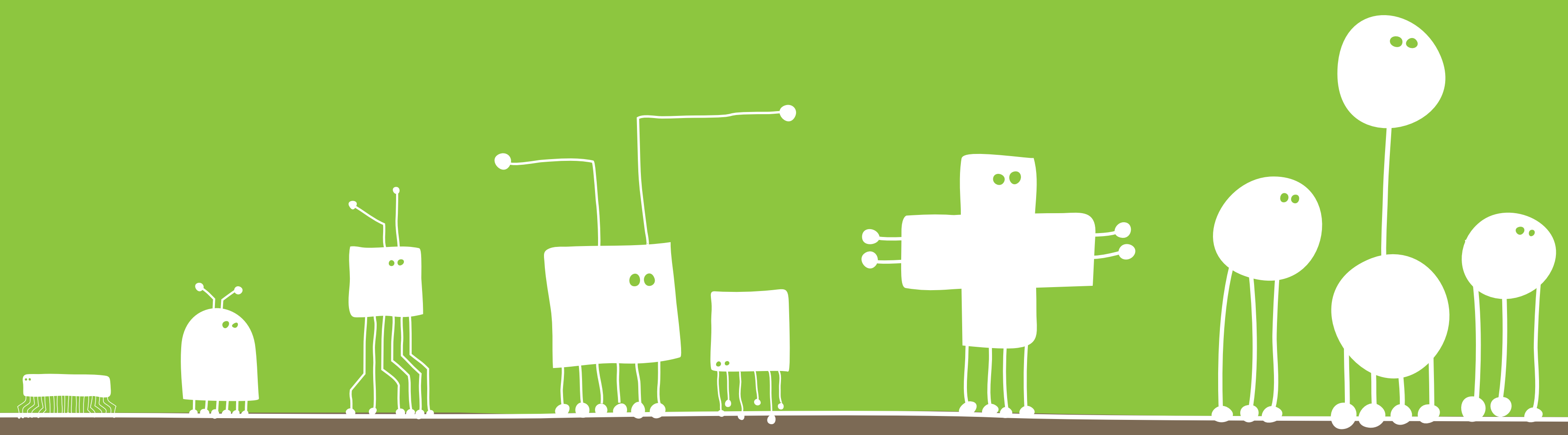
Games for a digital age:

K-12 market map and investment analysis



John Richards, Ph.D.
Leslie Stebbins, M.Ed.
Kurt Moellering, Ph.D.

Winter 2013
The Joan Ganz Cooney Center at Sesame Workshop

In 2011, with generous support from the Bill and Melinda Gates Foundation, E-Line Media and the Joan Ganz Cooney Center at Sesame Workshop established the Games and Learning Publishing Council. The goal of the Council is to understand the market dynamics for digital learning games in K-12 schools and to identify areas of innovation that are ready for new investment. The Council, which is made up of a multi-sector leadership group of industry, research, philanthropic, policy, and practice leaders, is developing analytical tools, business case examples, and national survey reports to help build public understanding and to identify research-based opportunities to "raise the sector."

Games for a Digital Age advances the Council's efforts to position digital games and new forms of pedagogy as potentially important allies in creating more personalized and deeper learning in the decade ahead. The report draws on a wide cross-section of expert interviews, a literature and document review, and a deep dive into the market forces that are swirling around the evolving games and learning sector. Dr. John Richards and colleagues have helped chart a current market map of game-based learning initiatives, including an analysis of relevant trends in education and digital technology that are likely to impact the game-based learning market.

In addition to this report, the Council is documenting significant developments on both the "demand" and "supply side" of the education marketplace. Future efforts will focus on dissemination of:

- analytic briefs focused on the creation of successful research-based products, models, and tools for advancing children's learning with games;
- practice "proof-points," including video case studies of effective uses of games in the classroom;
- the development of a policy and industry briefs outlining options for new national R&D and industry-led investments in the effective use of games in advancing deeper student engagement and achievement; and
- the creation of a permanent, online resource for the education gaming field that blends the Council's analyses and key reports curated from other business leaders, investors, scholars, and philanthropic sources.

Games for a Digital Age explores the market potential of a fast moving field, tracking innovations from the commercial game industry and academic game labs, and examining pockets of game-based experimentation in the classroom and other learning settings. The authors conclude that current approaches to solving key educational challenges are ripe for disruption, but that the marketplace is slow to adapt and dominated by forces that may well resist high-quality digital products. While games are by no means a "silver bullet" to the current challenges that roil America's schools, this report is a timely reminder that our educational institutions would be wise to more robustly leverage the ubiquitous digital media—including digital games—that currently pervade children's lives.

Michael H. Levine
Executive Director
Joan Ganz Cooney Center at Sesame Workshop

table of contents

advancing children's learning in a digital age

the Joan Ganz Cooney Center at Sesame Workshop

"Imagine if kids poured their time and passion into a video game that taught them math concepts while they barely noticed, because it was so enjoyable."

- **Bill Gates,** in his speech to the Education Commission of the States' National Forum on Education Policy, July 11, 2012

This report analyzes the sales and market potential for digital learning games in the institutional K-12 market. Our analysis is the result of extensive market research and a series of fifty structured interviews conducted from June 2011 through July 2012. These interviews were with leaders from the developer and publishing industries, and from the government, foundation, investment, and research communities.

Schools provide a significant opportunity for investors, publishers, and learning game developers: they are a $600 billion market (Market Data Retrieval, 2011). However, they are also a complex market that may seem difficult to access because few rules that apply on the consumer side apply to the K-12 institutional space.

This report provides a blueprint for those wishing to succeed in the institutional school space. It defines the two essential areas that must be understood to successfully sell digital learning games to schools: the K-12 learning game landscape and the K-12 institutional market.

The first part, "*Defining the K-12 Learning Games Landscape*," concludes that:

- Learning games are not a single type. Rather, they are best understood in terms of the functions they serve in the school context.
- In terms of selling to the K-12 market, understanding the continuum from short-form to long-form games is critical.
- Short-form games provide tools for practice and focused concepts. They fit easily into the classroom time period and are especially attractive to schools as part of collections from which individual games can be selected as curricular needs arise.
- Long-form games have a stronger research base than short-form games and are focused on higher order thinking skills that align more naturally with new common core standards. These games do not fit as easily into the existing school day or classroom time period, but are the source of new experimentation in the research community and a variety of school contexts.

The second part, "*Selling to Schools*," defines the complex and expansive K-12 institutional market, as well as systemic barriers to entry for any new product into the market. However, we also identify recent enabling trends that should give investors, game developers, and publishers optimism moving forward.

The systemic barriers to entry include:

- the dominance of a few multi-billion dollar players;
- a long buying cycle, byzantine decision-making process, and narrow sales window;
- locally controlled decision making that creates a fragmented marketplace of individual districts, schools, and teachers;
- frequently changing federal and state government policies and cyclical district resource constraints that impact the availability of funding;
- the demand for curriculum and standards alignment and research-based proof of effectiveness; and
- the requirement for locally delivered professional development.

However, recent trends provide an increasingly positive arena for learning games and other digital products, including:

- the move to one-to-one computing in schools and the rise of a "Bring Your Own Device" (BYOD) infrastructure for learning;
- the widespread acceptance and purchase of interactive white boards;
- the improvement of school IT infrastructure and access to the Internet;
- the 2010 National Education Technology Plan;
- a strong focus on Science, Technology, Engineering, and Math (STEM) skills, and more broadly, on higher-order thinking skills;
- an increasing move in schools from print to digital materials and from a highly structured to a somewhat flexible textbook adoption process;
- the increasing interest in Personalized Learning Environments (PLEs) and adaptive engines; and
- an expanding base of research that shows the effectiveness of long-form games in learning.

We believe that the information presented here—combining an understanding of the learning-game landscape and the K-12 market—offers a unique perspective that will allow marketers and investors to enter the school space.

Ultimately, "Games for a Digital Age" recommends that marketers and investors:

- produce collections of short, focused games, each of which fits easily into the single-subject, forty-minute classroom. There is already a roadmap and market that works for these types of games.
- affiliate selectively with school reform leaders to help move schools towards content-rich, deep curricula that foster critical thinking and problem solving. This is a longer process, but the types of games produced for such an environment are better supported by research. Furthermore, a deeper involvement with schools offers game developers the opportunity to cement exclusive, long-lasting relationships with a developing market.

"I'm calling for investments in educational technology that will help create digital tutors that are as effective as personal tutors, educational software as compelling as the best video game."

- **President Barack Obama** (Lee, 2011)

the story of a developing market

Playing games is a natural and universal human activity. For millennia, games have inspired and motivated active learning. They encourage collaboration, offer performance challenges, compel adaptation to diverse situations, leverage and reward practice, and engage players for a lifetime. As Games and Squire (2011, p. 18) argue "play is central to the learning theories of Dewey, Piaget, and Vygotsky."

In the past decade, digital games have become the most successful segment of the market for consumer digital products.

Following this commercial success, and because games may be a model for how students should engage curricula and can aid teachers in their efforts to motivate and challenge students, there is renewed interest in digital learning games by the government, foundations, researchers, and the investment community. Many educators and researchers see learning games as offering a "promising and untapped opportunity to leverage children's enthusiasm and to help transform learning" (Thai, Lowenstein, Ching, & Rejeski, 2009).

Over the past thirty years, games such as *Where in the* ***World is Carmen Sandiego?, Math Blaster, Oregon Trail,*** and ***SimCity*** have seen some success in the K-12 institutional market. These games were engaging and commercially profitable. They managed to catch the attention of schools and had some success in the K-12 market at a time when personal computers were first being introduced in schools. More recently, a new generation of games has emerged and is beginning to penetrate the K-12 market; but this penetration has been slow. BrainPOP, Discovery Education, and Explore Learning have created broad collections of games and other interactives that teachers now access to fill particular places in the curriculum.

The perspective of foundations and investors on learning games combines heady enthusiasm with a "wait and see" attitude. There seems to be a great deal of excitement in these communities for the potential of learning games in the K-12 market. At the same time, the lack of success stories and easy formulas for dealing with distribution issues makes both somewhat reluctant to jump in.

However, the big picture from our interviews is more encouraging than not, as foundations, government representatives from NSF, and investors all feel games inevitably will succeed in the school space, with many believing there may be movement in the next several years. Tom Vander Ark expresses the beliefs of many: "I think it is fair to say learning games and game-based content will be part of every student's day five years from now" (CS4Ed interview, April 2012).

Overall, the attitude of investors, despite their questions about learning games in the K-12 space, is one of "when" and "how," not "if." For example, Josh Cohen, Managing Partner of City Light Capital, sees that investors "are generally optimistic" about learning games even though he "can't point to any winners in terms of being able to make money." Nevertheless, he finds "an intuitive acceptance and excitement" in spite of a general "lack of proof or data" (CS4Ed interview, April 2012). Vander Ark says that his firm, Learn Capital, recognizes that although "[g]ames historically have been expensive to make and difficult to sell . . . it is becoming less expensive to develop which is helping on the return on investment" (CS4Ed interview, April 2012). Additionally, several investors also say that they are particularly interested in funding early stage entrepreneurs in the immersive games space even though they are not seeing much to fund in this space right now.

Optimism for the viability of learning games in the K-12 classrooms comes from the very top of the funding community. According to the *Atlanta Journal-Constitution*, Bill Gates believes "there are lessons to be learned from the enthusiasm kids have when playing video games, including that winning can be a motivator and that students should be able to move to the next level when ready." In an interview with the *Constitution*, Gates stated, "We're not saying the whole curriculum turns into this big game. We're saying it's an adjunct to a serious curriculum" (interview with Jaime Sarrio, *AJC*). Last year in fact, the Bill and Melinda Gates Foundation gave $20 million in grants to provide schools with teaching tools—including learning games.

overview

This report provides information and recommendations for investors, game developers, and publishers hoping to succeed in the K-12 institutional space. To do this, we analyze the two discrete fields investors must understand: first, the continuum of learning games, including different types of games and research on their effectiveness; and second, the unique and, at times, complex landscape of the K-12 institutional market. We have explicitly not looked at the rich consumer market for digital learning games, nor have we examined the less traditional adjacent markets, e.g. after school, independent distance learning courses, game design contests, or homeschooling.

Many of our conclusions come from extensive research that is exclusive to this report (see Appendix B for the Literature Review). Between June 2011 and April 2012, fifty in-depth interviews were carried out with game developers, game publishers, foundation and government funders, and non-profit and for profit education investors.

The interviewees include individuals from multiple communities:

- Game developers: companies that create games for third party distribution.
- University researchers: funded research and development efforts in the university environment.
- Game publishers: companies that both create and distribute games.
- Educational publishers: companies that market and sell a variety of educational materials to the K-12 market.
- Investors: companies from the financial services industry, including venture capital, mergers and acquisitions, and investment banking.
- Foundations: non-profit funding organizations with an interest in education and learning games.
- Government: program officials from the National Science Foundation and the Office of Science and Technology Policy.

This report is also driven by the focus of recent studies such as the National Research Council's *Learning Science Through Computer Games and Simulations* (Honey and Hilton, 2011and the recent AERA Journal review of 300 research articles on the impact of learning games in education (Young, et al., 2012).

This report has three parts: *(1) Defining the K-12 Learning Games Landscape, (2) Selling to Schools: The K-12 Institutional Market,* and *(3) Moving Forward.*

Part 1 of the report, *Defining the K-12 Learning Games Landscape*, provides an analysis of the nature of learning games themselves based on our market research and interviews. We use this data to provide a taxonomy and overview of products and approaches in the market. We adopt a useful and, in our judgment, critical distinction between long-form games (games that continue for more than a class period and may extend for weeks), and short-form games (games that take place within a single class, often for under ten minutes). The taxonomy and continuum of game products presented in this section clarify what types of games are being discussed and illustrate the elements of successful approaches to the K-12 institutional market.

Part 2, *Selling to Schools: The K-12 Institutional Market*, begins with a brief overview of the existing K-12 institutional market and an analysis of the sales process in that market. Learning games are almost always purchased to supplement the core curriculum. In many ways, they are no different from other supplemental materials that are purchased and used in schools. Supplemental materials that succeed commercially must meet a market need (e.g., reading remediation), be easy to use and cost effective, fit into the curriculum, make the teacher's job of teaching easier, and make the student's job of learning effective and measurable.

The title of a recent paper, "K-12 entrepreneurship: Slow entry, distant exit," (Berger & Stevenson, 2007) summarizes the somewhat unique dynamics of this market that currently present systemic barriers to entry for any new product. These barriers include the dominance of a few multi-billion dollar players, a long buying cycle, selling costs, a byzantine decision-making process, demand for curriculum and standards alignment, requirements for proof of effectiveness, and a need for professional development. Such barriers are compounded by shifting federal and state government policies, as well as by local decision-making that creates a fragmented pre-K-12 public school marketplace of 50 states, 13,600 districts, and 99,000 schools.

