BENEFITS OF VIDEO GAMES

in K-12 Education

HEVGA
HIGHER EDUCATION VIDEO GAME ALLIANCE

esa
entertainment software association

TABLE OF CONTENTS

This report was created through a collaboration of the Higher Education Video Game Alliance (HEVGA) and the Entertainment Software Association (ESA). The report's authors are Katrina Aranas, Jonathan Elmergreen, Kenzie Gordon, Sean Gouglas, Sean Groten, Brayden Kagel, Carrie Robison, and Anna Sollazzo.

Note: Interview quotations used throughout this report have been edited for clarity and comprehension.

FOREWORD

We learn through play. Whether it's chess, playing with dolls, or a digital game of solitaire, play inspires critical thinking, creativity, and connection. For children, play shapes and improves their social and psychological development. It is an important and necessary way for them to experiment with the world.

Each game we play teaches different lessons. Chess, for example, emphasizes planning, problem solving, and complex thinking. Playing with dolls emphasizes imagination and role playing. Board and card games can teach strategy. Memory games can teach facts. Storytelling games help children remember and appreciate the past and connect with shared cultural and collective experiences. The games we play on computers, consoles, and phones are simply the newest iteration of how we have used games to teach and learn for thousands of years.

"Nothing brings out kids' thinking better than gameplay."

- MIDDLE SCHOOL SCIENCE TEACHER

Teachers use video games in their classrooms to help students think through creative approaches to complex problems. These practices promote the development of digital skills and competencies in this important media form. Understanding how teachers use games in the classroom and how students learn through play will inform educators and policy makers in developing a curriculum that positions students for success after graduation.

Our organizations believe in the power of video games. This report represents a unique collaboration between HEVGA and the ESA to explore and highlight the important role of video games in today's educational ecosystem. It carefully examines current practices and trends regarding the important contributions that teachers are making through the use of games in the K-12 environments of today and tomorrow.

Through playing and creating games, students develop problem-solving skills, promote critical thinking, and create meaningful relationships with their peers. Virtual worlds help students learn about the real world. They learn through play.

- **Andrew Phelps,** *President, Higher Education Video Game Alliance*

- **Stanley Pierre-Louis,** *President & Chief Executive Officer, Entertainment Software Association*

EXECUTIVE SUMMARY

Video games are ubiquitous. In the United States alone, nearly 227 million people play games every week, and video game revenues reached nearly $57 billion in 2020 according to NPD. Worldwide, there are three billion video game players, and global revenues reached nearly $180 billion in 2020 according to Newzoo. Video games are not, however, just a source of entertainment. Increasingly, video games are becoming valuable tools across a broad range of sectors, from healthcare to industry to education.

The use of video games in the classroom is not surprising considering that 80 percent of Americans believe that video games can serve an educational purpose. As described in the ESA's *2021 Essential Facts About the Video Game Industry* report, most Americans believe that video games can improve both cognitive and creative skills. Our report underscores these same potentials.

This report outlines how today's teachers are using video games in schools from kindergarten to grade 12. The report is written for a general audience that is interested in the uses of video games to augment the K-12 learning environment. It is based on an extensive review of academic literature on video games in K-12 education and draws on in-depth interviews with experienced teachers on their use of video games to extend and enhance student learning. These teachers work in public, charter, and independent schools in big cities, suburbs, and towns across the country. They teach chemistry, physics, math, history, English language arts, Spanish, and a host of other subjects. They use big budget games, free mobile games, text adventure games, game engines, and more.

This report finds several important, high-level benefits to the use of video games in education:

- **Video games create networks of playful learning,** which facilitates increased engagement;
- **Video games meet students where they are,** which connects students to the educational material;
- **Video games enhance problem-solving skills,** which enables students to work within systems and make meaningful choices; and
- **Video games help teachers accommodate different learners,** which provides students opportunities to engage with materials at their own speed and in their own way.

When utilized in schools, video games provide real, tangible benefits to the education process in the classroom and beyond:

- **Video games are dynamic,** which gives teachers opportunities to tie current events to curricular objectives;
- **Video games promote engagement and resilience,** which improves students' attitudes towards learning, as well as increases social and emotional well-being inside and outside the classroom;

- **Video games stimulate collaboration,** which promotes leadership and cooperation opportunities within the school;
- **Video games develop technical skills,** which offers students new career pathways in game design and development; and
- **Video games encourage participation,** which generates opportunities for students who do not otherwise participate in extracurricular activities through games clubs and esports.

The report concludes with a discussion of how teachers have successfully integrated games into their teaching and their recommendations for anyone interested in games as educational tools.

THEORY AND PRACTICE

The Benefits of Games as Objects of Learning

The use of video games in the classroom is often grounded in *discovery learning* and *problem-based learning* — theories of learning that promote students' exploration and observation of the world as a means of understanding a lesson. A student constructs this understanding by synthesizing the game with additional materials and their prior experiences in the world.

"My pitch to parents went like this: 'We're using the next generation science standards around ecology, ecosystems, interaction, resource availability, and we're putting them into action in gameplay.'"

- ELEMENTARY SCHOOL TEACHER

CULTIVATING Networks of Playful **LEARNING**

Education has a long history of integrating play and games into teaching and learning. Meaningful learning occurs when a student is given the opportunity to discover and play, rather than passively receive information. Successful teachers nurture a culture of playful learning, where learning is built on previous knowledge and contextualized through peer interactions. This community of learning makes a culture of playfulness possible.

Students acquire skills as they learn to navigate a challenging task with assistance from more experienced students. They then pass those lessons on to their classmates. Guided by their teacher, this community of learners constructs and negotiates the meaning of their play.

The learning environment affects the child, and the child affects the learning environment. Supportive networks outside the classroom, such as peers and family members, can reinforce these relationships, and video games can enhance this process.

MEETING LEARNERS Where They Are

Students experience video games in one form or another on a daily basis. Video games are a cultural touchstone increasingly connected to their lives in a multitude of ways. Students who watched the opening ceremonies for the 2020 Tokyo Olympics, for example, saw athletes parade into Olympic Stadium to music from 19 famous Japanese video games.

Most of today's students have grown up playing games with their parents and friends. The ESA's research indicates that more than three quarters of children under 18 play video games at least weekly. Many students aspire to become game developers and designers, hoping to create games that address important social and cultural issues.

Games play a significant role in a culture of informal learning. Students bring content from games they play (characters, narratives, and experiences) outside of the classroom into traditional learning environments. By bringing games into the classroom, teachers meet students where they are. This provides students with a video game literacy to help them understand and navigate this increasingly important media and augments the learning environment.

WORKING with **SYSTEMS** and Making Meaningful **CHOICES**

Games are systems with sets of rules that allow the player to do some things but not everything. These rules create opportunities for exploration and experimentation. Learning through games takes the form of playing, analyzing, and even building a game around a specific topic, such as Roman history or cell biology. The more complex these activities, the more students learn about how to understand systems and solve abstract problems.

