design not only increased students' understand of key representations but also brought in, as predicted, informal understandings. Just like the original microworlds, such sandbox games offer students as designers and players access to ideas and phenomena such as the frictionless world that they may not easily encounter in their regular textbooks or classroom lessons. These sandbox games also are environments that challenge naïve understandings by providing the learner with feedback to their interactions and manipulations. Finally, interactions with the sandbox games allow the learner to develop the kind of personal knowledge that can provide the foundation for more formalized interactions. It is precisely these formal representations that underlie many commercial racing games but that are hard to extract for players from the actual gaming experience.

What these realizations of sandbox games signal is a vision of connected gaming, where playing and making games are coming together rather than being apart. It is a vision in which computational participation can and will be part of everyday play [25]. Connected gaming sees making and playing games as a form of computational participation, and promotes solving problems with others, designing intuitive systems for and with others, and understanding the cultural and social nature of human behavior in these contexts or what Ito called the "the constructing and problem solving in a networked world" [22]. Previously such ideas were closely tied to concepts, practices, and perspectives fundamental to computer science but they now are becoming markers of everyday digital citizenship. Minecraft illustrates the beginnings of communal practices such as constructing, remixing, and sharing that allow players to become full participants in their respective communities. Having the chance to participate and collaborate in communities of programming and gaming is key to becoming a participant, an active contributor, and not just a consumer of digital media and devices. To realize this potential of connected gaming, however, requires addressing two critical challenges that have long faced gaming culture in an instructionist context: access and participation. The first issue stems from the lack of access to learning coding skills. While children may have the devices themselves, they have little to no understanding how the devices actually work. The second issue follows the first and addresses the strong disparities in participation as to who actually produces within both gaming and coding communities.

## *5. Challenges for connected gaming*

While there are many benefits to connected gaming, there are also challenges in getting everyone involved in making and playing. The first challenge is concerned with broadening participation in connected gaming. Not only inviting but also sustaining participation in fact might be one of the biggest challenges that Minecraft and other online connected communities face in becoming viable learning communities for all. The millions of makers that have accounts in Minecraft and the millions of projects that have been posted on the Scratch site suggest a broad and extensive range of participation. But this is not the case. The sheer numbers actually mask a lack of diversity in participants and projects. Research of content and creators in Scratch and Minecraft online communities revealed that diversity is lacking [35][42][54]. Such observations should be seen as an indicator that not everyone feels comfortable in joining and participating in online communities. There is further need to better understand who is participating and in what ways. What is known from few available studies is that while millions of players are registered, in fact only a relatively small percentage of players are participating [11][12]. In other words, a minority of participants produces the vast majority of content that one encounters online. Further observations indicate that participation fluctuates in quantity and quality over time; it is neither a gradual linear increase nor a constant that many imagine.

The second challenge concerns deepening participation in connected gaming. Getting more kids into the clubhouses of gaming, computing, and making and opening these up to more diverse groups of players and makers, is important. But once they are there, it is also critical that they become engaged more deeply so that their participation can become the meaningful and enriching learning experience it is meant to be. While playing and making games are important stepping stones into computational participation, these activities are not enough alone. The fuller forms of computational participation only emerge once projects are also discussed, critiqued, and exchanged [14] Learning to code involves not just learning the technicalities of programming language and common algorithms but also draws learning the social practices within programming communities. In other words, learning coding not only encompasses an acquisition of technical skills, but is also appropriated within a social context. A recent survey of over hundred kid-oriented DIY media sites [18] found that while many these sites invite making, not a lot of sharing is going on thus most participants are missing out on elements critical for developing computational participation. With the increased interest in getting kids into coding, the importance that such communities play in providing access and participation to computation will only grow.

## 6. Conclusions

While instructionist gaming has made it into schools as a tool to enhance and support learning of academics, constructionist gaming buys us the added advantage of introducing computing. More current developments have added a new layer to the potential of making games for learning. Educators, researchers, and general enthusiasts now situate game making in the field of new media literacies and emphasize benefits such as system-based thinking and critical engagement with media [3][30][43]. The push to consider game making as educationally significant enough to be a "literacy" or one of many "literacies" has proved to be a powerful leverage point in terms of reconsidering what skills and content K-12 schools value and instill in their students. The goal is not necessarily to produce legions of professional game designers but rather give young learners the opportunity to design, develop, and debug their own digital content and, in the process, better grasp the nature of web-based media and the potential to collaborate through such media on project-based assessments. More than twenty years ago, gaming and computing were considered curious niches in education, but now these are worldwide industries surpassing the movie industry in income and relevance. Digital games are no longer just a medium. They have also become a method to transform learning and everyday activity. In playing and making games, we come to understand, change, and re-make the digital world in which we live and participate. This is the function of literacy, of any literacy.

We of course have only touched upon the surface in imagining what connected gaming could look like and how it can begin to address these issues of access and participation. When the field of serious gaming started, attention nearly inordinately focused on proving the effectiveness of instructionist gaming [5] and "researching learning in popular gaming cultures, designing learning environments based on those principles, and reconceptualizing educational practice for an interactive age" [50]. Constructionist gaming really was not part of either discussion in building the field of serious gaming. But if we want to realize the larger potential of serious gaming, we need embrace a larger agenda that recognizes that opening access and participation in serious games is not solely a matter of making better games for the end user but allowing these end users themselves to make the games they would like to see and play. Ultimately, connected gaming's goal is to promote environments good for learning, and it is here where constructionist approaches join instructionist efforts. This is the case for "connected gaming", an approach that doesn't draw boundaries between players and designers as participants of digital media culture but rather sees them as complimentary to each other as already Papert envisioned: "if one does belong to a culture in which video games are important, transforming oneself from a consumer to a producer of games may well be an even more powerful way for some children to find importance in what they are doing" [p. ii, 38].

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