However, the K-12 environment is evolving. The technology infrastructure is becoming ubiquitous, a print to digital transition has been energized by changes in state policies, technologies like the interactive whiteboard have paved the path to digital lessons, and the use of interactives is enlivening learning and engaging students. Teachers themselves are becoming more digitally savvy.[1] Long-held assumptions about the K-12 market are losing validity. From our perspective, this is a technologically disruptive time for the K-12 market, and with disruption comes opportunity (Christensen, 1997). This part of the report gives an up-to-date, comprehensive view of this evolving market.

Part 3, *Moving Forward*, takes a step back to explain some of the macro-trends that are producing big picture optimism for investors and developers. It also puts together what we have presented about learning games and the current state of the K-12 market to draw two broad conclusions investors should consider when making funding decisions in the K-12 space.

1. Investors should support collections of short-form games that maximize teacher flexibility, align to standards, and can be utilized during a 40-minute class.

2. Investors looking for long-form games to support will succeed to the extent that they can simultaneously be involved in education reform movements that will re-imagine the school day to promote in-depth study, provide longer class periods, involve open ended projects, and engage critical thinking skills.

defining the K-12 games landscape

the nature of learning games

Games have been characterized as having four traits: a goal, rules, a feedback system, and voluntary participation (McGonigal, 2011). Along these same lines, key researchers in the field have identified games as “incorporating a voluntary activity structured by rules, with a defined outcome (winning, losing) or other quantifiable feedback (e.g., points) that facilitates reliable comparisons of in-player performances" (Klopfer, Osterweil, & Salen, 2009, p. 11). Learning games differ from entertainment and training games because they "… target the acquisition of knowledge as its own end and foster habits of mind and understanding that are generally useful or useful within an academic context" (Klopfer, et al, 2009, p. 21). In this report we are only looking at *digital* learning games—that is a game that must be played by manipulating some form of electronic media (computer, game console, or cell phone).

The language of gaming and learning games is still in flux, and there has been little agreement between experts in the field about what falls under the category of "learning game" and what is not a game, but has "game-like" elements. Not surprisingly, the literature of games contains no agreed upon definition of a learning game. When we asked our interviewees what they considered a game, we found no consensus. One extreme cited any "formative assessment based on an adaptive engine," while the other cited products with aspects of game mechanics such as badges, rewards, and points. Although the Software and Information Industry Association (SIIA) Codie awards category is for "Games and Simulations" (and researchers are sometimes careful to distinguish between simulations and games), for the purposes of this report we have included simulations in our broad definition of learning games.

Such a wide range of products is confusing to the K-12 audience, because "games" can vary from products that are prototypical to ones that only leverage somewhat extraneous game mechanics to engage and to motivate. Confusion among types of games is of particular concern when examining the research evidence of the effectiveness of games in learning. Most university-based research evaluates learning games in environments that engage students for several weeks with immersive, challenging experiences. Thus, when researchers argue that learning games are efficacious, promote critical thinking, and engage 21st century skills, it is not necessarily clear that these conclusions apply to many shorter forms of learning games.

All games have game mechanics that are the central element of the game and, to some degree, are integrated with the learning content. As James Gee argues in his keynote at the 2012 Games for Change conference, the extent to which the mechanics of creating motivation and directing attention is intrinsic to the content of the game can greatly influence learning outcomes.[2]

Gamification is the use of game-based elements or game mechanics to drive user engagement and actions in non-game contexts. In gamification, the game mechanics are divorced from the content being taught and are instead added in the form of some sort of reward element after completion of an activity. For example, a short-form math game that involves answering math questions where correct answers are followed by a badge or the reward of playing a "dunk the clown" game would be called gamification. David Dockterman, Ed.D., Chief

Architect, Learning Sciences with Tom Snyder Productions/Scholastic is concerned about this use of game mechanics, stating "Gamification can begin to undermine a kid's desire to learn" (CS4Ed interview, March, 2012).

In what follows, we define a time continuum for games. We also attempt to categorize and provide examples of different types of learning games in order to better understand the value and market potential of each in the K-12 world. In practice, there are many different types and "degrees" of learning games, so that any such categorization must encompass a loosely structured *family of meanings* where learning games can be grouped along this continuum and seen to possess some, but not always all, of the same traits. Some of these more specific traits include objectives, outcomes, feedback, conflict, competition, challenge, opposition, interaction, and representation of story (Prensky, 2001). Learning games can be "purposeful, goal-oriented, rule-based activities that the players perceive as fun" (Klopfer, 2008, p. 4). "They move beyond entertainment per se to deliver engaging interactive media to support learning in its broadest sense" (Stone, 2008, p. 277).

Based on our initial set of interviews, we created a matrix of more than 30 game characteristics or key variables to classify and characterize learning games. We tested this model by placing current games into our matrix (see Appendix A). The matrix is oriented toward the K-12 institutional market: what will assist developers and others in determining what types of games will have a higher chance of success in this market.

The Time Continuum

What struck us as most important in analyzing the matrix and reflecting on the interviews was the critical need to fit into the inflexible time constraints of the school calendar. The school day is divided into class periods, and this division limits lesson length. Furthermore, the combination of standards and the scope and sequence tied to core curriculum create "coverage" requirements that place practical limits on the number of lessons that can be devoted to a single topic.

Nearly all games fall clearly along a continuum ranging from short-form to long-form with a critical distinction and a bi-modal distribution pattern based on fitting in a class period. As noted by Rob Lippincott, Sr. Vice President of Education, PBS, "Games don't fit the time box of a class period; a game succeeds when it is sticky and gobbles up more time. You want games in school to finish quickly and speed up learning" (CS4Ed interview, April 2012).

We placed games into these two time-based categories, short-form and long-form. Within these broad areas fall dozens of different kinds of games, ranging from three-minute apps to open, immersive Multi-User Virtual Environments (MUVEs) that involve lengthy game playing. In addition to the length of play, the mechanics of a gaming experience varies broadly, with simple "add-on" gamification-type reward systems falling typically at the short end of the time continuum, and more complex, multiple-path, role playing games falling at the long end. In longer-form games, the game mechanics are typically intrinsic to the learning experience rather than placed at the end of or external to the game play itself.

We are not the first to note the relevance of *time played* in creating a framework for learning games. In 2008, Kurt Squire created a genre grouping that differed in part from previous classification attempts by calling attention to the need for different theories to "explain how learning operates in each domain" (Squire, 2008). Though Squire's framework was not focused on market issues, the "time" factor is relevant both for ease of entry into the K-12 space as well as for evaluating learning outcomes for different types of games (see Table 1).

Table 1. Framework for Examining Different Games (Squire, 2008)

Game Genre	Time to Completion	Timescale	Openendedness	Modes of Creative Expression	Eduational Examples
Targeted games (puzzle, mini-games)	1-4 hours	Weeks	Low	Style of completion; level creation	Supercharged
Linear games (Viewtiful Joe, Ninja Gaiden)	20-40 hours	Month	Low	Style of completion, machinema	Full Spectrum Warrior; epistemic games
Open-ended, sandbox games	100-200 hours played over multiple months	2-24 months	High	Style of completion, multiple solution paths, modding	Civ, Sim City
Persistent worlds (WoW, Everquest)	500+ hours	6-48 months	High	Modding, social engineering, game play	Quest Atlantis

When marketing games in the K-12 space, knowing how games fit into the school curriculum and school schedules is critical. Because of the importance of this distinction for schools, we provide the following loosely classified collection of game types divided into short-form and long-form categories with examples. It is essential to keep the continuum delineated here in mind when examining the sales and marketing strategies involved in selling learning games to schools in section 2 and when reading our final recommendations in section 3.

1. Short-Form Learning Games

In most K-12 schools the day is organized in blocks of time that average 40 minutes or less. Transition time and time for instruction or discussion connected to curricular material frequently leaves only 20 to 30 minutes for actually using a learning game. Short-form games are interactive digital activities that fit within a single class period and have some components common to all learning games. They focus on a particular concept or on skill refinement, skills practice, memorization, or performing specific drills.

Successful short-form games meet an important and defined market need, whether it is by demonstrating a concept to the whole class on an interactive white board, or by providing individual students with practice on a specific concept or skill. Short-form games include drill and practice, brief simulations, visualizations, or simulated training tools, and different types of "game-like" interactive learning objects. These types of games have the potential to be embedded in personalized learning environments or adaptive engines that combine data and feedback loops that are becoming increasingly popular in schools.

This type of game product is starting to gain traction in the K-12 market, due in part to its alignment to standards and to extensive product lines that cover many topics within the curriculum or meet an important, albeit narrow, market need. Teachers find such games easy to access and understand, and the games fit neatly into the short blocks of time available in the structured school day.

2. Long-Form Learning Games

Long-form learning games extend beyond a single class period. Typically game playing is spread over multiple sessions or even several weeks. Long-form games lend themselves to the development of 21st century skills such as critical thinking, problem solving, collaboration, creativity, and communication. Squire underlines the distinction between the sophisticated learning skills developed through immersive experiences versus games where students are rewarded for memorizing vocabulary words or performing math drills. Squire views games such as ***Civilization III*** as having the potential to push students to engage actively in problem solving, reflection, and decision making related to historical and political situations (Squire as quoted in Klopfer, Osterweil, Groff, & Haas, 2009). Other researchers concur, and view long-form, immersive game play as a critical factor supporting a broad arena of social and cognitive learning (Shaffer, 2006; Bogost, 2007).

A number of individual studies have demonstrated that specific long-form games perform better when compared to typical lectures. Examples from research studies include ***Supercharged!***, an electrostatics game that showed a 28% increase in learning (Squire, Barnett, Grant, & Higginbotham, 2004); ***Geography Explorer***, a geology game that showed a 15 to 40% increase in learning (McClean, Saini-Eidukat, Schwert, Slator, & White, 2001); ***Virtual Cell***, a cell biology game that showed a 30–63% increase in learning (McClean et al., 2001); and ***River City***, a game that showed a 370% increase in learning for D students and 14% increase for B students (Ketelhut, 2007).

Recent research also points to the significance of the engagement factor produced by long-form learning games. Engagement fosters motivation and keeps students involved in the learning experience. While many educational software products have focused on extrinsic rewards for skills practice, longer form games where game play and learning are closely connected have been proven to be even more engaging than following a learning task with an external reward (Habgood & Ainsworth, 2011).

The authors of a report issued by the Committee on Science Learning at the National Research Council concluded that simulations and games have great potential to improve science learning in the classroom because they can "individualize learning to match the pace, interests, and capabilities of each particular student and contextualize learning in engaging virtual environments" (Honey & Hilton, 2011). The authors also echoed previous research demonstrating the appeal and engagement of learning games, and indicate that games can help support new inquiry-based approaches to science instruction by providing virtual laboratories or field learning experiences that overcome practical constraints.

The time required for playing long-form games has proven to be a significant barrier to their widespread adoption. As Dave McCool, co-founder, President and CEO of Muzzy Lane Software explains, "For us, with **Making History**[3], it was a matter of having a product that was deep and narrow and was only needed for content that was covered for one week of the curriculum" (CS4Ed interview, February 2012). In our interview, Scott Traylor, CEO and founder of 360KID, argued that long-form games can more easily fit into the homework side of the equation and that class time can be reserved for discussing results of the homework activities, strategies, and content learned (CS4Ed interview, March 2012). This "flipped classroom" model addresses the classroom time factor in that teachers can control how much time is spent on discussion sessions. However, there remain challenges with connectivity for students from lower-income households. As more schools experiment with various forms of online and blended learning, a better fit between available class time and long-form games may emerge.

Game Taxonomies

In a comprehensive review of the research literature on learning games, Tobias and Fletcher (2011) conclude that the findings on learning from games and the transfer of that learning to external tasks are "less robust than one might wish." They call for the development of a taxonomy of games in order to help clarify future research on what types of outcomes might be expected from what types of games and for what types of students. From our interviews we believe it also is critical to develop such a taxonomy in light of the distinction between short-form to long-form games.

Taxonomies have attempted to classify learning games for a variety of goals. They typically focus on efficacy research and on determining whether a particular game type is effective for particular types of learning. An early attempt by Herz (1997) divided games into the following types:

- Action
- Adventure
- Puzzle

- Role-Playing
- Simulations

The game map developed for this report builds on previous attempts at game taxonomies, (including more recent taxonomies developed by Squire, 2008; Wilson, et al. 2009; Liu & Lin, 2009; Frazer, Argles, & Willis, 2008; and others). However, it is primarily related to marketing into the institutional market for learning games, and only secondarily on issues of learning games and efficacy. This taxonomy synthesizes previous attempts to develop a list of types of learning games.

Genre types

The following categories or genres were created with the assumption that some degree of overlap between categories is inevitable:

1. Drill and Practice
2. Puzzle
3. Interactive Learning Tools
4. Role Playing
5. Strategy
6. Sandbox
7. Action/Adventure
8. Simulations

1. Drill and Practice

Drill and practice activities are the prototypical short-form games. They are focused on the acquisition of factual knowledge or skill development through repetitive practice. Small tasks such as the memorization of vocabulary word definitions, math facts, or touch typing skills are the focus of drill and practice games. Many online interactive drill and practice programs provide some sort of game mechanic to bolster student engagement. Sometimes the game mechanic is integrated into the learning content and sometimes it comes at the end of a group of activities in the form of gamification such as providing the student with a small reward or the opportunity to play a quick game after achieving a certain score on the content-learning portion of the tool. Some drill and practice games also provide an instructional component in addition to the quiz or practice piece, are able to provide feedback on right and wrong answers, differentiate instruction according to student responses, provide data for teachers and administrators, and can be used in conjunction with teacher-led classroom activities. One of the most successful drill and practice programs from the late 1980's, ***MathBlaster***, is still available from **Knowledge Adventure.**[4]

Motion Math[5] produces learning games that are played on mobile devices or tablets. ***Motion Math HD***, the first Motion Math product, is a fractions number line game developed at the Stanford School of Education and launched successfully in 2010 with investment and foundation support. The learning piece—e.g. understanding fractions, percentages, decimals, and pie charts—is directly connected to the game mechanic so that, for example, learners steer a bouncing ball to the correct spot on a number line. Motion Math is standards-based and grounded in research that, among other things, suggests that learning is enhanced when physical experiences connect to intellectual content, and that

Motion Math is standards-based and grounded in research

learning games work best when there is no separation between game play and content learning.