This way of thinking is called *computational thinking* and encompasses four interrelated skills: 1) decomposition — breaking problems into smaller parts; 2) pattern recognition; 3) algorithm design — expressing a task in step-by-step instructions; and 4) abstraction — seeing how problems relate to other similar problems and how solutions may be adapted and reused. Computational thinking is not about programming but about how to solve problems, and it extends beyond STEM-related fields.

Relatedly, games provide students opportunities to make meaningful choices. These choices provide learners with clear alternatives that can be evaluated. Those interactions can have a noticeable and logical impact on the game world. For example, in strategy games, players make small decisions from what resources to gather and units to produce, to what buildings to construct and battles to fight.

Players make these decisions based on known and unknown factors in the game world, and hope that their decisions result in the desired outcome. In an educational context, meaningful choices in games take on an additional dimension — students are challenged to consider how their curricular knowledge might interact with the game.

ACCOMMODATING Different **LEARNERS**

Games help accommodate different learners. Teachers must consider how to approach curricular outcomes in a way that is mindful of student backgrounds, abilities, behaviors, and interests. However, it is impractical and taxing for teachers to develop multiple sets of resources for each student every day. It can also be alienating for students with complex needs who find themselves unable to complete class activities at the same pace as their peers.

Games provide a common platform around which students of various learning abilities can meaningfully engage with the material at different speeds. For example, students might learn about different aspects of ancient Greece (settlement,

"It's such an 'aha' moment... Teachers have grown up playing games. They realize that all those mechanics that they've been exposed to could potentially be mechanics that they can weave into their instructional design to completely change the way that a classroom operates. It's just an amazing thing."

- HIGH SCHOOL LANGUAGE TEACHER

"Schools are systems and games are systems. Games are dynamic systems, and they're diverse. There's all kinds of different game systems, they are a resource for us to rethink how to create dynamic and engaging systems at a larger kind of structural level than what schools have to offer."

- HIGH SCHOOL LANGUAGE TEACHER

politics, economies, etc.) by playing the Discovery Tour mode of *Assassin's Creed Odyssey* (2018). The game provides opportunities for students to make connections and to demonstrate understanding in flexible and safe ways as they progress through the game world at their own pace. Teachers using games in the classroom emphasize that these personalized learning experiences are key to engagement and retention.

Games are designed to address the different skills and abilities of players. Games can readily adapt mechanics and progression based on player choices — interactions that can be repeated almost infinitely. A student can work through a problem in a well-designed game as many times as needed, getting feedback from the game in places where they are stuck. This may not be true in a crowded classroom filled with students advancing at different rates. Games provide a common 'text' for the entire class, but they also provide a diverse set of pathways for students to explore and re-explore at their own pace.

Further, the interdisciplinary nature of game design and development offers students the opportunity to engage with the curriculum in the manner most aligned with their interests. In building an interactive text adventure, for example, one student might be drawn to the creative writing demands of the project, another to the programming, and another to the musical score. In projects such as this, students frequently learn about other disciplines through such collaborations — the programmer learns a little about story structure, the creative writer picks up some programming skills, and so on. The entire team benefits from building their object of study together, which promotes engagement with the course curriculum.

GAMES IN THE CLASSROOM

Connecting Games with Curriculum

Curriculum documents are generally static. They are legislated programs of study that often take years to develop and may go a decade or more without revisions. They tend not to reflect recent developments in youth culture, technology, and media. Teachers are responsible for implementing these curricular documents, but also for bridging the gap between those documents and students' lived experiences. At times, teachers must exceed curricular expectations to best serve their students' growth. Here, video games can help.

"I had a superintendent say this once, and it really resonated with me. She said, 'We always say 'All Students,' but I like the term, 'Each Student.'' They each deserve access to the information. And if they're not getting it the way we teach it, then we need to teach it differently."

- MIDDLE SCHOOL SCIENCE TEACHER

Games are dynamic. Game makers often create games in direct response to current events, providing teachers a unique opportunity to use games in the classroom to tie curricular objectives to current issues. For example, in the game *Papers, Please* (2013), players take on the role of a customs agent who admits or rejects people at a fictional border crossing. Senior high school students who play this game would have to grapple with concepts like citizenship, national ideology, human rights, and constantly changing immigration policies, all within the context of a compelling narrative.

Games promote cognitive engagement in ways that other media do not, especially with respect to interdisciplinary approaches to understanding problems. *Papers, Please* has been commended as an empathy game that explores complex and relevant tensions. From a teacher's perspective, it provides an immersive experience for senior students to play with concepts from the curriculum, to take on different perspectives, and to engage in meaningful conversations about those concepts with their peers.

Teachers have also had success using games when teaching new languages. Open-world games, such as *Minecraft (2011)*, have been tied to improved curricular outcomes when the target language is embedded in the game's environment and mechanics. In an open-world game that focuses on teaching Spanish, for example, students must use that language to purchase an item from a shopkeeper. Research indicates that learners perceive these required interactions as more engaging than traditional activities such as vocabulary worksheets. This engagement with the educational material is an important component of the learning process.

Games set in the past provide additional opportunities for learning as exploring different ways in which history might have unfolded can prompt students to consider the unique contexts of historical events. Games provide

"There are absolutely brilliant kids that I know, and the way that the school is structured is not allowing them to express themselves in a way that's meaningful for them. What I have found, particularly with alternate-reality games, is that these kids' brains just light up differently. It lets different kids emerge. I've seen it. I've seen that when you change the system, it changes the behavior, it changes the attitude, and it changes the investment."

- HIGH SCHOOL LANGUAGE TEACHER

robust platforms to explore such counterfactuals, creating opportunities to contextualize and expand knowledge. Many games that draw on real historical settings are factually inaccurate, but an exploration of students' choices within these scenarios allow for complex investigations by teachers and students.

Although an emphasis on standardized testing in curriculum is a common concern for teachers who have chosen to use games in their classrooms, there is good evidence to suggest that students develop better attitudes towards learning and demonstrate higher levels of engagement when game-based learning is included in the curriculum. In particular, students show greater resilience when facing obstacles and implementing strategies to overcome those obstacles. In turn, increased engagement and positive learning attitudes can translate into measurable results in standardized assessments. For example, when the reading material is integrated directly into the game rather than as an accompanying text, some students read at a higher grade level.

Extending the **CURRICULUM** and **CREATING** a **COMMUNITY** of Learners

Schools are places of informal learning shaped by the experiences students bring into the school. Video games play a role in this culture of informal learning, as students chat about their favorite characters over lunch or share memes about the newest games between classes. They bring these experiences into their traditional learning activities, using games as examples in some of their assignments. Teachers should consider being open to and encouraging of such efforts given the importance of games to students and the relevance of games to society.