Study Island[6] produces a variety of web-based drill and practice programs. These include assessment and skills practice in all major subject areas and are aligned to state and Common Core standards.[7] Students take a pre-test and are then provided with drills that target their needs and level. Then, after successfully completing lesson units, students are rewarded with a choice of short motivational games. The program further provides teachers with assessment data.

2. Puzzle Games

Puzzle games emphasize problem-solving skills often involving shapes, colors, or symbols that the player must directly or indirectly manipulate into a specific pattern. *Tetris* is an example of a classic puzzle game.

As with *Tetris*, puzzles are typically short-form in design. A new variety of long-form puzzle games present a series of related puzzles that contain a variation on a single theme such as pattern recognition, logic, or the understanding of a specific process. Typically players must unravel clues to achieve a win state, which then allows them to level up.

Foldit[8] is a puzzle learning game focused on protein folding. Designed by a research team at the University of Washington's Center for Game Science, this game's objective revolves around folding the structure of selected proteins using various tools provided within the game. Researchers analyze the highest scoring solutions to determine whether there is a native, structural configuration that can be applied to the relevant proteins in the "real world." Scientists can then use such solutions to solve real-world problems by targeting and eradicating diseases and creating biological innovations. This game makes use of crowdsourcing and distributed computing as well as gamification to make the program more appealing to a wider audience. Learners using the game are given a score and can join groups and share solutions. Remarkably, a team of gamers used Foldit to solve the structure of a retrovirus from an AIDS-like virus that had previously stumped scientists (University of Washington, 2011).

3. Interactive Learning Tools

Interactive learning tools or objects are short pieces of online instruction that can be easily integrated into a larger curriculum. These items can have game-like properties or can be connected to games or rewards. In the K-12 world, learning objects can be short animations, videos, interactive quizzes, or other tools.

BrainPOP[9], frequently thought of as a game, is essentially more than 1,000 animated lessons with interactive items like quizzes attached. Its short animations and interactive tools cover science, social studies, English, math, arts, music, health, and technology and have been aligned with curriculum standards by state. The site was marketed initially to parents and became very popular in the consumer market, transitioning gradually into schools. Similar to the drill and practice games mentioned above, these short-form animations fit easily into the school day. Teachers understand what they are, how to make use of them for limited parts of the school day, and how to use them to meet specific learning goals such as memorizing math facts or learning about George Washington.

BrainPOP has also added a new product for younger children called ***BrainPOP Jr.***, which incorporates games into each brief animation. The site now links their own interactives to various free learning games available through a portal called ***Game-Up***.

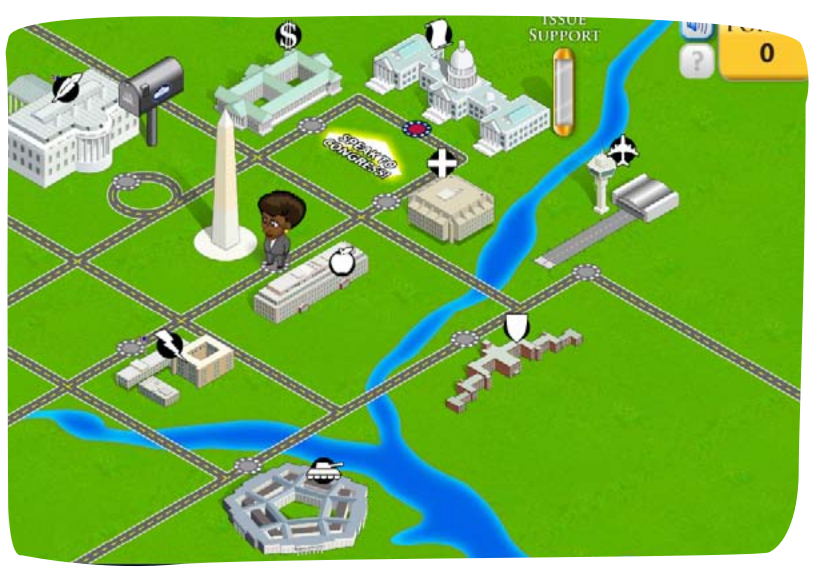
4. Role Playing

Role-playing games portray some sequence of events within the game world which gives the game a narrative element. Players have a range of options for interacting with the game world through their characters and can take multiple paths or double back and revisit times of places they have previously explored (Hitchens & Drachen, 2009). Role-playing games are particularly useful for subjects such as social studies, for example, where students can be immersed in a specific time period in history and grapple with challenges that occurred at the time being studied in order to more fully comprehend concepts such as slavery or civics.

Multi-User Virtual Environments (MUVEs) are a form of role-playing and simulation games that enable participants to access virtual worlds, interact with online artifacts, represent themselves online via an avatar, communicate with other participants, and take part in experiences that model real world environments (Dede, Nelson, Ketelhut, Clarke & Bowman, 2004).

Early role-playing games such as **Oregon Trail**[10] were immensely successful in schools. In this simulation, students played roles that required successful navigation of the onerous conditions that pioneers encountered in the Westward expansion.

iCivics[11] is a web-based learning game founded by former Supreme Court Justice Sandra Day O'Connor. It is designed to teach civics and inspire students to be active participants in U.S. democracy. ***iCivics*** includes role-playing games that simulate such things as being "President for a Day" or arguing a case before the Supreme Court. This game is aligned to state standards and includes teacher materials, lesson plans, and PowerPoint presentations. Its modularized format is especially appealing to teachers, allowing them to select specific pieces of the content and connect that content to state standards. ***iCivics*** is a free resource to schools.



iCivics provides opportunities to engage in role-playing games such as Executive Command.

Similarly, Mission U.S.[12] is a series of multiplayer games that immerse players in U.S. historical content. "For Crown or Colony?" places the player in the role of a printer's apprentice in 1770 Boston. In "Flight to Freedom" the player is a slave in Kentucky in 1848. It is funded by the National Endowment for the Humanities and the Corporation for Public Broadcasting with several partners in the non-profit sector.

River City[13] is a research-based project funded by the National Science Foundation (NSF) that involves an interactive computer simulation for middle grade science students to learn scientific inquiry and 21st century skills. It combines the look and feel of a learning game with content developed from National Science Education Standards and the National Educational Technology Standards.

The creators of ***River City*** were well aware of the challenging nature of introducing immersive games into the formal education environment, the challenges specific to middle school students, and issues of engagement and teacher reluctance to learn new technologies. As the product was created, the developers addressed these issues to the degree possible and tried to solve the challenges of scalability. In the end, after years of successful research and development, ***River City*** did not have the kind of funding needed to go to market on its own and could not find an industry partner willing to take the product to market, even when it was offered for free.

CSI[14], also funded by the NSF as well as Rice University, CBS, and the American Academy of Forensic Sciences, is a series of role-playing games based on the CSI television series designed to teach students the process of forensic investigation and problem solving. ***CSI*** is known for its extremely high quality graphics and navigational features that rival games in the consumer market.

Martha Madison[15], a new game currently being designed by Second Avenue Software, also uses


Civilization V is a strategy game that exposes players to historical content.

role-playing to teach students. It is focused on engaging girls in STEM learning and careers. The game is being created using the Unity 3D platform, which allows for publishing to a diverse array of applications including tablets, computers, consoles, and mobile devices. ***Martha Madison*** is being designed to align with emerging Common Core standards in science.

5. Strategy

Strategy games are multiplayer games involving resource management, planning, and strategic deployment (Frazer et al., 2008). The most successful strategy games are in social studies and history.

Civilization V[16] is an incredibly popular consumer strategy game (over nine million units sold worldwide) developed by Firaxis. Players strive to become "Ruler of the World" by establishing and leading a civilization from prehistoric times into the space age, and make strategic decisions regarding diplomacy, expansion, economic development, technology, government, and military conquest.

Civilization has made inroads into the K-12 market albeit with some reservations. At issue: historical accuracy, and whether students are in fact learning the properties of complex systems or just simple heuristics that help them succeed in the game (Squire & Durga, in press). The game exposes players to historical content and asks them to balance multiple variables, as well as make tradeoffs related to financial, military, technological, and cultural issues. Under the best of circumstances, students use the game "...as a model to think about history and the design of social systems" (Squire 2008, p. 179).

Making History II: The War of the World[17] is a multiplayer strategy game developed by Muzzy Lane Software that takes place in the years up to and including World War II. Players take control of nation-level trade and diplomacy, industrial and technology development, transportation infrastructure, and military movement and deployment. The product originally targeted schools, but caught on in the consumer space. Muzzy Lane sold 50,000 copies of this game at $39.99 a piece, with about 10-20% of these sales going to the K-12 classroom. (K-12 discounts for packs of 5 and 10 and units of 25 for $500 were also sold.) A sequel, ***Making History: The Great War***, takes place in the years up to and including World War I.

6. Sandbox

Sandboxes are open-ended exploration environments rather than linear, goal-oriented games. They are characterized by multiple user paths and open-ended structures. These games tend to be highly learner centered, designed to foster 21st century skills including problem-solving, collaboration, and creativity, and frequently allow players to experiment with the mechanics of game play. Some Sandbox games also allow different content to be placed within the Sandbox "container, versatility that can often appeal to teachers. Sandbox games follow in a tradition of student construction that derives from the *Logo* programming movement in the 80's and 90's, which despite never becoming commercially successful, has certainly captured the imagination of researchers and educators (Feurzeig, Papert, Bloom, Grant & Solomon,1969; Papert, 1980).

Scratch[18] is a programming language that makes it easy to create interactive stories, animations, games, music, and art that follows in the Logo tradition and was developed by the Lifelong Kindergarten Group at the MIT Media Lab. A critical component is the Scratch Online Community where students are able to share and augment projects, download others' work, open it up to see how it was created, make changes and upload a new version.

Minecraft is a consumer game where players place blocks to build anything they can imagine in order to survive monsters that come out at night. This popular product has sales of more than 7 million units and an educational adaptation, **MinecraftEdu.**[19] The adaptation further offers custom versions designed for teachers and students, onsite workshops and in-service training, and world-building tools that make it easier to incorporate curricular content. A **video case**[20] study of its use in the classroom is available at on the Joan Ganz Cooney Center website.

7. Action/Adventure

Action/Adventure games typically involve players traveling to an unknown space or environment, often in the role of a traveler or warrior. Some action/adventure games include fighting games, and most action/adventure games are massive multiplayer online games (Harushimana, 2008).

Lure of the Labyrinth is designed for middle-school pre-algebra students. It includes a large number of math-based puzzles wrapped into a narrative game in which students work to find their lost pet and save the world from monsters. The developers have created extensive resources to help teachers incorporate the game in their teaching. Originally developed in 2007 at the MIT Education Arcade, ***Lure of the Labyrinth*** is designed to be used by students outside of the classroom. Teachers and students then use class time to discuss the strategies students used and concepts discovered in playing.

This game is designed to foster collaborative skills and includes a messaging system as a function of game play, giving the students the opportunity to share strategies and work in teams. ***Lure of the Labyrinth*** also provides teachers with assessment data on student work.

8. Simulations

A learning simulation is the manipulation of a model of some event in such a way that it operates on time, space, or magnitude to exert change. Kurt Squire argues that "if it is not a simulation on some level, it is probably not a good educational game" (CS4Ed interview, June 2012). Many simulations clearly lack the dynamics typical of games, but some overlap a great deal with games types such as strategy and sandbox. In an early analysis of simulations as learning tools (and the Sim series by Maxis in particular), Star expresses concern about the assumptions and simplifications built into any simulation (Star, 1994).

Often, simulations do not have the true mechanics that would characterize them as games, but for the purposes of this report both longer simulations and brief simulations are being included in the broad category of learning games. Short, two or three minute simulations or visualizations have been developed for many content areas, but are probably most common in the K-12 sciences or more broadly in Science, Technology, Engineering, and Math (STEM) fields. Simulations are common in adult training environments as well. Short simulations can require a significant amount of resources to develop, but can fit easily into a classroom curriculum. **Molecular Workbench**[21] is a collection of free, interactive, scientific simulations and learning modules developed by the Concord Consortium with support from the National Science Foundation (NSF). The simulations are typically used within a larger curriculum where they can help demonstrate concepts discussed in class such as gas laws, diffusion heat transfer, chemical reactions, and fluid mechanics, and student progress can be tracked (Project WISE at University of California, Berkeley; Linn 2012). ***Molecular Workbench*** also acts as a tool for students to create their own simulations in order to demonstrate their own learning of scientific concepts.

MiddWorld Online[22] is a web-based quest and role-play simulation. Students immerse themselves in culturally accurate environments (such as going to a café in Paris and ordering coffee), while practicing their language skills and using target language vocabulary while interacting with non-player characters and other students in the environment. The ***MiddWorld*** game framework is also designed so that the games can be replicated for other languages and cultures in addition to their initial versions for Spanish and French.

Whitebox Learning[23] designs simulations using CAD to provide a simplified version of a realistic development process such as building a bridge or dragster while simulating the scientific method. Students can then analyze, test, and evaluate what they've built through virtual game play that involves, for example, a drag race or monster truck rally. Like many learning simulations, the ***Whitebox Learning System*** was created as a complement to hands-on activities; students explore designs in the simulated environment and then go on to build real world models based on these explorations.

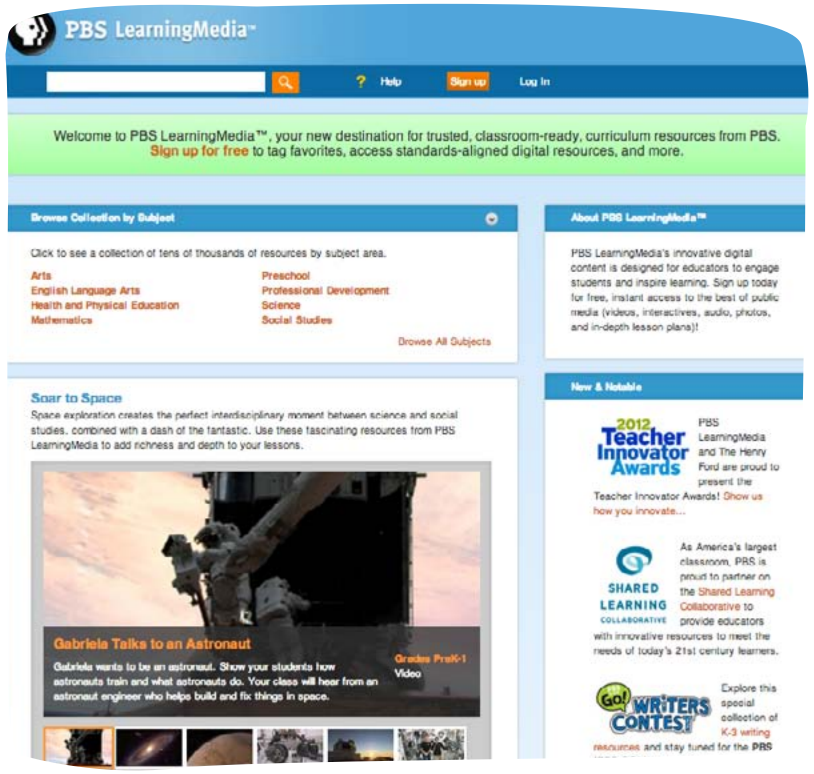
EcoMUVE[24] is a curriculum research project at Harvard's Graduate School of Education that uses immersive simulations to teach middle school students about causal patterns within ecosystems. The project includes two one-week computer based modules that take place in a four-week curriculum, and uses a Multi-User Virtual Environment (MUVE) that has the look and feel of a commercial videogame. Also similar to a commercial gaming environment, here students explore and collaborate in teams, but their purpose is to learn science by exploring and solving problems within a realistic simulation. The curriculum uses a jigsaw pedagogy in which each student plays a different role (e.g., water quality specialist, naturalist, microscopic specialist, investigator) and data is generated from student activities that provide embedded assessment (Dede, 2012).

Collections of Short-Form Games

Short-form games are being used more frequently in schools, but they can be difficult for teachers to find and apply to fast moving classroom situations. The most successful efforts to bring games into schools have combined games with other learning objects into collections. We distinguish three types of collections by the manner in which the teacher or student accesses specific objects.

1. Digital Repositories

Curated digital repositories are libraries of short-form games and other learning objects that consist of extensive product lines and cover large areas of curriculum. These libraries have structured metadata that facilitate search, and their objects are typically aligned to standards. ***BrainPOP's*** repository (described earlier) is in 20% of all schools in the United States and is designed to be as flexible as possible to fit the needs of a classroom teacher. As General Manager of ***BrainPOP*** Din Heiman describes, "The story of BrainPOP is all about appealing to teachers" (CS4Ed interview, February 2012).



PBS LearningMedia is a repository of classroom-ready digital resources searchable by content area and grade level.

PBS LearningMedia[25] offers a repository of tens of thousands of classroom-ready, digital resources searchable by content area and grade level, including content drawn from over 1,500 public media producers and 350 local stations. The collection includes resources from the PBS series NOVA, Frontline, American Experience, The Electric Company, and Sid the Science Kid as well as resources funded by NASA, the National Science Foundation, the National Institutes of Health, the Department of Education, the

Library of Congress, National Public Radio and the National Archives. Recently digital content from Annenberg Learner, part of the Annenberg Foundation, was added to the collection. The collection is aligned to the Common Core State Standards and is available free to all preK-16 classrooms. It includes videos and interactives, audio and photos, and in-depth lesson plans. PBS also offers professional development courses related to the collection and the ability to customize it for schools and districts for seamless integration into local systems.

ExploreLearning[26] has an extensive library of interactive, online math and science simulations called "Gizmos" for grades 3-12. These called Gizmos are designed to supplement existing curricula and are correlated to state standards, connected to over 200 textbooks, and include more than 450 interactives searchable by standard, grade, textbook, and topic. Gizmos are currently being used in all 50 states and have been the subject of a number of research studies. ***ExploreLearning*** offers training and professional development services to assist teachers in using the collection. The company has also created ***Reflex***, an online game-based system that helps students learn basic math facts.

2. Adaptive Engines

At the heart of gaming is the increasing difficulty implicit as players move to new levels. An adaptive engine manages this progression through a game, personalizing the experience and/or providing students with material that is challenging but that the user is capable of solving. According to Josh Cohen, managing partner of City Light Capital, adaptive learning platforms"... take student data and give feedback so that the student is essentially being quizzed and seeing what they get right and what they get wrong. Gaming does two things, it is a massive data aggregator and it is really fun and engaging" (CS4Ed interview, April 2012).

Fastt Math Next Generation[27] teaches math fact fluency, using an adaptive technology that creates individualized learning progressions with embedded assessments to help students learn math skills. Teachers are provided with dashboards that allow for ongoing progress monitoring. Each student receives diagnostic assessments to measure current math fact skills and is then provided with 10-minute daily sessions of adaptive instruction in either English or Spanish. The program targets both accuracy and speed using a research-validated algorithm. ***Fastt Math*** is aligned to the common core.

Dreambox works with three central elements: a robust curriculum, an intelligent adaptive platform, and a highly engaging environment. According to their CEO, Jessie Woolley-Wilson, they do not consider themselves a gaming company because their focus is on learning as the primary objective, whereas for many gaming companies, fun comes first (CS4Ed interview, March 2012). ***Dreambox* does** use separate rewards, but they contain learning activities such as more math games. This provider also does not try to hide the learning involved, instead leveraging the fact that kids are extremely motivated by their own mastery and achievement. ***Dreambox*** has also developed an intelligent, standards-aligned adaptive platform that collects data with every click to demonstrate what a student knows and does not know and build a personal learning path. The path is not tied to age or grade and is not linear for all students. ***Dreambox*** focused on what is viewed as the "hot" area of K-2, but now has expanded up to grade 5.

Knewton is an online adaptive learning platform that is currently designed to support college level students in developmental math courses. The company's main focus is on the backend, developing a sophisticated algorithm that allows for individualization. The company does not appear to be developing much content, but rather is outsourcing that job to other organizations. Recently Knewton and Pearson announced a partnership that should provide access to the K-12 market.

Skills Tutor[28] is a division of Houghton Mifflin Harcourt. It provides an online supplemental adaptive engine for math, reading, writing, language, science, and workforce readiness for K-16. It can be used as a teacher-aided instructional tool or as a one-on-one tutoring resource with minimal guidance. ***Skills Tutor*** provides differentiated instruction, diagnostic testing, prescriptive assignments, and automatic reporting. It also has a management system that enables teachers to assign lessons by standard and to monitor progress on real-time usage. The program can be used with smart mobile devices and aligns to state and national standards.

MangaHigh[29] has created a large collection of free math games that were originally developed for the U.K. market and are now offered in the United States. ***MangaHigh's*** most powerful game is Prodigi, a mathematics adaptive engine that features thousands of math problems with solutions and hints that adapt to each student's ability and learning speed. Students, teachers and parents can customize ***Prodigi*** by skipping items that have already been mastered in the classroom, or focus on areas that need specific attention. If necessary, students can use ***Prodigi*** independently, as it guides the student through the math curriculum in a logical order. Throughout the puzzle games in ***MangaHigh***, students are able to rank their performance and teachers are provided with data on student proficiency.

3. Integrated Digital Curricula

As comprehensive core curricula move from print to digital, many supplemental materials including games are embedded as components. Digital curricula are designed for networked classrooms where every student has a computing device. These sophisticated curricula and connected technology elements are aligned to standards, may be personalized, generally allow searching for specific topics by level of difficulty, and form a foundation for the broader acceptance of learning games in the classroom (Dede, 2012).

Time To Know[30] is a comprehensive digital teaching platform that contains integrated core curriculum in reading and math for the upper elementary grades. Digital teaching platforms are designed to operate in one-to-one classrooms, deliver a personalized curriculum to every student, and provide support for the teacher to manage all classroom activities (cf. Dede & Richards, 2012). The ***Time To Know*** curriculum contains open-ended explorations, practice environments, games, videos and other digital learning objects.

The Discovery Education Science Techbook[31] are core curriculum digital products for elementary and middle school science that have been adopted in a number of states including Florida, Texas, and Oregon. A "tech-book" contains a large collection of online learning tools and games ranging from videos, quizzes, animations, simulations, and puzzles, all aligned to standards, made completely searchable, and organized into a complete K – 8 science curriculum. ***Discovery*** won the 2012 CODIE award for the best educational product.

Class Time and School Reform

The most important factor in the failure to achieve scale for long-form games such as ***River City*** had to do with trying to fit a long-form game into an unaccommodating school structure. Clarke & Dede report that River ***City*** failed to achieve scale in schools because it needed to be a more flexible product that could retain its success in a variety of contexts, and that this flexible robust-design approach has intrinsic limits:

[S]ome essential conditions that affect the success of an educational innovation cannot be remediated through ruggedizing. Further, in the shadow of high stakes testing and accountability measures mandated by the federal No Child Left Behind legislation, persuading schools to make available multiple weeks of curricular time for a single intervention is very hard (2009, pg. 230).

Similar to these findings at Harvard, the ***MIT Education Arcade*** has found that their long-form immersive games are not being adopted easily into the schools because of the time factor. Recently the ***Arcade*** has been working on math and biology games for mobile devices that are designed to be played for 1 to 3 minutes a dozen times a day. These games are being developed in reaction to limited classroom time, limited access to technology, and the rise of mobile and tablet devices in the classroom.

Klopfer et al. (2009, pg. 2) have put forward the idea that eventually long-form games will bring about changes in the organization of the school day to provide for in-depth, longer-form activities such as immersive games. The successful reading intervention program **Read 180**[32] from Scholastic, Inc. that combines whole group and small group instruction with adaptive software requires a 90-minute time block and has been implemented in schools that have adjusted their time blocks to accommodate the program. However, ***Read 180*** is a research-proven reading intervention product serving a critical need. Examples of schools shifting the structure of the school day to accommodate a new technology program are rare. Ultimately, games that fit into a discrete school period have a higher chance of success, while longer games have yet to gain acceptance. It is clear that changes in the basic organization of the school day and the relationship between classroom time and homework are still a long way off. Most teachers will continue bending the technology to fit their needs rather than the other way around.

James Gee enunciates a dozen principles of learning built into good games that could and should be applied to school learning. "If implemented in schools they would necessitate significant changes in the structure and nature of formal schooling as we have long known it" (Gee 2007, p.30). **Gee's recent keynote address to the 2012 Games for Change Annual Conference**[33] goes further in re-defining the changes that will be needed in how classroom time is managed in the next wave of education reform.

Such challenges to achieving scale have resulted in bringing the research-funded gaming community in line with other efforts to reform public schools. Even though school reform requires a long-term effort, our interviews demonstrated significant interest by the research, foundation, and government communities to make reform possible. However, in the next section of this report, we analyze the sales and marketing processes for the distribution of digital games to schools as they are *today*.

selling to schools

In this section, we examine the dynamics of the institutional K-12 market, both as a primer for investors and game developers who are new to the market, and as a means for analyzing traditional barriers to entry. We also look ahead and offer a picture of how current levels of funding and

"The stigma of games seems to have pretty much fallen away at this point. It is a much more friendly market than it was ten years ago. The time issue is a factor and maybe cost, but less so."

- **Dave McCool,** Co-Founder, President and CEO, Muzzy Lane

legislation will be affecting the market in the short and long term. Specific recommendations are restated at the end of each section.

Total expenditures for K-12 public schools are more than half a trillion dollars, with the vast majority of funding going to salaries and benefits. As such, products and services that can draw from the salary and benefits portion of budgets have a much larger growth potential. Doing this means items that either make the teacher more efficient—able to handle more students—or provide services directly to students, thereby freeing the teacher to engage with other students. The challenge is to provide these benefits while maintaining educational quality.

The K-12 Institutional Market

Here, games are sold into schools as supplemental materials.[34] They complement the class content, either replacing particular units or focusing on specific concepts or topics. However, selling anything to schools is a difficult and time consuming process; products take a long time to become established, but once successful, they persist in the market for years and can produce stable and reliable revenue. K-12 is a large market and steady growth in student enrollment is expected, which in turn translates into additional funding largely determined by per pupil allocation. Here, the market divides into public and private segments, and typically, start-ups need to target either the public or the private market. However, the market further segments by grade level and curriculum area. Because purchasing authority is determined by rank—superintendent, principal, curriculum coordinator, and teacher, buying decisions are mostly a function of product pricing. The following discussion analyzes school demographics, funding, the importance of district size, and significant positive changes in technology infrastructure.

1. Demographics

There are 54 million students enrolled in public and private schools in the U.S. An additional 1.5 million homeschoolers constitute 3% of the market (see Table 2). The National Center for Education Statistics (NCES) projects steady growth in enrollments to 57.9

million students in 2020 (NCES 2011a, Table 1, p. 31). During this time, private school enrollments will decline slightly.

The teacher population has grown from 3.0M in 1995 to 3.7M in 2008 and is projected to grow to 3.9 million in 2020 (NCES 2011a, Table 16). The Department of Education projects more than a million new teachers will be needed in the next eight years because growth is occurring at the same time as the baby boomer component of the teaching profession is retiring. This demographic dilemma presents an opportunity for companies engaged in teacher professional development.

Public school students make up 86% of the school and homeschool population, and public school teachers are 89% of all teachers.

Table 2. Public and Private school enrollments and teacher population.[35]

	Public	Private	Total
Schools	99,000	33,000	132,000
Students	48,023,000	5,488,000	53,511,000
Teachers	3,210,000	437,000	3,647,000
Staff	6,355,000	779,000	7,134,000
Homeschoolers		1,500,000	

2. Funding

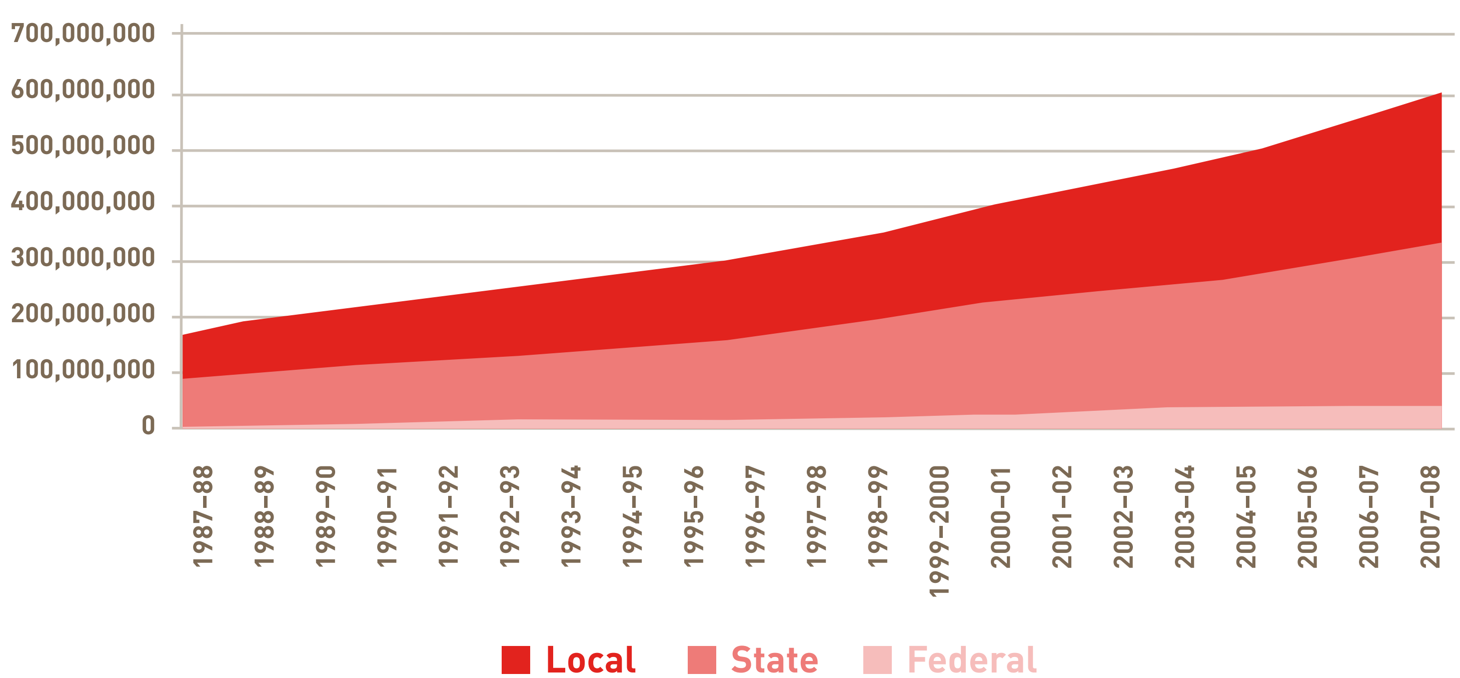
Increases in the student population feed into the positive long-term outlook for the K-12 market because funding is largely determined by a per pupil allocation. NCES projects that per pupil spending will grow from the current $10,439 to $11,905 in 2020 (in constant 2008 dollars). Overall, public school spending is projected to increase from $513.8B to $627B in 2020, (NCES 2011a, Table 18, p. 55).