This integration of informal and formal learning when game play and game building are integrated into the curriculum tends to promote collaborative learning. Every teacher interviewed noted how collaboration improved attitudes towards learning. Even when activities were designed to be individual, students gravitated towards group work. To promote additional cooperation, some teachers choose to introduce a competitive element where the class struggles against some external enemy (such as an alien invasion), with no one winning unless the entire class completes the exercise and crosses the line together.

Collaboration through games prompts students to share knowledge with their peers, with students naturally falling into the role of peer mentors and instructors. In fact, in peer-to-peer learning, students shift between roles as instructor and learner fluidly. Students with video game knowledge and those with content knowledge are driven by a common goal to collaborate, which can promote more organic learning opportunities. When students occupy the role of an instructor, even briefly, it can instill in them a confidence regarding the entire learning process. This can improve their engagement with the material as well as that of their peers. Such collaborations have also been found to foster links between groups of peers who might not normally interact.

It is likely that some students will know certain games better than their teachers. Students may have more experience with open-source tools or freely available tutorials. Teachers welcoming this brief inversion of classroom authority can promote student engagement in the current exercise and beyond.

Cultivating a community of learners is an active process that requires support, attention, mentorship, and guidance. Discussions around boundaries, expectations, and respectful behavior are just as necessary in digital spaces as physical ones. These discussions are most fruitful when they take place in collaboration with the students. These boundaries can give confidence to communities who don't often see themselves represented in gaming communities. For example, without the added pressure of feeling they need to prove themselves to 'make up' for their identity, young girls are more likely to take risks and try new things.

"It's not a vision that looks to completely overhaul an English curriculum and just play games. I think it's part of a repertoire of relevant narrative techniques and manifestations they should be exposed to, because part of consuming narratives is having the critical tools to think about the narratives that you actually consume — the way that narrative is playing out in the 21st century."

- HIGH SCHOOL LANGUAGE TEACHER

LEARNING THROUGH CREATION

Making Games, Building Worlds

Although many teachers use finished games (in whole or in part) as educational tools, there are many benefits of creating games as part of the educational process. Building games centered on complex problems invites students to bring what they know and what they can research into an immersive learning experience. Building inspires conversations, requires critical thinking, and prompts students to connect game systems to parallel concepts in the real world.

> "When kids think as game designers, I think they get a better understanding of how to build something complex. If they say, 'I'm going to build this whole game,' they need to be able to chunk it and break it out into smaller pieces. That's a pretty fundamental skill."
>
> **- MIDDLE SCHOOL SCIENCE TEACHER**

Beyond entertainment, game design involves players in the productive act of making meaning of — and through — the game. When students design games, they employ critical thinking as they make design decisions about what to include and exclude from their games.

When making a game for a class in history, for example, students need to engage meaningfully with the material in ways that enhance their understanding of the past. As students decide what to include and exclude, they make arguments about the event in question. This high-level thinking prompts students to ask important questions about how they will represent the past:

- Am I basing the game on original (primary) documents, or am I depending on what others have said about the past?
- Am I acknowledging the complexity of the past, or am I making it too simple?
- Am I designing game mechanics that add to the story I want to tell, or do the mechanics get in the way?
- Am I giving players enough information to make sense of the story, or do they need to uncover it for themselves outside of the game?
- Am I making ethical decisions about how I am representing the past?

In answering these questions, students engage meaningfully with questions of agency, ethics, and abstraction that promote peer-learning and metacognitive development.

Building games may seem like a daunting task, but some simple first steps can ease the transition. For example, building an interactive narrative in an English language arts class may serve as a useful first step into game design activities. Stories are a natural fit for game building. They may be viewed as systems that can be decomposed into sequential steps. Creating interactive narratives using easy-to-use and freely-available programming tools such as *Twine* or *Scratch* can bridge curricular learning and the development of problem solving skills.

"You know, those silly quotes that are like, 'it's good to fail gloriously.' I think there's some truth to that. I think there's some truth to taking risks as a teacher and having your students witness that. If all they get from it is you courageously worked through a lesson that you weren't sure how it was going to go and you handled it even as it collapsed technologically, I think that in and of itself is a good thing for them to learn."

- HIGH SCHOOL SOCIAL STUDIES TEACHER

"If they don't have the opportunity, if they don't have a sandbox, or an opportunity to do any world building, or anything in which they're really coming up with ideas, I think that we lose a lot of them."

- ELEMENTARY SCHOOL TEACHER

Hybrid approaches, which straddle the physical and the digital, can be another way to gradually build up technological skills. Students could be tasked with building a game with pen and paper before building the same game using an introductory programming language. In doing so, students develop an understanding of a game's logic, rules, and systems before having to map that understanding onto potentially unfamiliar programming syntax. Here, content literacy informs tool literacy. In some cases, building a board game may be entirely sufficient to meet the pedagogical goals of a particular lesson.

In these ways, making games develops and reinforces computational thinking without necessarily requiring students to learn to code. Even editing and remixing existing games can promote learning, serving as an important intermediate step in game development and computational thinking.

Building games can also expand students' awareness of potential employment pathways, such as ones in creative writing, level design, musical composition, and programming.

BEYOND THE CLASSROOM

Game Clubs and Esports

Learning occurs at a nexus of interest, relationships, and opportunities. Students who feel connected to their school do better in school. Extracurricular activities such as esports and game clubs provide authentic learning opportunities that can improve literacy, skill acquisition, and peer cohesion.

Even without specific pedagogical goals, design clubs, game jams, and student groups that focus on simply playing games can also bring students together and promote social cohesion. Coding clubs for girls, for example, can lessen anxiety about participation in STEM-related disciplines, providing students an alternate avenue for success in disciplines from which they have traditionally been excluded.

Esports is a growing cultural phenomenon that benefits many K-12 students. One of the oldest and most popular competitive games is *League of Legends* (2009), which has over 115 million active monthly players worldwide. In recent years, the number of people who watched the various *League of Legends* World Championships has exceeded the number of people who watch the final game of the NBA Finals, the World Series final, and the Stanley Cup finals combined. The esports industry includes not just athletes and coaches, but also managers, sponsors, physical location staff, concessions, merchandising, advertising, streaming platforms, and more. As such, after school activities may prompt students to pursue a viable career in esports.

There are hundreds of North American colleges and universities that have varsity-level esports teams. Many of those institutions offer scholarships and financial support for esports players. In fact, colleges and universities provide millions of dollars annually for collegiate esports players.

Increasingly, K-12 institutions are creating formal esports leagues with the help of partners such as the Varsity Esports Foundation, the High School Esports League, and Play VS. This new kind of extracurricular activity provides students who may not normally belong to any other school teams an important opportunity to be part of the fabric of the school.

"I tell them all the time, 'You belong here. You're supposed to be here. This is where you should be. And yeah, it's difficult, you're going to get stuck, but there are many ways to get yourself unstuck. We have everybody here in the classroom who can help us and you can do this.' I think the whole point behind these extracurricular clubs is to reinforce that sense of belonging, which is pretty crucial I think, for young women and marginalized peoples."