In most years, approximately 92% of school funding has come from state and local sources. These funds are largely spent on capital outlays and salaries. On average, 48% of funding for education comes from state sources and 44% comes from local funding; however, average household income in a community directly affects the amount of funding its local schools will have (see Figure 1). As a result, per-pupil spending varies widely, with economically healthy states and more affluent communities more likely to devote resources to educational technologies. Because funding for education is dependent on tax revenues, education budgets are the last to suffer in a recession, and the last to recover.

The relative contributions of state funding (48%), local funding (44%), and federal funding (8%) have remained constant for some time.[36] While federal dollars constitute only 8% of total funding, this money is very important to the technology vendor community because it supports supplemental programs and services that often include technology. Furthermore, in 2009 the American Recovery and Reinvestment Act (ARRA), "the Stimulus," provided a onetime additional $97.4B to education department budgets for direct K-12 program support as well as postsecondary and adult education. The ARRA funding also included $39.7B from the education portion of the "State Fiscal Stabilization Fund" designed to augment depleted state budgets.

Federal funding for K-12 education comes principally from three distinct sources. The Department of Education administers two of these: the Elementary and Secondary Education Act (ESEA, currently designated "No Child Left Behind") and its ten Titles, and parts and the Individuals with Disabilities Education Act (IDEA). The third source, the E-Rate, is administered by the Universal Service Administrative Company (USAC) under the direction of the FCC. Other agencies, such as the National Science Foundation, NIH, and NASA support research in education and have Small Business Innovation Research (SBIR) programs that are designed to support Research and Development that has the potential for commercialization.

Figure 1. Federal, state and local funding for education 1987 to 2008.



3. Policy and Funding: Looking Forward

Although political rhetoric in favor of innovative new models for education has been fervent, the current funding situation for educational technology—at both the national and state level—is not promising for FY 2013 or 2014. Cuts in both overall public education budgets and in funds earmarked for technology speak to other priorities and to the economic stresses dominating U.S. government and state-level policy.

While the U.S. Department of Education is projecting rising costs for K-12 educational institutions in the form of almost 260,000 new children to educate in the 2011–2012 school year (Williams, Leachman, & Johnson, 2011), the Center on Budget and Policy Priorities reports that in the coming fiscal year, "at least 23 states have enacted identifiable, deep cuts in Pre-K and/or K-12 spending." Even those products being purchased with more generally allocated funds may see a drop in institutional sales over the coming year. In those areas where sales of technology products and services come from non-technology funds, the picture is not encouraging.

Additionally, educators are in a "wait and see" period as the reauthorization of ESEA (NCLB) is debated. Because it is an election year and consensus among the different parties who control the branches of Congress will be difficult, any reauthorization of this largest funding vehicle for K-12 education reform will be unlikely to occur until after November 2012. Until that time, continuing resolutions will be likely to fund the current law as-is until reauthorization or new legislation is passed.

Despite this overall downturn in funding, there is promise for educational technology. Technology will receive an increasingly larger proportion of the shrinking pool of funds if it can further demonstrate value in terms of both educational effectiveness and cost efficiency.

4. Opportunities with Grants

Much of school funding for products and services is derived from state and federal grants to school districts that meet certain funding criteria for both formula and competitive requirements. Furthermore, schools can use grant funding to purchase products and services only if what they purchase meets the requirements outlined by the federal or state departments of education. Companies selling to the K-12 market can assist districts in navigating, sourcing, and writing state, federal, and foundation grants. If you are a publisher, knowing what funding you can align with can be critical for having sales.

Experienced companies in the K-12 space analyze their products and services to create collateral that aligns product features with specific grant requirements. This alignment includes narrative for grants that school personnel can use in proposals. This is an essential component of the marketing collateral, and generally involves at least one dedicated person assigned to assist districts with grant-writing.

5. Districts: Size Matters

The single most important factor affecting K-12 marketing and sales is the size of the district. Examining the educational technology market from a geographical or district funding viewpoint risks overlooking the vast majority of districts nationwide. Of the 13,600 districts nationwide, the largest 26 claim 12.3% of the students, and the largest 6.4% (874 districts) have 53.5% of the students (see TABLE 3). The remaining 93.6% of the districts contain only 47% of the students. Two-thirds of the districts in the country have fewer than 2,500 students enrolled.

There are 874 districts with at least 10,000 students. Nationally, 6.4% of public school districts have 53% of the students.

The sales process is very different depending on the size of the district. Larger districts often require several years of "pilot testing" before anything can be rolled out district-wide, and employ a formal purchasing process that may involve several levels of approval and multiple committee presentations. Smaller districts may still have a formal purchasing process, but the decision-process may be much simpler.

When 6% of the districts contain over 50% of the student population, they also have over 50% of the money. The larger publishers have dedicated personnel selling to the largest school districts. Smaller companies and startups do not have the capacity or time to sell to the largest 2% of districts (those with 25,000 students or more), in spite of the fact that these districts have 33% of the students. At the other extreme, there are 6,400 districts with fewer than 1,000 students—a lack of volume that makes it hard to justify any targeted sales to this segment. The sweet spot is the 3,500 districts with between 2,500 and 25,000 students. They have approximately 50% of the students in the country.

District size also has an impact on technology infrastructure. Smaller districts, particularly those with under 2,500 students, are unlikely to have sophisticated IT infrastructure and may be outsourcing critical functions. These districts are very likely to have need of IT infrastructure services, including cloud computing that can provide backup and security.

One additional market approach is to target education service agencies. These are consortia formed by smaller districts in order to consolidate their buying power. These "intermediate units" are influential and an important sales target. They are known by different names and acronyms in different states. For example, in New York

Table 3. Student population in districts with more than 10,000 students

	Districts		Students	
Districts Size	**# of**	**% of**	**# of (millions)**	**% of**
100,000 or more	26	0.2%	5.9	12%
50,000 to 99,999	61	0.4%	4.2	9%
25,000 to 29,999	193	1.4%	6.6	14%
10,000 to 24,999	594	4.4%	9.0	19%
Total	**874**	**6.4%**	**Total**	**54%**

these are BOCES; in Texas ESCs; and in Georgia and Michigan they are RESAs. Most of these belong to the Association of Education Service Agencies.

6. Infrastructure

In the past, schools were not receptive to technological innovation because many lacked the basic technology infrastructure. This lack of resources blocked any attempt to base curriculum on digital resources, including games or simulations. In our judgment, this picture is changing dramatically. Together, these changes comprise a technology-driven disruption. This is a time of change in the classroom. As noted by Vic Vuchic, Associate Program Officer at the Hewlett Foundation,

The buzz driving the VC community may be because the infrastructure is possibly maturing to a level where you can do distribution and reach at a reasonable cost. There may be enough districts and enough infrastructure that it takes a lot less capital to have a fair impact. But the majority of schools they visit still have horrific infrastructures (CS4Ed interview, April 2012).

a) Moving to One-to-One: One-to-one classrooms where every student has a computer have become increasingly common in U.S. schools. This trend has accelerated in the past four years, abetted by a price drop for all devices and the increasing popularity of tablets and mobile devices in schools.

One-to-one computing is ubiquitous throughout higher education where almost all students now carry around multiple devices. Today, K-12 is finally embracing this goal of one-to-one due to the increasing acceptance of digital curricula, the need to prepare students for 21st century skills in a digital world, and the encouraging research results of one-to-one initiatives (Greaves, Wilson, Gielniak & Peterson, 2010).

b) The Rise of "BYOD": "Bring Your Own Device" (BYOD) involves students bringing their own cell phones, tablets, and laptops into the classroom for use in educational activities and real-time assessments. BYOD is being embraced by schools throughout the country as a way of achieving one-to-one initiatives (Devaney, 2011a). This tactic is a natural solution for schools seeking to meet the challenges of the move to digital curricula and to move forward on the goals contained in the National Education Technology Plan.

Seventy-seven percent of children ages 12 to 17 own cell phones (Pew, 2012), and about a third of these are smart phones that have many of the same capabilities as laptops. Even kindergarten students now have access to mobile devices. As such, the BYOD movement could have a dramatic and compelling effect on how student-computer ratios are measured and understood. The impact on the market for software and digital content and resources could also be significant. The resulting increase in access and cost-savings should increase demand and provide resources for applications. At the same time, the likely diversity of devices in a given classroom or school may have a great impact on developers who will need to ensure some degree of standardization of display, navigation across platforms, screen sizes, and operating systems.

However, the BYOD trend may have lopsided effects on hardware and software spending from district to district, and issues such as security, privacy, the digital divide, and adequate teacher professional development will need to be addressed for BYOD to gain ground quickly. Further, more focused research is needed to shed light on the real nature of educational software and platform use by older students, who may be more likely to take advantage of free online and mobile services, resources, software, and business-to-consumer products on their own (or their parents') initiative. The related possibility of one-to-one classrooms on a larger, district-wide scale could also affect how vendors—content vendors especially—approach their digital offerings. At the moment, many content publishers are not fully up to speed in offering useful formats and easy interfaces for their products across multiple devices; the incentives to do so will change as standards begin to emerge and demand and competition grow.

c) Interactive White Boards: The incredibly rapid and widespread acceptance, purchase, and installation of interactive whiteboards in the education community has almost no precedent. In a recent survey of technology leaders, interactive white boards were identified as the most useful classroom tool (MDR, 2012). Resnick, 2011 reports that more than 63% of teachers have their own interactive white board, and another 7% share one with one or two other teachers.

The interactive whiteboard market continues to increase, growing by 15% in 2011 for total revenues of $1.4 billion, and it is predicted to grow more than three-fold over the next 5 years (FutureSource Consulting, 2011). Even in the current economy, digital sales of interactive white boards, online digital content, LMS/SIS, and mobile devices are up, and print sales are down.

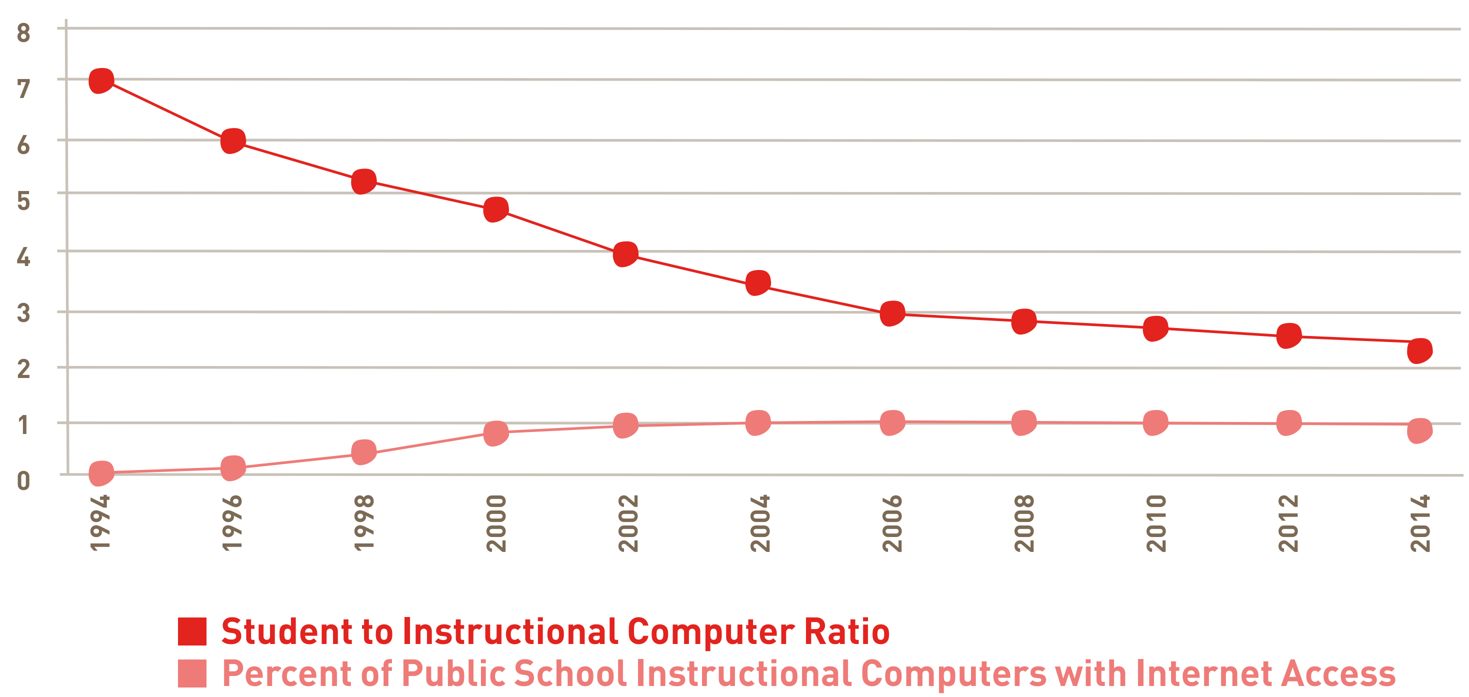
d) Internet Access: The U.S. Department of Education reports that as of 2008, effectively all public school computers were connected to the Internet and the current student to computer ratio is less than 3:1 (see Figure 2). The move towards universal connectivity is largely due to the E-Rate program. Across the board, connectivity is continuing to improve, although gaps in support and technology infrastructure continue to plague schools.

e) Related Industry Trends in IT: Overall trends in the hardware and software industries have an important influence on the direction of technology purchases by K-12 institutions.

Several notable developments affecting education include:

- ***Cloud-based services:*** The growth and expansion of storage and resources, virtualization tools, and improved Internet access have made it easier for companies to offer key software products and services online. In turn, this trend has lowered costs for implementation and training on new software for schools and educators (Anderson & Rainie, 2010).

Figure 2. The student to computer ratio, and the percentage of public school computers from 1994 through 2014 (projected)[37]



- ***Mobile technologies:*** A flourishing ecosystem of third-party developers who supply useful applications has sparked interest in educational applications for mobile devices. Although mobile technology was not a main focus of institutional spending in 2009-2010, a new pool of entrepreneurs and established companies (e.g., Apple and Nokia) have been paying increased attention to potential K-12 institutional markets for their products and apps (Adkins, 2011).
- ***Cheap data storage:*** Whether they are tied to cloud-based services or on-site servers, data storage and management systems have continued to become more scalable and cost-effective, both of which are key elements for schools. Available data storage is also important for vendors, as educational products become increasingly sophisticated in tracking incredibly fine-grained student-, educator-, school-, and district-level information (Johnson, Smith, Levine & Haywood, 2010).
- ***Social networks and community websites:*** The increasing acceptance, use, and consumer understanding of collaboration technologies and platforms for educators and students to share ideas, resources, reviews, and information on an up-to-the-second basis has led to these resources being co-opted for educational purposes.

7. Recommendations

With this overview of the current realities of the demographics, funding, and technological possibilities in the K-12 market, our recommendations for learning game investors, publishers, and developers are that they should:

- target the 3,500 districts with between 2,500 and 25,000 students;
- assist districts in navigating, sourcing, and writing state, federal, and foundation grants;

- target education service agencies. These are consortia formed by smaller districts in order to consolidate their buying power;
- support learning games that can be used on interactive white boards, as these are becoming ubiquitous in classrooms; and
- anticipating BYOD, support learning games on inexpensive computing devices and mobile devices.

The Dynamics of Selling to K-12

In this section we present the common market categories for institutional sales. As noted by Valerie Sakimura, Senior Analyst, New Schools Venture Fund, "One of the problems with going to scale is that the distribution channel is very tricky to figure out" (CS4Ed interview, April 2012). District distribution channels not only are distinguished by district size, as mentioned above, but also by grade level and curriculum area.

1. Market Segmentation

a) Core vs. Supplemental Materials: The distinction between "core," or what is commonly called "basal," curriculum and "supplemental" curriculum is critical within the education publishing industry. The core curriculum is the main carrier for content in a course and typically has a defined scope and sequence. Traditionally, the core was the textbook for the course, which often came with a variety of other materials, such as videos, software, and teacher professional development.

Supplemental materials literally supplement basal materials, and can take a variety of forms, including for example, a four-week module that covers a particular topic in depth, a video that shows a dramatic event, a game that provides practice for a skill or concept, or a consumable workbook. It is rare for a teacher to make an individual decision on the core curriculum, but teachers do frequently choose supplemental materials on their own.

In the 1980s, basal curriculum accounted for as much as 75% of spending on instructional materials. By 2000, spending on basal and supplemental had become equal. Now supplemental instructional materials, including testing and assessment and reference materials, are at least double the basal.[38]

In addition, the line between what is considered basal and what is considered supplemental is being blurred. Some schools are finding that their needs are better met through picking and choosing supplemental materials than through a monolithic basal product.

Because purchase of supplemental materials can sometimes be funded through nontraditional instructional materials budgets, supplemental content needs to be linked to standards. In the future, vendors may need to meet other curriculum requirements such as scope and sequence, as well as appropriate reading level. Today, publishers are required to submit a worksheet correlating their content to standards. This is challenging to complete for digital materials, particularly games, given the non-linear, adaptive interfaces involved with online content.

b) State Adoption of Instructional Materials: Twenty-two states follow a formal adoption process to review and approve K-12 textbooks and other core resources. The primary goal of the process is to ensure that core materials align with state standards and meet state regulations relating to a range of requirements. In most states, local school districts can use state funds only for approved and adopted resources, though some states require only a percentage of the funds be used for approved resources.

Roughly $7 billion is spent each year on K-12 instructional resources, and adoption state purchases make up roughly 1/3 or $2.2 billion of the total (Tullis, 2008). The adoption process is a high-stakes game with significant risks, costs, and rewards for vendors. Adoption is "all or nothing." If a textbook is adopted, it can be sold as core curriculum in the adopting state. If a textbook fails to be adopted, a district cannot use state money to buy it, which virtually excludes it from consideration by other districts in the state. Typically multiple products are approved for adoption. In this way, adoption gives the publisher a "hunting license", but it is still necessary to convince individual districts to purchase your product.

Winning adoption in the influential states of Florida, Texas, and California makes the adopted product much more valuable in all states and almost guarantees its success. The adoption process includes a strict schedule spanning more than six years. There is a lengthy review process to verify each state's standards alignment, adherence to other state regulations, and district quality reviews. Political trends, such as the role of drill and practice in math education, can also play a role in adoptions.

The minimum cost of submitting a product for adoption is estimated at $1 million per subject area, per state. For basal reading or mathematics, the cost can be as much as $50 million nationwide. Print-based materials still make up about 90% of the basal programs adopted in the 22 adoption states; adoption of digital materials has been slow (Tullis, 2008).

c) Content Areas: District budgets are allocated to specific curriculum content areas. Typically, different curriculum coordinators have responsibility over their own area of expertise. Historically reading/English language arts (ELA) and mathematics together had the lion's share of the curriculum budget, and with the advent of high-stakes testing, even more emphasis has been placed on these two areas. A 2011 educational technology survey by The Software & Information Industry Association (SIIA) on digital products and services preK-12 reported a stronger emphasis on reading, English and language arts (47% of total) than has been reported in other market studies that combined digital and print products (SIIA 2011). The SIIA survey also found higher overall sales in Science (19%) and lower sales in social studies/history and other content areas (5% each). Overall findings from the SIIA report, Resnick 2012, and the American Association of Publishers 2010 surveys, all show a dominance by English/language arts materials' revenue from sales of content, with arithmetic/mathematics in second place for all studies.

The particular capability of technology to provide simulations, probes, and interactivity may contribute to the outcome for science materials in the SIIA survey. It should be noted that all of the studies were undertaken before rather significant digital science adoption competitions in both Texas and Florida.

The report of the SIIA survey estimated that the overall market for digital instructional content approaches $3B in the U.S., with revenue from market segments for digital content areas as follows:

- English/language arts is close to $1.4B.
- Mathematics is near $696MM.
- Science is close to $553MM.
- Social studies is close to $160MM.
- Other content areas are close to $160MM.

2. Channel Analysis

Direct sales (where the company controls the sales channel), can be separated into four basic channels (see Table 7). The least expensive items are sold by mail order or through a company's web site. More expensive products are sold (in order from lowest to highest price of product) through telesales, an inside sales force, or a field sales force. Expensive products can take up to eighteen months for a sale to close and require a direct relationship sell to a superintendent. At the other extreme, less costly items can be purchased by teachers using a restricted budget or their own money.

Sales price determines channel, customer, type of product and sales cycle.

Indirect sales or "sales outsourcing," uses an external company (a third party), to complete the sale. This keeps overhead low and allows a small company such as a game developer to concentrate on what they do best. Typically, the third party will take a percentage of the

Table 7. Correlation of sales price, cycle, typoe of product, customer and direct sales channel (all figures are rough approximations).[39]

Sales Channel	Field Sales	Inside Sales	Telesales	Mail Order/Web
Customer	Superintendent	District and Site Admin	Principal/ Teacher	Teacher
Type of Product Sold	Enterprise/ Integrated	Single Solutions	Packaged Products	Packages Products
Sales Cycle	18 Months	6–12 Months	90 Days	30 Days
Typical Sale	$50,000+	$5,000 to $25,000	$1,000 to $2,500	$100 to $500

sale. Indirect sales is particularly effective if there is demand—because, for example, a product has received positive publicity. Third parties have no commitment to your products and will sell whatever the customer is requesting. Going to indirect sales does not reduce the need for a solid marketing effort—if anything, it actually requires more.

For inexpensive items, a company can use a distribution outlet, including catalog sales. Resellers and Value Added Resellers (VARs) are similar in scale to telesales, handling products with a typical sales price of $2,500–$5,000. Independent agents are parallel to a field sales force and may specialize in particular large districts where they know the terrain.

3. The School Buying Cycle

Generally, the buying cycle in education follows a predictable seasonal calendar and a July 1 through June 30 fiscal year. In addition, structural constraints designed to protect public monies and reinforce competitive bidding affect the timing and length of the sales cycle.

Table 8. Typical school buying cycle for major products

July–November	Determination of need and selection of products to review
December–March	Request for Proposal (RFP) process
March–May	Review of RFP responses and vendor selection
June–August	Issuance of purchase order by district

In anticipation of new budgets beginning in July, major content conferences occur in the spring. These conferences are designed to produce leads for sales in the following fiscal year. For products that are ready to launch, the timing of these conferences is critical.

That said, purchasing decisions in the education market are highly decentralized, with patterns and dates that vary from state to state and even from district to district within a state. It is common in the education market to have funds encumbered long before they are spent. Vendors are compelled to continuously market and sell to schools in order to remain involved in the process. The buying cycle for major products typically involves four stages (see Table 8).

4. Market Leaders

In the educational market a few huge players dominate in all content categories (see Table 9). This certainly presents barriers to entry that for new players can appear insurmountable. As Laurie Racine, Co-Founder and Managing Director of STARTL, puts it, “Distribution in K-12 is a key problem because of the big three publishers” (CS4Ed interview, April 2012). These publishers have products and services in almost every K-12 market segment and have expanded through aggressive acquisitions, particularly in the last ten years. In the arena of learning games and interactives, they have successfully partnered or outsourced work to game developers such as Tabula Digita and 360KID.

In addition, second tier companies have also been fairly active in mergers and acquisitions. Private equity has also taken an interest in the education space, as seen in the acquisition of BlackBoard and Edline and the sale of Archiplelago Learning.

In addition to the education market players, giant companies such as Microsoft, Adobe, Oracle, IBM, NBC, Discovery, and NewsCorp, who normally are not in the education space, have taken a significant interest in education during the last decade. NewsCorp acquired Wireless Generation in 2010 for example, for approximately $360 million in cash.

The other large category of major players in education are the testing businesses such as: ETS, Scantron, College Board, and Princeton Review. Scantron purchased GlobalScholar in 2011, just after Global Scholar had acquired Spectrum K12.

More than half of those interviewed mentioned market dominance by large publishers as a major impediment to the success of learning games. The consensus was that this dominance hinders innovation. According to Constance Steinkuehler, Senior Policy Analyst at the Office of Science and Technology Policy in the Executive Office of the President of the United States and an assistant professor at from the University of Wisconsin-Madison, “Huge textbook publishers dominate the market and squash innovation and the smaller publishers sweep around the edges but with little innovation. The model of point-by-point purchase by the teacher, individual, or parent and how to sell to this market needs to be resolved” (CS4Ed interview, June 2011). This is particularly important given that teachers spend over $500 annually of their own money on classroom materials (NSSEA Retail Market Awareness Study, 2010.)

Further, the sheer size of the “big three” makes them slow to adapt to new trends in educational games. As Scott Traylor, CEO and founder of 360KID, has found: “The larger publishers often take two or three years to move forward and are having a lot of trouble transitioning from print and do not understand what makes a good game. The smaller more nimble players who make engaging learning games have trouble getting into the adoption cycle or at least seen by districts, administrators or teachers who might be interested in their game” (CS4Ed interview, March 2012).

Table 9. 2010 and 2011 revenue for the largest companies in the K-12 institutional market.[40]

	2011		2010	
Company	**Total Revenue**	**K-12 Revenue**	**Total Revenue**	**K-12 Revenue**
Pearson	$9,058 M	$3,993 M	$8,759 M	$3,500 M
McGraw-Hill	$6,246 M	$949 M	$6,072 M	$1,109 M
HMH	$1,1295 M	$1,295 M	$ 1,507 M	$1,507 M

Given this, one way for newer or smaller companies to enter the market is to partner together or with one of the Big Three—a significant opportunity for current investors to pursue. For example, **Muzzy Lane** sees partnering with a large publisher as a good strategy going forward because the Big Three have long ago figured out distribution and sales issues, and because the big entities are finally ready to enter the learning games market to some degree. Co-founder and president Dave McCool reports with enthusiasm that this partnership is working well. "[Muzzy Lane] started very much on a supplemental line with McGraw Hill, but now they are looking for more interactive stuff, not just digitized textbooks. Games really fit that bill nicely and blend with the other activities" (CS4Ed interview, February 2012). Likewise, **Emantras**, a company in the education market in K-12, higher education, and virtual schools as well as in healthcare publishing, has had some success partnering with larger companies— in their case **Pearson, McGraw-Hill, Cengage Learning**, and others.

Partnerships outside of the Big Three also have the potential for creating success: partnerships with universities, foundations, media conglomerates, and smaller publishers. Each relationship brings diverse expertise, resources, and an increased reach. Partnerships with academic institutions can provide a research base for a project and create credibility, and in terms of ***iCue***, partnerships with distribution companies such as **Blackboard** and online universities provided distribution that eventually helped **NBC Learn** get off the ground when they were unable to work successfully with textbook companies. Partnerships with foundations brought in needed resources as well.

Klopfer and Haas explain the benefits of partnerships:
"[M]ost of these companies, individuals, and nonprofits know little about schools, teachers, students, or the market forces operating on each of them. At best they know only one piece of this puzzle. It is hard to know more than that. But given the volume of interest, and the growing expertise in educational media production, particularly in games, more efforts can succeed if the right partners come together" (In Press).

5. Key Market Demands

a) Standards Alignment: Throughout the 1990s, legislative activity relating to education focused on raising academic standards and holding schools accountable for student performance (NCES, 2003). By the late 1990s, the vast majority of states had developed standards for English/language arts, math, science, and social studies. These standards directly impacted curriculum, as well as "high-stakes" statewide assessments. By the year 2000, almost all states were administering tests in 4th and 8th grades, and 46 states were issuing district report cards annually (NCES, 2003).