- MIDDLE SCHOOL SCIENCE TEACHER

Creating **OPPORTUNITIES** for **STUDENT PARTICIPATION**

Creating opportunities for more students to be a part of school teams benefits individual students and the entire school community. Students who participate in extracurricular activities tend to have more lasting positive memories about school. Esports provide space for students with differing physical abilities to build connections with teammates, coaches, and the school at large.

Esports can teach soft skills to students as they become personally invested in the success of their team. Students learn to relate with one another while developing communication and problem-solving skills. They become more aware of themselves and others. Presenting esports teams as opportunities to improve student experience and performance may be a successful avenue towards garnering support from parents, teachers, and other stakeholders in school communities.

Esports can be a safe space for students to experience passionate disagreement. Coaches have an important mentoring role in esports and traditional sports alike. Good coaches moderate communication, model the proper ways to handle stressful situations, and demonstrate active interest and care for students' development. These skills and connections help build student success and happiness in schools.

> "I had a robotics club. And one of the things I did was I offered a girls robotics club by itself. I find that girls, when it's just them together, they will engage in a different way."
>
> **- MIDDLE SCHOOL SCIENCE TEACHER**

IMPROVING Student Outcomes

Through esports, students may improve their academic achievement in more traditional subject areas. For example, students who participate in esports improve problem-framing skills such as asking better questions, defining problems, and analyzing and interpreting data.

Participating in esports can give students additional extrinsic motivation to do well. By allowing students to participate in something that is both challenging and fun, esports provides an opportunity for students to excel both inside and outside the classroom. The academic standards required of varsity athletes in high school can encourage attendance and scholastic achievement.

The benefits associated with esports activities seem most profound with disaffected and marginalized students. There is measurable improvement for students in school when providing mentorship inside and outside of a classroom setting, especially for those not likely to receive such guidance elsewhere. Those most at-risk often receive the greatest benefit from after-school programming, offering increased social interactions with peers in a safer play space. These opportunities provide an often low-pressure environment where students and teachers can interact outside of environments associated with summative assessment. These activities offer increased flexibility for parents who may now be able to work a full shift instead of leaving early to pick up their child. These activities also tend to be much cheaper than formal after-school care.

MAKING GAMES WORK

Considerations for Educators

Video games can seem infinitely complex. Integrating games into the classroom might seem daunting to any educator. Although there are no nationally recognized curriculum standards for video games, there are teachers, education research groups, and advisory organizations that offer guidance for those seeking to insert games into classrooms. Based on the advice provided by those interviewed for this report, teachers looking to effectively bring games into their teaching may consider the following suggestions.

"Start at a point that you feel you can be successful. Start someplace small and someplace where you feel will do the most good. And if it completely fails ... well cool."

- ELEMENTARY SCHOOL TEACHER

Be **MEANINGFUL** and **RELEVANT**

Games must be coherent and internally consistent with the learning objectives. Care must be taken not to simply replace traditional rote learning exercises with irrelevant game-like activities. Many teachers see gamification as a superficial way to address a flawed curriculum, and students have become fatigued with poorly designed rewards systems that have no meaningful connection to the material. As one student said to a teacher with respect to badge and point systems that were not actual games, "They're lying to us. They're pretending this is a game, but they're lying to us."

Students should see themselves and the issues they care about in the games they play in the classroom. Games provide a space for students to grapple with learning material as part of a playful community of learners. Students will understand the course content better if it is relevant to their experiences and the experiences of their peers.

START SMALL and Pick the **RIGHT TOOLS**

No game will satisfy all the social, cultural, and curricular needs of a group of learners. Rather, games are rich sites of pedagogical potential to be integrated within a larger classroom ecology of teachers and learners. Short excerpts from age-appropriate games, such as the introduction or a single mission, can be more effective as a teaching tool than having students play an entire game. These brief gaming moments can be supplemented with supporting materials — such as a reading, a video, an historical document, or a reflection document — that provide additional context for the lesson. Keeping gameplay short also creates space for the inclusion of a wider variety of games, each of which might offer a different perspective on a topic.

"You just use a 10-minute segment of the game; you don't have to play the whole thing. You put it in front of the class, and you arrive at this kind of juncture. And then you get them to go off and choose a school of moral philosophy to justify the decision they're going to want to make at that particular moment."

- HIGH SCHOOL LANGUAGE TEACHER

While it can be tempting to jump on the newest technology, these often have a steeper learning curve for both students and instructors. The engagement incited by novelty does not last. The most important consideration when choosing technology is to choose games and tools that will not add barriers to learning.

OBTAIN Administrative and Parental **SUPPORT**

The majority of the teachers interviewed identified administrator support as absolutely essential to success in integrating games into the curriculum. Administrators help secure the financial resources necessary to bring games into the classroom. A supportive administration provides legitimacy to the entire exercise, reassuring parents and other teachers that learning outcomes are being addressed. District administrators are also instrumental in introducing game-based learning at a larger scale. They connect teachers between schools and create a community of teaching practice where ideas, resources, stories, and solutions to common problems can be shared.

Clear and consistent communication with parents is key to securing their approval. Parents are more likely to accept game-based learning when teachers demonstrate clearly how such efforts meet curricular outcomes. Parents seem reassured by explanations of curriculum research that underpins the use of games.

Be **FLEXIBLE**

Game-based learning experiences, whether focused on playing games or building games, should emphasize discovery and exploration. Creating space for student exploration and curiosity allows students opportunities to find new avenues for learning and promotes intrinsic motivation. Too much planning can curtail these efforts.

A teacher's most crucial role may be modelling the learning process. If a teacher works through a new game puzzle alongside their students, for example, the teacher can model positive learning and troubleshooting practices. Problem solving is an iterative process that requires embracing uncertainty and failure. Good game-based learning experiences reflect this. It's okay to not know how things will turn out — it may even be better that way.

BUILD Scaffolding to **PROMOTE LEARNING**

Instructional scaffolding guides students through unknowns by introducing skills and knowledge as required. It is essential to game-based learning as it bridges the gap between limited content knowledge presented by a video game and a broader, more contextualized understanding of a topic defined by the curriculum. Teachers should provide internal and external scaffolding.

Internal scaffolding is integrated into the flow of the game. It caters to the needs of different learners by providing students with just enough help navigating content or mechanics to let them advance through the game at an appropriate pace.

External scaffolding involves teachers helping students make explicit connections between game concepts and their "real world" counterparts. External scaffolding connects game expertise (knowing how to move around the game world, for example) and content expertise (knowing the history depicted in the game). The challenge is to offer additional context in a way that isn't divorced from the game, as students retain more information when external scaffolding meaningfully informs in-game experiences.

Ideally, the level of scaffolding should be such that students still feel challenged during play but have access to enough support and feedback that the perceived challenges seem manageable. Scaffolding should provide enough help that the tools used to play and build games are not a barrier to learning or expression, without eliminating the learning that comes from failure.

DESIGN for **EQUITY**

In deciding what tools to use and how to use them, every teacher interviewed was above all focused on equity. School budgets often don't allow for expensive consoles or games. Teachers favored lightweight games as they were more likely to be able to run on widely available devices, such as phones. Teachers were careful to keep gameplay in class, with the school or teacher providing the required technology. Freely available games and tools were preferred.

"At the beginning, things were very simple... simple tasks, simple things. We kept building upon those kinds of game skills as we went through. And while building on these game skills, I found they grew in combination with the Spanish skills."

- HIGH SCHOOL LANGUAGE TEACHER

CONCLUSION

With millions of players nationwide, and the majority of Americans convinced of their educational value, it's no surprise that video games have made their way into today's K-12 classrooms.

Teachers leverage the interactivity of games to create structured learning experiences that engage all types of students. Playing games in the classroom as part of a community of learners increases students' engagement with the curriculum and broadens their digital literacy. Building games in the classroom engages students in complex problem solving and introduces them to increasingly important technical skills. Beyond the skills needed to play and build games, game-based activities teach critical thinking as well as soft skills such as self-awareness and teamwork.

Games amplify student agency in learning. Students make meaningful choices allowing them to see how their decisions impact the game world. In doing so, students are prompted to connect these game experiences to the real world.

Games are a community activity. They create space for a diversity of skill sets — programming, art, music, etc. — fostering a culture of collaboration and peer mentorship. Esports teams may offer a sense of belonging to students who often feel they don't have a place in the school community.

With no nation-wide curricular guidelines, game-based learning in the American school system is currently practiced and promoted by small communities of teachers. This report summarized the efforts of these teachers to use games in the classroom and to connect those efforts to larger communities of practice. It showed a small glimpse of the potential of games to cultivate a playful learning environment that can benefit a diversity of students across America.

WORKS CITED

Adachi, P. J., & Willoughby, T. (2013). More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades. *Journal of Youth and Adolescence*, *42*(7), 1041–1052. https://doi.org/10.1007/s10964-013-9913-9

Adams, D. M., & Clark, D. B. (2014). Integrating self-explanation functionality into a complex game environment: Keeping gaming in motion. *Computers & Education*, *73*, 149–159. https://doi.org/10.1016/j.compedu.2014.01.002

Adams, J. C., & Webster, A. R. (2012). What do students learn about programming from game, music video, and storytelling projects? *Proceedings of the 43rd ACM Technical Symposium on Computer Science Education - SIGCSE '12*. https://doi.org/10.1145/2157136.2157319

Akcaoglu, M., & Koehler, M. J. (2014). Cognitive outcomes from the game-design and learning (GDL) after-school program. *Computers & Education*, *75*, 72–81. https://doi.org/10.1016/j.compedu.2014.02.003

Bar-El, D., & Ringland, K. E. (2020). Crafting game-based learning: An analysis of lessons for Minecraft education edition. *International Conference on the Foundations of Digital Games*, 1–4. https://doi.org/10.1145/3402942.3409788

Bebbington, S., & Vellino, A. (2015). Can playing Minecraft improve teenagers' information literacy? *Journal of Information Literacy*, *9*(2). https://doi.org/10.11645/9.2.2029

Bell, T., Alexander, J., Freeman, I., & Grimley, M. (2009). Computer science unplugged: School students doing real computing without computers. *The New Zealand Journal of Applied Computing and Information Technology*, *13*(1), 20–29.

Best, J. R. (2012). Exergaming immediately enhances children's executive function. *Developmental Psychology*, *48*(5), 1501–1510. https://doi.org/10.1037/a0026648

Boulton, H., Spieler, B., Petri, A., Schindler, C., Slany, W., & Beltran, M. (2016). Conference on Education and New Learning Technologies. In *EDULEARN16 Proceedings* (pp. 7034–7044). Valencia, ESP; IATED Academy.

Bricken, M., & Byrne, C. M. (1992). (rep.). *Summer students in virtual reality: A pilot study on educational applications of virtual reality technology* (pp. 1–14). Seattle, WA: Washington University.

Bronfenbrenner, U. (1981). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Bruner, J. S., Jolly, A., & Sylva, K. (1976). *Play: Its role in development and evolution*. Penguin.
Burren, J. (2019). Video games and the classroom (Masters Thesis).

Ceconello, M., Spagnoli, A., Spallazzo, D., & Tolino, U. (2015). Playing design mobile serious games to valorize design culture in the urban space. *2015 Digital Heritage*, 671–674. https://doi.org/10.1109/digitalheritage.2015.7419595

Cheng, M.-T., Rosenheck, L., Lin, C.-Y., & Klopfer, E. (2017). Analyzing gameplay data to inform feedback loops in the Radix Endeavor. *Computers & Education*, *111*, 60–73. https://doi.org/10.1016/j.compedu.2017.03.015

Chorianopoulos, K., & Giannakos, M. (2014). Design principles for serious video games in mathematics education: From theory to practice. *International Journal of Serious Games*, *1*(3), 51–59. https://doi.org/10.17083/ijsg.v1i3.12

Cicchino, M. I. (2015). Using game-based learning to foster critical thinking in student discourse. *Interdisciplinary Journal of Problem-Based Learning*, *9*(2). https://doi.org/10.7771/1541-5015.1481

Clark, D. B., Nelson, B. C., Chang, H.-Y., Martinez-Garza, M., Slack, K., & D'Angelo, C. M. (2011). Exploring Newtonian mechanics in a conceptually-integrated digital game: Comparison of learning and affective outcomes for students in Taiwan and the United States. *Computers & Education*, *57*(3), 2178–2195. https://doi.org/10.1016/j.compedu.2011.05.007

Clark, D. B., Tanner-Smith, E., Hostetler, A., Fradkin, A., & Polikov, V. (2017). Substantial integration of typical educational games into extended curricula. *Journal of the Learning Sciences*, *27*(2), 265–318. https://doi.org/10.1080/10508406.2017.1333431

Clark, D. B., Virk, S. S., Barnes, J., & Adams, D. M. (2016). Self-explanation and Digital Games: Adaptively increasing abstraction. *Computers & Education*, *103*, 28–43. https://doi.org/10.1016/j.compedu.2016.09.010

Cornillie, F., Thorne, S. L., & Desmet, P. (2012). Digital games for language learning: From hype to insight? *ReCALL*, *24*(3), 243–256.

Corredor, J. (2018). Fostering situated conversation through game play. *Simulation & Gaming*, *49*(6), 718–734. https://doi.org/10.1177/1046878118801408

Corredor, J., Gaydos, M., & Squire, K. (2013). Seeing change in time: Video games to teach about temporal change in scientific phenomena. *Journal of Science Education and Technology*, *23*(3), 324–343. https://doi.org/10.1007/s10956-013-9466-4

Cox, E. (2021, March 2). *NASEF and NACE partner to provide high school - college esports connections to benefit students*. NAC Esports. Retrieved from https://nacesports.org/nasef-and-nace-partner/.