The federal No Child Left Behind (NCLB) Act of 2001 increased attention given to standardized testing by mandating assessment and accountability for all states. A measure of Annual Yearly Progress (AYP) became a critical school-level evaluation with punishments instituted if schools failed to achieve AYP goals. Since the passage of NCLB, each state has created its own process for developing and implementing standards. Standards for what students are expected to know varies greatly from state to state. Schools have focused their efforts on making sure students are able to pass state standardized tests, and this has created both a challenge and a market for any basal or supplementary curriculum resource that is effective in helping teachers assist their students in meeting the goals of NCLB legislation. According to Steinkuehler, "Schools don't have money unless they can tie the instructional materials to standards. And teachers cannot justify a purchase unless it will contribute to learning standards" (CS4Ed interview, June 2011).

Such standards present both challenges and opportunities for learning games. Short-form drill and practice games that include formative assessment and teacher feedback are becoming more attractive to teachers seeking ways to help students achieve required proficiencies. Short-form skills practice games such as ***MotionMath***, ***Sokikom***, and ***Dreambox***, as well as other curricular materials that are aligned to state standards, are seeing increased adoption in schools as well.

The final Common Core State Standards (CCSS) were released in June of 2010 to provide an agreed-upon set of state-led educational standards in English/language arts and mathematics for grades K-12. Led by the National Governors Association Center for Best Practices and the Council of Chief State School Officers, the CCSS has now been adopted by all but five states (Alaska, Minnesota, Nebraska, Texas, and Virginia). Frameworks for Common Core Standards for science are expected to be released by 2014 or 2015. The limited nature of the high stakes tests based on the state standards has impacted the ability to develop the kind of engaging, immersive experience that fosters difficult-to-assess 21st century learning skills such as creativity, collaboration, and problem solving. The assessments that are now being developed for the CCSS are trying to address these shortcomings.

States have been quick to adopt the Common Core in order to affirm their commitment to the federal "Race to the Top" school reform efforts. Presumably, states that move to CCSS will continue to assess using tests designed for their old state standards until the CCSS assessments are released, with the result that during the transition there will be confusion for publishers attempting to create materials targeting assessments. Finding the right mix of standards alignment—whether to existing state standards or to the Common Core—is one more factor that needs to be attended to in designing useful learning games for schools. But, the eventual establishment of a single set of standards for all states and the subsequent process of aligning content to one set of standards will lower the cost of entry and open the market to smaller companies.

b) Platform Compatibility: Increases in BYOD initiatives and the use of interactive whiteboards, tablets, mobile devices, and laptops in the K-12 school setting is forcing both schools and technology developers to support mixed device environments. The issue with this is that each tool enters the market bundled with a different level of software and cross-platform compatibility, and providing even forward/backward compatibility within a platform can present significant challenges. Schools must ensure that their wireless infrastructures have enough bandwidth and that their device management capability is sufficient to handle the increased demand from multiple devices. School administrators must be aware that they might buy new technologies that are not able to communicate or connect with each other or with other components that already exist in the school infrastructure. In turn, developers must ensure that their products can run on multiple platforms and be hosted in multiple infrastructure environments. To do so, developers are often required to create and maintain different versions of a game or simulation for each major platform type. Despite progress being made in universal design and interoperability standards, producing cross-platform products is expensive and often involves different development teams for each major platform type. Thankfully, such issues are likely to be resolved in the next few years, lowering the cost burden of making products available to multiple devices and browsers.

c) Professional Development: Teacher support goes a long way toward determining the long-term success of any game in the classroom. However, according to Victoria Van Voorhis, CEO of Second Avenue Learning, "Teachers can also be a big barrier. They are not familiar with gaming and are unclear about how to use games in the curriculum—are they for independent practice, group work, or integrated learning?" (CS4Ed interview, June 2011). Professional development to familiarize teachers with games is essential for ensuring that they can successfully integrate learning games into their classrooms.

Teachers themselves include among their top four priorities for further professional development "using technology in the classroom" (National Staff Development Council, 2011). As more teachers are becoming supportive of using games in the classroom, initial as well as ongoing professional development support will likely be paired with the purchase of new digital curriculum products such as interactive tools or learning games. In a recent survey sponsored by the Joan Ganz Cooney Center (Millstone, 2012), results indicated that the majority of teachers first learn about using digital games in the classroom from in-service professional development workshops (46%), followed by self-directed study (35%).

In 2012, Congress appropriated $3.1 billion for teacher programs that are designed to improve the quality of teachers in the K-12 classroom. These funds account for 4.5% of the total discretionary budget of the U.S. Department of Education. The programs include monies to support professional development in technology integration. The funds are distributed by the U.S. Department of Education to states and local education agencies, and in some cases they are distributed directly to individual teachers.

d) Research on Effectiveness: The No Child Left Behind (NCLB) Act requires that schools use federal money only on products and services that have an established research base through "Scientifically Based Research" (SBR). SBR is, in essence, a randomized trial similar to the clinical trials required for pharmaceuticals. In an effort to avoid poor quality evaluations, NCLB designates any type of research that does not meet SBR requirements as being of poor quality. It is important to document the efficacy of any product to be used in schools, but using SBR in the education field is fraught with challenges, and it should be noted that SBR is costly and time-consuming. However, as NCLB now stands, SBR is required on all new products (Richards & Walters, 2008). Any developer of a game needs to understand the complexity and limitations of SBR in order to comply with its requirements.

Among the numerous challenges are the difficulties of randomly assigning subjects to treatment and control groups in a classroom setting and creating a true control group (the equivalent of a "placebo" in a medical setting). Maintaining both treatment and control groups is difficult given the turnover of student populations. The SBR requirement that statistical analysis of quantitative measures be standardized using large samples ignores the risk of finding no effect due to imprecise measurement, misuse of the product, or irrelevant variables in the research environment.

Unfortunately, the requirements of NCLB fail to acknowledge that evaluating different types of products requires different kinds of evaluation design and devalues valid research methods that are useful in ferreting out product effectiveness and supporting product development. Formative evaluation, ad hoc measures, and various quasi-experimental procedures provide useful information about the effectiveness of a new product at relatively low cost, and they can greatly aid in improving the product, even though they lack the putative rigor of SBR. Few products are full-grown at birth, and an iterative, multimodal approach to product evaluation is effective in gathering sufficient enough information about efficacy to guide the design and evolution of a particular product,

6. Recommendations

The K-12 market is unique and it can be difficult to access. We recommend that learning game investors, publishers, and developers consider the following:

- Market games as supplemental material.
- Keep in mind that English/Language arts budgets are larger than any other curriculum area, with math a somewhat distant second.
- Consider using a third party to complete sales of learning games. Doing this keeps overhead low and allows a small company such as a game developer to concentrate on what it does best—develop great learning games.
- Remember the buying cycle: successful companies roll out new products and market them in the spring, in anticipation of a new budget as of July 1.

- Develop partnerships to leverage the resources of the Big Three publishers and universities, foundations, media conglomerates, and other small publishers.
- Create and market short-form games that are aligned to state standards and the soon-to-come Common Core standards.
- Ensure that products can run on multiple platforms and in multiple infrastructure environments.
- Integrate teacher training and professional development opportunities with any new learning game.
- Remember that any learning game that receives federal money must adhere to the Scientifically Based Research standards mandated by the No Child Left Behind Act.
- Develop collections of short-form games that allow teachers great flexibility for using them within the 40 minute classroom period. Develop long-form games in conjunction with engaging schools in large and small reforms to reallocate school time to allow longer game playing and more immersive learning.
- Consider developing short- or long-form games that can be used as homework to avoid the constraints imposed by discrete blocks of class time.

moving forward

Investment in Education Technology

The majority of our interviewees were excited and enthusiastic about the potential of learning games in schools. This optimism was balanced by the realities of the market. Josh Cohen, Managing Partner of City Light Capital, says that his organization is actively looking at companies in the marketplace, "But our excitement will be based on two things: their ability to prove that people using their product leads to a higher performance outcome from a learning standpoint. And to the extent that those two things happen we will be significantly more interested than we are today" (CS4Ed interview, April 2012). Tom Vander Ark, partner at Learn Capital, explains their investment in Blue Duck Education (MangaHigh) as such: "Toby Rowland [CEO] would say procedural fluency is their strength, they have developed games around the mechanics of mathematics rather than using math as a barrier. … Toby would also be quick to say that adoption and monetization has been a challenge. There is so much free stuff out there… and the use-barriers like adoption have been a tough combination in the game space" (CS4Ed interview, April 2012).

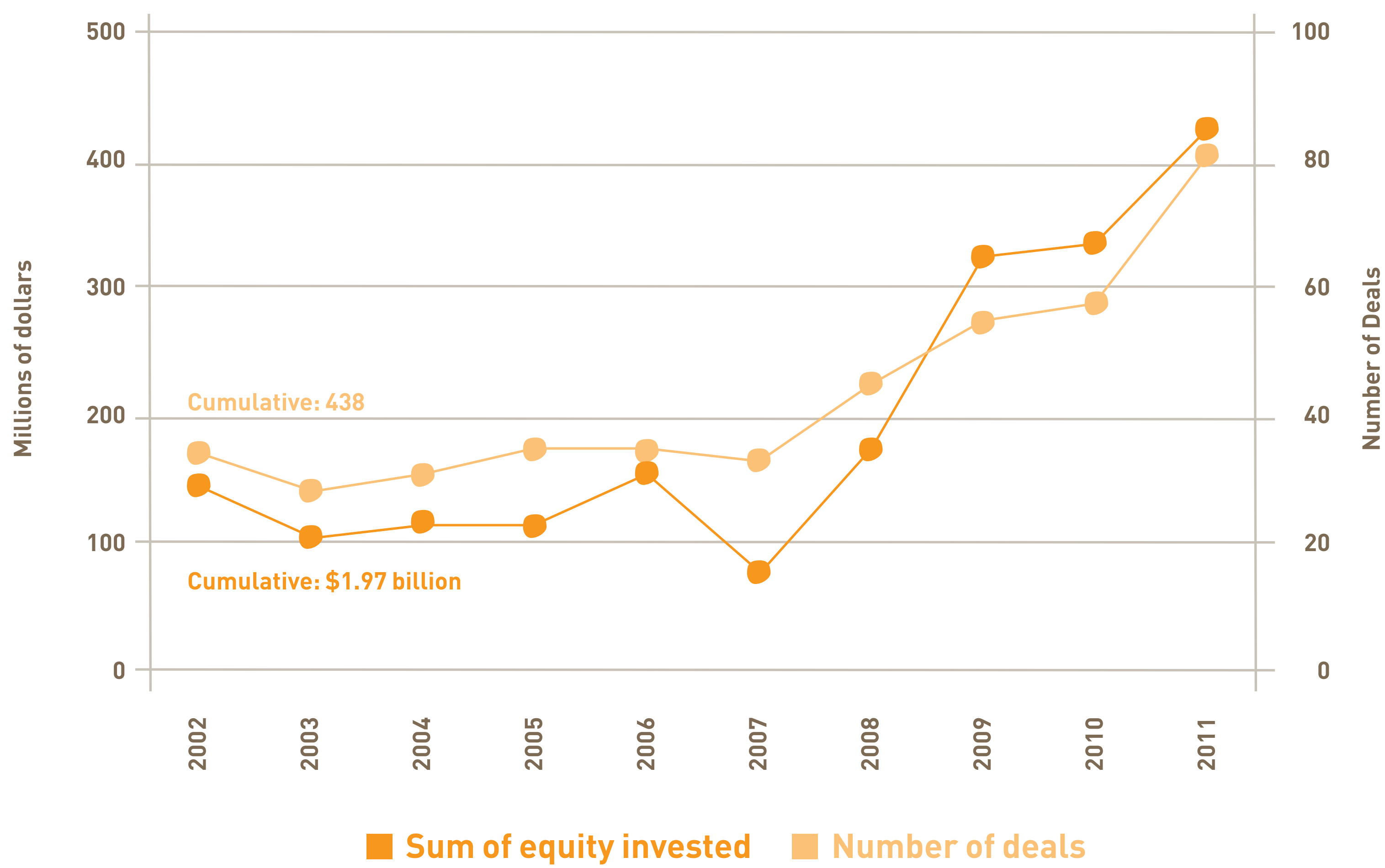
In 2011 there was a notable rise in investment capital in educational technology, including in learning games. According to a national market survey done at the time by GSV Advisors, investors funded educational technology companies at levels not seen since the late 1990's. Education technology companies received investment capital 127 times in 2011, an increase from the 106 funded in 1999, and well above the annual averages of the past decade (Global Silicon Valley Advisors, 2012). The survey also reported that while the number of companies funded increased, the capital raised on average was $9.0 million per company, which was down 30.4% from $13.0 million per company in 1999.

The National Venture Capital Association reported similar findings (see Figure 3), discovering that investment in education technology companies has tripled in the past decade rising from $146 million in 2002 to roughly $429 million in 2011. The increase in funds began to pick up significant speed beginning in 2009, with investments increasing by $150 million from the previous year, even though the economy was entering a recession (National Venture Capital Association, 2011). A recent significant investment by News Corp was announced in August of 2012. News Corp plans to invest $180 million in Amplify, up from $100 million the previous year. Amplify is focused on digital curriculum with analytics that are aligned to the Common Core using a tablet-based platform.[41]

In some of the interviews investors talked about skirting the institutional market altogether. Dr. Bobbi Kurshan, President of Educorp Consulting said, "We just closed on a deal in January [2012] on a new gaming company. It was a combination of digital assets and investment from the Vancouver Aquarium and FableVision, a spinoff called Sparkbridge in Boston. … We looked at both the school market and the afterschool learning market (museums, boys and girls clubs) and we ended up creating something in the afterschool space after doing a lot of research" (CS4Ed interview, March, 2012). This mix of enthusiasm and caution is captured best by Josh Cohen, Managing Partner of City Light Capital. When we asked him about the excitement over games and the educational market he said that people "…are taking that leap of faith. Matt

LeBlanc's *Friends* television character's theory of food: meat is good and jam is good so if you put meat and jam together it will probably be great. There is a little bit of the 'meat and jam' mentality out there, which may turn out to be disgusting even though all the elements are exciting to some folks" (CS4Ed interview, April, 2012). This expansion of venture investment into educational technology is matched with Foundation-based university and game developer collaboration. ATT has contributed $3.8 million to expand **GameDesk**[42], a non-profit organization based on research at the University of Southern California. ***The Institute of Play***, a nonprofit video game institute, will manage the new **Games, Learning and Assessment (GLASS) Lab**[43] with $10.3 million in grants from the John D. and Catherine T. MacArthur Foundation, the Bill & Melinda Gates Foundation, Electronic Arts, and the Entertainment Software Association.