Csizmadia, A., Curzon, P., Dorling, M., Humphreys, S., Ng, T., Selby, C., & Woollard, J. (2018). Computational thinking: A guide for teachers. *Computing At School*.

David, O. A., Cardoș, R. A., & Matu, S. (2018). Is REThink therapeutic game effective in preventing emotional disorders in children and adolescents? Outcomes of a randomized clinical trial. *European Child & Adolescent Psychiatry*, *28*(1), 111–122. https://doi.org/10.1007/s00787-018-1192-2

Dealessandri, M. (2021, January 15). *2020 sees record US games spending at $56.9bn | US Annual Report*. gamesindustry.biz. Retrieved from https://www.gamesindustry.biz/articles/2021-01-15-2020-sees-record-us-games-spending-at-usd56-9bn-us-annual-report

de Castell, S., Larios, H., & Jenson, J. (2019). Gender, videogames and navigation in virtual space. *Acta Psychologica*, *199*. https://doi.org/10.1016/j.actpsy.2019.102895

DeLiema, D., Enyedy, N., & Danish, J. A. (2019). Roles, rules, and keys: How different play configurations shape collaborative science inquiry. *Journal of the Learning Sciences*, *28*(4-5), 513–555. https://doi.org/10.1080/10508406.2019.1675071

Denner, J., Werner, L., & Ortiz, E. (2012). Computer games created by middle school girls: Can they be used to measure understanding of computer science concepts? *Computers & Education*, *58*(1), 240–249. https://doi.org/10.1016/j.compedu.2011.08.006

Devlin-Scherer, R., & Sardone, N. B. (2010). Digital simulation games for social studies classrooms. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *83*(4), 138–144. https://doi.org/10.1080/00098651003774836

Dindar, M. (2018). An empirical study on gender, video game play, academic success and complex problem solving skills. *Computers & Education*, *125*, 39–52. https://doi.org/10.1016/j.compedu.2018.05.018

DiSalvo, B., Guzdial, M., Bruckman, A., & McKlin, T. (2014). Saving face while geeking out: Video game testing as a justification for learning computer science. *Journal of the Learning Sciences*, *23*(3), 272–315. https://doi.org/10.1080/10508406.2014.893434

Duncan, C., Atlas, J., & Bell, T. (2017). What do the teachers think? Introducing computational thinking in the primary school curriculum. In *Proceedings of the Nineteenth Australasian Computing Education Conference - ACE 17* (pp. 65–74). New York, NY; Association for Computing Machinery.

Engerman, J. A., Carr-Chellman, A. A., & MacAllan, M. (2019). Understanding learning in video games: A phenomenological approach to unpacking boy cultures in virtual worlds. *Education and Information Technologies*, *24*(6), 3311–3327. https://doi.org/10.1007/s10639-019-09930-2

Fields, D. A., Kafai, Y. B., & Pantic, K. (2015). "I have a tutorial for this": The language of online peer support in the Scratch programming community. In *Proceedings of the 14th International Conference on Interaction Design and Children*. New York, NY; Association for Computing Machinery.

Foreman, J. (2003). *Next-generation educational technology versus the lecture*. EDUCAUSE Review.

Gaydos, M. J., & Squire, K. D. (2012). Role playing games for scientific citizenship. *Cultural Studies of Science Education*, *7*(4), 821–844. https://doi.org/10.1007/s11422-012-9414-2

Gentile, M., Città, G., Perna, S., Signa, A., Dal Grande, V., Ottaviano, S., La Guardia, D., & Allegra, M. (2019). The role of disposition to critical thinking in digital game-based learning. *International Journal of Serious Games*, *6*(3), 51–63. https://doi.org/10.17083/ijsg.v6i3.316

Gilje, Ø., & Silseth, K. (2019). Unpacking FIFA play as text and action in literacy practices in and out of school. *Learning, Media and Technology*, *44*(2), 180–192. https://doi.org/10.1080/17439884.2018.1563105

Groff, J., Howells, C., & Cranmer, S. (2012). Console game-based pedagogy. *International Journal of Game-Based Learning*, *2*(2), 35–54. https://doi.org/10.4018/ijgbl.2012040103

Hava, K., Guyer, T., & Cakir, H. (2020). Gifted students' learning experiences in systematic game development process in after-school activities. *Educational Technology Research and Development*, *68*(3), 1439–1459. https://doi.org/10.1007/s11423-020-09750-z

Holbert, N., & Wilensky, U. (2018). Designing educational video games to be objects-to-think-with. *Journal of the Learning Sciences*, *28*(1), 32–72. https://doi.org/10.1080/10508406.2018.1487302

Horn, M. S. (2018). Tangible interaction and cultural forms: Supporting learning in informal environments. *Journal of the Learning Sciences*, *27*(4), 632–665. https://doi.org/10.1080/10508406.2018.1468259

Howland, K., & Good, J. (2015). Learning to communicate computationally with Flip: A bi-modal programming language for game creation. *Computers & Education*, *80*, 224–240. https://doi.org/10.1016/j.compedu.2014.08.014

Jenson, J., & de Castell, S. (2011). Girls@Play: An ethnographic study of gender and digital gameplay. *Feminist Media Studies*, *11*(2), 167–179. https://doi.org/10.1080/14680777.2010.521625

Kafai, Y. B., & Burke, Q. (2015). Constructionist gaming: Understanding the benefits of making games for learning. *Educational Psychologist*, *50*(4), 313–334. https://doi.org/10.1080/00461520.2015.1124022

Kafai, Y. B., & Vasudevan, V. (2015). Constructionist gaming beyond the screen: Middle school students' crafting and computing of touchpads, board games, and controllers. In *Proceedings of the Workshop in Primary and Secondary Computing Education* (pp. 49–54). New York, NY; Association for Computing Machinery.

Ke, F. (2008). A case study of computer gaming for math: Engaged learning from gameplay? *Computers & Education*, *51*(4), 1609–1620. https://doi.org/10.1016/j.compedu.2008.03.003

Kee, K., Vaughan, T., & Graham, S. (2011). The haunted school on horror hill: A case study of interactive fiction in an elementary classroom. In *Management Association (Ed.), Gaming and Simulations: Concepts, Methodologies, Tools and Applications* (pp. 1405–1416). Hershey, PA; IGI Global.

Killingsworth, S. S., Clark, D. B., & Adams, D. M. (2015). Self-explanation and explanatory feedback in games: Individual differences, gameplay, and learning. *International Journal of Education in Mathematics, Science and Technology*, *3*(3), 162–186. https://doi.org/10.18404/ijemst.15600

Klopfer, E., & Sheldon, J. (2010). Augmenting your own reality: Student authoring of science-based augmented reality games. *New Directions for Youth Development*, *2010*(128), 85–94. https://doi.org/10.1002/yd.378

Krinks, K. D., Sengupta, P., & Clark, D. B. (2019). Modeling games in the K-12 science classroom. *International Journal of Gaming and Computer-Mediated Simulations*, *11*(1), 31–50. https://doi.org/10.4018/ijgcms.2019010103

Kronholz, J. (2012). Academic value of non-academics: The case for keeping extracurriculars. *Education Digest: Essential Readings Condensed for Quick Review*, *77*(8), 4–10.

Lamb, R., Annetta, L., & Vallett, D. (2017). The interface of creativity, fluency, lateral thinking, and technology while designing serious educational games in a science classroom. *Electronic Journal of Research in Education Psychology*, *13*(36). https://doi.org/10.14204/ejrep.36.14110

Lee, J. K., & Probert, J. (2010). Civilization III and whole-class play in high school social studies. *Journal of Social Studies Research*, *34*(1), 1–28.

Lee, J. S., & Steinkuehler, C. (2019). Esports as a catalyst for connected learning: The North America Scholastics Esports Federation. *XRDS: Crossroads, The ACM Magazine for Students - Computer Science and Sports*, *25*(4), 54–59. https://doi.org/10.1145/3331075

Lee, J. S., Wu, M., Lee, D., Fleming, L., Ruben, L., Turner, T., Brown, K., & Steinkuehler, C. (2020). Designing an interest-based integrated curriculum around esports. *International Journal of Designs for Learning*, *11*(3), 78–95. https://doi.org/10.14434/ijdl.v11i3.27663

Lee, V. R., Poole, F., Clarke-Midura, J., Recker, M., & Rasmussen, M. (2020). Introducing coding through tabletop board games and their digital instantiations across elementary classrooms and school libraries. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (pp. 787–793). New York, NY; Association for Computing Machinery.

Martinez-Garza, M. M., & Clark, D. B. (2017). Investigating epistemic stances in game play with Data Mining. *International Journal of Gaming and Computer-Mediated Simulations*, *9*(3), 1–40. https://doi.org/10.4018/ijgcms.2017070101

Mayer, R. E., Parong, J., & Bainbridge, K. (2019). Young adults learning executive function skills by playing focused video games. *Cognitive Development*, *49*, 43–50. https://doi.org/10.1016/j.cogdev.2018.11.002

McCall, J. (2011). *Gaming the past: Using video games to teach secondary history*. Routledge.

Menendez-Ferreira, R., Torregrosa, J., Panizo-Lledot, A., Gonzalez-Pardo, A., & Camacho, D. (2020). Improving youngsters' resilience through video game-based interventions. *Vietnam Journal of Computer Science*, *07*(03), 263–279. https://doi.org/10.1142/s2196888820500153

Moshirnia, A., & Israel, M. (2010). The educational efficacy of distinct information delivery systems in modified video games. *Journal of Interactive Learning Research*, *21*(3), 383–405.

Muehrer, R., Jenson, J., Friedberg, J., & Husain, N. (2012). Challenges and opportunities: Using a science-based video game in secondary school settings. *Cultural Studies of Science Education*, *7*(4), 783–805. https://doi.org/10.1007/s11422-012-9409-z

Nebel, S., Schneider, S., & Rey, G. D. (2016). Mining learning and crafting scientific experiments: A literature review on the use of Minecraft in education and research. *Educational Technology & Society*, *19*(2), 355–366.

Nelson, B. C. (2006). Exploring the use of individualized, reflective guidance in an educational multi-user virtual environment. *Journal of Science Education and Technology*, *16*(1), 83–97. https://doi.org/10.1007/s10956-006-9039-x

Nietfeld, J. L., Shores, L. R., & Hoffmann, K. F. (2014). Self-regulation and gender within a game-based learning environment. *Journal of Educational Psychology*, *106*(4), 961–973. https://doi.org/10.1037/a0037116

No Child Left Behind Act of 2001, 20 U.S.C. § 6319 (2008).

Parong, J., & Mayer, R. E. (2020). Cognitive and affective processes for learning science in Immersive virtual reality. *Journal of Computer Assisted Learning*, *37*(1), 226–241. https://doi.org/10.1111/jcal.12482

Parong, J., Wells, A., & Mayer, R. E. (2020). Replicated evidence towards a cognitive theory of game-based training. *Journal of Educational Psychology*, *112*(5), 922–937. https://doi.org/10.1037/edu0000413

Patsenko, E. G., Adluru, N., Birn, R. M., Stodola, D. E., Kral, T. R., Farajian, R., Flook, L., Burghy, C. A., Steinkuehler, C., & Davidson, R. J. (2019). Mindfulness video game improves connectivity of the fronto-parietal attentional network in adolescents: A multi-modal imaging study. *Nature Research Scientific Reports*, *9*(18667). https://doi.org/10.1038/s41598-019-53393-x

Patton, R. M. (2013). Games as an artistic medium: Investigating complexity thinking in game-based art pedagogy. *Studies in Art Education*, *55*(1), 35–50. https://doi.org/10.1080/00393541.2013.11518915

Perry, B. (2015). Gamifying French language learning: A case study examining a quest-based, augmented reality mobile learning-tool. *Procedia - Social and Behavioral Sciences*, *174*, 2308–2315. https://doi.org/10.1016/j.sbspro.2015.01.892

Peterson, M. (2012). Language learner interaction in a massively multiplayer online role-playing game (MMORPG): A sociocultural discourse analysis . *Digital Games in Language Learning and Teaching*, 70–92. https://doi.org/10.1057/9781137005267_5

Piaget, J. (1936). *Origins of intelligence in the child*. Routledge & Kegan Paul.

Piaget, J. (1957). *The construction of reality in the child*. Routledge & Kegan Paul.

Pinar, W. F. (2011). *What is curriculum theory?* Routledge.

Plass, J. L., O'Keefe, P. A., Homer, B. D., Case, J., Hayward, E. O., Stein, M., & Perlin, K. (2013). The impact of individual, competitive, and collaborative mathematics game play on learning, performance, and motivation. *Journal of Educational Psychology*, *105*(4), 1050–1066. https://doi.org/10.1037/a0032688

Proctor, C., & Blikstein, P. (2017). Interactive fiction: Weaving together literacies of text and code. In *Proceedings of the 2017 Conference on Interaction Design and Children* (pp. 555–560). Stanford, CA; Association of Computing Machinery.

Pusey, M., & Pusey, G. (2015). Using Minecraft in the science classroom. *International Journal of Innovation in Science and Mathematics Education*, *23*(3), 22–34.
Puttick, G., & Tucker-Raymond, E. (2018). Building systems from scratch: An exploratory study of students learning about climate change. *Journal of Science Education and Technology*, *27*(4), 306–321. https://doi.org/10.1007/s10956-017-9725-x

Reitman, J. G., Anderson-Coto, M. J., Wu, M., Lee, J. S., & Steinkuehler, C. (2019). Esports research: A literature review. *Games and Culture*, *15*(1), 32–50. https://doi.org/10.1177/1555412019840892

Rosenheck, L., Clarke-Midura, J., Gordon-Messer, S., & Klopfer, E. (2017). Tipping the scales: Classroom feasibility of the radix endeavor game. *Serious Games and Edutainment Applications*, 225–258. https://doi.org/10.1007/978-3-319-51645-5_10

Rothwell, G., & Shaffer, M. (2019). ESports in K-12 and post-secondary schools. *Education Sciences*, *9*(2), 105. https://doi.org/10.3390/educsci9020105

Ryu, D., & Jeong, J. (2018). Two faces of today's learners: Multiple identity formation. *Journal of Educational Computing Research*, *57*(6), 1351–1375. https://doi.org/10.1177/0735633118791830

Slota, S. T., Young, M. F., Travis, R., Choi, B., & Kaufman, J. C. (2015). Game narrative, interactive fiction, and storytelling: Creating a "time for telling" in the classroom. In G. P. Green (Ed.), *Video Games & Creativity* (1st ed., pp. 199–222). essay, Academic Press.

Squire, K. D. (2005). Changing the game: What happens when video games enter the classroom? *Innovate: Journal of Online Education*, *1*(6).

Squire, K. D. (2010). From information to experience: Place-based augmented reality games as a model for learning in a globally networked society. *Teachers College Record*, *112*(10), 2565–2602.

Staiano, A. E., Abraham, A. A., & Calvert, S. L. (2012). Competitive versus cooperative exergame play for African American adolescents' executive function skills: Short-term effects in a long-term training intervention: Interactive media and human development. *Developmental Psychology*, *48*(2), 337–342. https://doi.org/10.1037/a0026938

Steinkuehler, C. (2007). Massively multiplayer online gaming as a constellation of literacy practices. *E-Learning and Digital Media*, *4*(3), 297–318. https://doi.org/10.2304/elea.2007.4.3.297

Steinkuehler, C. A. (2006). Massively multiplayer online video gaming as participation in a discourse. *Mind, Culture, and Activity*, *13*(1), 38–52. https://doi.org/10.1207/s15327884mca1301_4

Sung, H.-Y., & Hwang, G.-J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. *Computers & Education*, *63*, 43–51. https://doi.org/10.1016/j.compedu.2012.11.019

Sáez-López, J., Miller, J., Vázquez-Cano, E., & Domínguez-Garrido, M. (2015). Exploring application, attitudes and integration of video games: MinecraftEdu in middle school. *Educational Technology & Society*, *18*(3), 114–128.

Tanner, H., & Jones, S. (2000). *Using ICT To Support Interactive Teaching and Learning on a Secondary Mathematics PGCE Course*. Australian Association for Research in Education.

Taradi, S. K., Taradi, M., Radić, K., & Pokrajac, N. (2005). Blending problem-based learning with web technology positively impacts student learning outcomes in acid-base physiology. *Advances in Physiology Education*, *29*(1), 35–39. https://doi.org/10.1152/advan.00026.2004

Taylor, T. L. (2009). *Play between worlds: Exploring online game culture*. The MIT Press.

Taylor, T. L. (2015). *Raising the stakes: E-sports and the professionalization of computer gaming*. MIT Press.

Van Eaton, G., Clark, D. B., & Smith, B. E. (2015). Patterns of physics reasoning in face-to-face and online forum collaboration around a digital game. *International Journal of Education in Mathematics, Science and Technology*, *3*(1), 1. https://doi.org/10.18404/ijemst.10740

Vandercruysse, S., ter Vrugte, J., de Jong, T., Wouters, P., van Oostendorp, H., Verschaffel, L., Moeyaert, M., & Elen, J. (2016). The effectiveness of a math game: The impact of integrating conceptual clarification as support. *Computers in Human Behavior*, *64*, 21–33. https://doi.org/10.1016/j.chb.2016.06.004

Voiskounsky, A. E., Yermolova, T. D., Yagolkovskiy, S. R., & Khromova, V. M. (2017). Creativity in online gaming: Individual and dyadic performance in Minecraft. *Psychology in Russia: State of the Art*, *10*(4), 144–161. https://doi.org/10.11621/pir.2017.0413

Vygotsky, L. S. (1979). Consciousness as a problem in the psychology of behavior. *Soviet Psychology*, *17*(4), 3–35. https://doi.org/10.2753/rpo1061-040517043

Vygotsky, L. S. (1990). Imagination and creativity in childhood. *Soviet Psychology*, *28*(1). https://doi.org/10.2753/RPO1061-0405280184

Werner, L., Denner, J., & Campe, S. (2015). Children programming games: A strategy for measuring computational learning. *ACM Transactions on Computing Education*, *14*(4), 1–22. https://doi.org/10.1145/2677091

Whitton, N. (2013). Games for learning: creating a level playing field or stacking the deck? *International Review of Qualitative Research*, *6*(3), 424–439. https://doi.org/10.1525/irqr.2013.6.3.424

Wijman, T. (2021, May 6). *Global games market to generate $175.8 billion in 2021; despite a slight decline, the market is on track to surpass $200 billion in 2023*. Newzoo. Retrieved from https://newzoo.com/insights/articles/global-games-market-to-generate-175-8-billion-in-2021-despite-a-slight-decline-the-market-is-on-track-to-surpass-200-billion-in-2023/#:~:text=We%20forecast%20that%202021's%20global,the%20games%20market%20to%20decline.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM*, *49*(3), 33–35.

Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology*, *105*(2), 249–265. https://doi.org/10.1037/a0031311

Young, M. F., Slota, S., Cutter, A. B., Jalette, G., Mullin, G., Lai, B., Simeoni, Z., Tran, M., & Yukhymenko, M. (2012). Our princess is in another castle: A review of trends in serious gaming for education. *Review of Educational Research*, *82*(1), 61–89. https://doi.org/10.3102/0034654312436980

Higher Education Video Game Alliance – HEVGA.org – @theHEVGA

The Higher Education Video Game Alliance is the leading academic association advocating for the critical role video game programs play in higher education, industry, and government. Our mission is to create a platform for higher education leaders which will underscore the cultural, scientific, and economic importance of video game programs in colleges and universities. The key is to create a robust network of resources—including unified advocacy, policymaker engagement, media coverage, and external funding—in order to incubate and harness the impact of this community in a 21st century learning environment.

For more information, visit HEVGA's website or follow HEVGA on Twitter @theHEVGA.

Entertainment Software Association – TheESA.com – @TheESA

The Entertainment Software Association (ESA) serves as the voice and advocate for the U.S. video game industry. Its members are the innovators, creators, publishers and business leaders that are reimagining entertainment and transforming how we interact, learn, connect and play. The ESA works to expand and protect the dynamic marketplace for video games through innovative and engaging initiatives that showcase the positive impact of video games on people, culture and the economy.

For more information, visit the ESA's website or follow the ESA on Twitter @theESA.