Figure 3. Venture Capital investment in education technology companies, 2002 through 2011.



Note: Data include educational technology companies in elementary and secondary education, higher education, lifelong learning, and informal education.

Source: National Venture Capital Association, Thomson Reuters

Macro-Trends Support Optimism

Much of the optimism about the role of games in education results from specific macro-trends that point to learning games becoming an increasingly, large part of the K-12 landscape. These macro-trends have been noted at various points in this report. They are: the growing ubiquity of tablets and mobile devices, the National Education

Technology Plan, the current emphasis on STEM and 21st century skills, the print to digital transition, the deployment of cloud computing, and the emergence of personal learning environments.

Tablets and Mobile Devices

There is widespread agreement among investors, educators, school administrators, and the Department of Education about changes on the horizon for the K-12 market. The growth of tablets and mobiles, apps and collections of short-form games, and intelligent adaptive platforms that provide data is seen as a positive trend for supporting learning games going forward. Several of those interviewed referenced the increased use of mobile devices and apps by younger children, and this increase was confirmed in two recent market research reviews (Gutnick, Robb, Takeuchi & Kotler, 2010; Chiong & Shuler, 2010).

STEM and 21st Century Skills

The recent focus on improving STEM skills (Science, Technology, Engineering and Math) and fostering higher order thinking skills (21st century skills) has generated an interest in learning games as a potential tool for helping improve teaching and learning in these important areas. The federal government, through the Department of Education, the National Science Foundation (NSF), and other agencies, is pushing for more attention to be focused on helping students develop STEM skills.

President Obama himself has called for the improvement of STEM education, and his 2013 budget for the Department of Education and his Blueprint are focused on strengthening **STEM**[44] education and fostering higher order thinking skills. Additionally, President Obama's 2009 "Educate to Innovate" campaign includes partnerships with industry, foundations, universities, and non-profits to support STEM and 21st century skill development in schools. One piece of this campaign is the National STEM Video Game Challenge launched by the Joan Ganz Cooney Center and E-Line Media in partnership with the Department of Education's Digital Promise Initiative, the Entertainment Software Association, AMD Foundation, Microsoft, and PBS-CPB Ready to Learn. This competition is aimed at motivating students to develop an interest in STEM learning and careers by asking them to participate in a video game design competition.

Print to Digital Transition

There is a shift in existing budgets for classroom materials away from printed and toward digital materials. Ricci & Worlock (2012), predict that the trend toward the purchase of digital textbooks is slow but steadily increasing, with the digital textbook market predicted to approach almost 25% of total textbook sales by 2014. New state laws and policies compel the adoption of digital materials, and the move toward more online learning and the development of virtual classes and schools are also having some influence. Notable examples of new legislation include laws in Texas, Florida, Indiana, and West Virginia. These policy advancements open public funds traditionally allocated to printed textbooks to educational technologies, including content, platforms, and device-specific applications, as the presence of dedicated readers and tablet computers dramatically increase in schools around the nation. These changes in state laws will have a significant impact on the creation, sales, and distribution of textbooks and digital content going forward, including the potential for interactive materials and learning games.

The Deployment of Cloud Computing

Universal connectivity, coupled with cloud-provided data and computing services will have a profound impact on the creation, sales, and distribution of textbooks and digital content going forward. Many large districts have made the move to the cloud. This not only eases the burden of deploying interactive materials and learning games in classroom and non-classroom environments, but can provide access to administrative and instructional data systems for a much more refined analysis of performance.

The relevance and importance of evidence-based decision-making continues to grow as districts move to digital instructional materials motivated by the desire to save money, increase student engagement, and provide more timely and flexible resources. Costs and the drive to improve learning outcomes are accelerating this push. While concerns about quality, Internet access, infrastructure, teacher professional development, and slow-moving school bureaucracies may slow the process of change, they will not significantly impede this global trend.

Personal Learning Environments (PLEs)

Learning games have great potential to help bring the model of adaptive, personalized learning environments (PLE) to fruition (SIIA, 2010). These PLEs rely on adaptive learning engines and are intrinsic to many long-form learning games. They are particularly attractive to educators because they are truly learner centered, as PLEs can directly connect with learner interests and allow students to be actively involved in the design of their learning experiences. This approach is unlike a differentiated activity that might place a student into one of three levels of difficulty. In PLEs, learners can select the appropriate technologies and resources to support their own learning and they can call on a network of peers, teachers, and others to aid them in this. Ongoing assessments are embedded in the learning process, and teachers steer learners toward being independent, setting their own goals, and actively reflecting on their own learning. As Stephen DeBerry, Partner, Kapor Capital explains, “Junyo is an interesting example [of an investment they just made]. It has the same incredible predictive analytics that Zynga has, and applies it to education. …We think this is a really big idea because education delivery right now broadly uses the same mechanism for everyone, although everyone learns differently” (CS4Ed interview, March 2012).

The National Educational Technology Plan

The National Educational Technology Plan calls for a PLE—a validated, integrated system that provides real-time access to learning results, that connects to levels of difficulty and assistance, and that contains self-improving features to increase effectiveness through interactions with learners. PLEs should be able to build upon—and integrate with—learning management systems and digital teaching platforms that are now widespread in schools. (In 2011, it was estimated that 75% of all districts had implemented some form of LMS. Projected LMS sales for 2013 were $375 million (Simba Information, 2011)).

Recommendations

The single most important thing investors can do to move learning games successfully into the K-12 space is to keep in mind how a game will be used in the classroom setting. It is crucial when approaching the institutional market to clearly communicate the type of game being sold, as well as the curriculum area and grade range. Many administrators and teachers confuse short-form and long-form games depending on what experiences they have had. This confusion could impact the success of selling learning games to schools.

Investors should support collections of short-form games that maximize teacher flexibility and are aligned to standards.

Collections of short-form games can be particularly attractive to schools because they have the ability to fit well into the current K-12 classroom structure and are easier to align to standards. Product lines composed of collections of short-form games and other materials are starting to experience success in the institutional market. These types of games also have the potential to be embedded in personalized learning environments or to be leveraged by adaptive engines that combine instruction with the use of data and feedback loops that are becoming increasingly popular in schools.

Short-form games provide tools for practice and focused concepts and fit easily into the classroom. While most lack the depth and research base of long-form games, it appears they are gaining traction in the classroom. Unfortunately, for particular types of skill development, they have a useful though somewhat limited role to play.

Investors should support long-form games that are affiliated with education reform initiatives; particularly those initiatives that re-imagine the school day in ways that promote in depth study, longer class periods, open ended projects, and critical thinking skills.

Long-form games come from stronger research terrain and are focused on higher order thinking skills. As we have demonstrated above, these games are starting to receive more attention and support. To the degree that classrooms shift from a hyper-focus on high stakes testing and free up the structure of the learning day to aid in fostering 21st century skills, long-form games will have a place in the classroom. Until those changes occur, long form games that manage to enter the institutional space will need to bend to fit the existing space, rather than expect that the classroom will naturally shift to embrace the requirements of long-form games.

However, the National Education Technology Plan (NETP, 2010), Transforming American Education: Learning Powered by Technology, offers investors in learning games hope. NETP calls for applying the advanced technologies that are used in everyday life to the education system in order to foster more effective teaching and learning, to scale up effective practices, and to use data to improve student learning. The model of learning described in the plan focuses on personalized learning experiences and on linking what is taught to what students need to learn. It calls for the use of state-of-the-art technologies, for "Universal Design for Learning," and for using the affordances of technology to support continuous and lifelong learning.

Of particular relevance for learning games, NETP calls for fundamental changes in the structure of the school day, including longer and more school days, access to learning online, flexibility in schedules, and a reduction in the use of "seat time" to determine student advancement. In addition, the plan focuses on using social interactions and collaborative activities to spur learning, using technology to improve content such as virtual online environments and games, and using data to inform and improve instruction (Devaney, 2011).

Making games work in the classroom requires an understanding not only of issues specific to learning games, but also of the systemic barriers to entry and constraints of the K-12 environment for any supplemental product in the K-12 space. The dominance of a few entrenched players, the long buying cycle, the multi-layered decision making process, the fragmented marketplace, the demand for curriculum alignment, the requirement of a research base, and the need for professional development all will impact any product trying to make its way into the institutional market. Therefore, it is incumbent upon game developers to consider how their product meets the goals of teachers and students, how it will be flexible and adaptable enough to fit into the school day, and how it can be used easily.

Adkins, S., (2011). *Ambient Insight's U.S. market for mobile learning products and services: 2010-2015 Forecast and analysis*. Ambient Insight Comprehensive Report.

Anderson, J.Q. & Rainie, R. (2010, June). *The future of cloud computing*. Pew Internet & American Life Project. Retrieved from **http://pewinternet.org/Reports/2010/The-future-of-cloud-computing.aspx**

Berger, L. & Stevenson, D. (2007). K-12 Entrepreneurship: Slow Entry, Distant Exit. *American Enterprise Institute Conference, "The Supply Side of School Reform and the Future of Educational Entrepreneurship,"* Retrieved from **http://ww.aei.org/event1522**

Bogost, I. (2007). *Persuasive games: The expressive power of videogames*. Cambridge: MIT Press.

Chiong, C., & Shuler, C. (2010). *Learning: Is there an app for that? Investigations of young children's usage and learning with mobile devices and apps.* New York: The Joan Ganz Cooney Center at Sesame Workshop.

Christensen, C. (1997). *The innovator's dilemma*. New York: HarperCollins.

Dede, C. (2012). Customization in immersive learning environments: implications for digital teaching platforms. In Dede & Richards,: 119 – 133. *Digital teaching platforms: Customizing class-room learning for each student*. New York: Teachers College Press.

Dede, C. & Richards, J. (2012). *Digital teaching platforms: Customizing classroom learning for each student*. New York: Teachers College Press.

Dede, C., Nelson, B., Ketelhut, D., Clarke, J., & Bowman, C. (2004). *Design-based research strategies for studying situated learning in a multi-user virtual environment*. Paper presented at the 2004 International Conference on Learning Sciences, Mahweh, NJ.

Devaney, L.(2011). Feds review progress on national ed-tech plan. *eSchool News*, 6/27. Retrieved from **https://www.eschoolnews.com/2011/06/27/feds-review-progress-on-national-ed-tech-plan**

Devaney, L. (2011a). Bring your own devices catching on in school *eSchool News*. Retrieved from **http://www.eschoolnews.com/2011/04/29/bring-your-own-device-catching-on-in-schools**

Feurzeig,W. Papert, S., Bloom, M., Grant, R., & Solomon, C. (1969). *Programming languages as a conceptual framework for teaching mathematics*. Taken from the Final Report on the first fifteen months of the LOGO Project, November30, 1969. Submitted to the National Science Foundation on Contract NSF- C 558. Retrieved from **http://beyondbitsandatoms.stanford.edu/readings/class3/Feurzeig-1969-Programming%20languages%20as%20a%20conceptual.pdf**

Frazer, A., Argles, D., & Wills, G. (2008). *The same, but different: The educational affordances of different gaming genres*. Presented at the eighth IEEE International Conference on Advanced Learning Technologies.

FutureSource Consulting. (2011). Interactive displays and ICT products market report. Boston, MA.

Bill and Melinda Gates Foundation. (2012). Technology and Effective Teaching in the U.S. Innovation in Education. Retrieved from **https://edsurge.s3.amazonaws.com/public/BMGF_Innovation_In_Education.pdf**

Games, A. & Squire, K. (2011) *Searching for the fun in learning: A historical perspective on the evolution of educational video games*. In Tobias, S. & Fletcher, J.D. (Eds.), 2011. *Computer games and instruction* (pp 17-46). Charlotte, NC: Information Age Press.

Gee, J. (2007). *Good Video Games + Good Learning*. New York: Peter Lang.

Global Silicon Valley Advisors (GSV). (2012). *Fall of the Wall: Capital Flows to Education Innovation*. White Paper retrieved from **http://gsvadvisors.com/wordpress/wp-content/themes/gsvadvisors/GSV%20Advisors_Fall%20of%20the%20Wall_2012-07-05.pdf.**

Greaves, T., Hayes, J., Wilson, L., Gielniak, M., & Peterson, R. (2010). *Technology factor: Nine keys to student achievement and cost-effectiveness*. Shelton: CT: MDR.

Gutnick, A. L., Robb, M., Takeuchi, L., & Kotler, J. (2010). *Always connected: The new digital media habits of young children*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Habgood, M. & Ainsworth, S. E., 2011. Motivating children to learn effectively: exploring the value of intrinsic integration in educational games. *Journal of the Learning Sciences*, 20(2), 169-206. doi:10.1080/10508406.2010.508029.

Harushimana, I. (2008). Literacy through gaming: The influence of videogames on the writings of high school freshman males. *Journal of Literacy and Technology*, 9(2), 35- 56. Retrieved from **http://www.literacyandtechnology.org/volume10/harushimana.pdf.**

Herz, J.C.(1997). *Joystick nation: How videogames ate our quarters, won our hearts, and rewired our minds*. Princeton, NJ: Little Brown & Company.

Hitchens, M. & Drachen, A. (2009). The many faces of role-playing games. *International Journal of Role-Playing*, 1(1), 3-21. Retrieved from **http://marinkacopier.nl/ ijrp/wp-content/uploads/2009/01/ hitchens_drachen_the_many_faces_of_rpgs.pdf**

Honey, M. & Hilton, M. eds. (2011). *Learning science: computer games, simulations, and education*. Committee on Science Learning. Retrieved from **http://www.nap.edu/openbook.php?record_id=13078&page=R1**

Johnson, L., Smith, R., Levine, A., & Haywood, K. (2010). 2010 horizon report: K-12 edition. Austin, TX: The New Media Consortium.

Ketelhut, D. J. (2007). The impact of student self-efficacy on scientific inquiry skills: An exploratory investigation in River City, a multi-user virtual environment. The Journal of Science Education and Technology,16 (1), 99–111.

Klopfer, E. (2008). Augmented *learning: Research and design of mobile educational games*. Cambridge. MA: MIT Press.

Klopfer, E. & J. Haas. In press. *The more we know: The story of an educational innovation that failed (and possibly saved NBC News)*. Manuscript submitted for Publication.

Klopfer, E., Osterweil, S., Groff, J. & Haas, J. (2009). Using the technology of today, in the classroom today. The Education Arcade. Retrieved from **http://education.mit.edu/papers/GamesSimsSocNets_EdArcade.pdf**

Klopfer, E., Osterweil, S. & Salen, K. (2009). *Moving learning games forward: Obstacles, opportunities, and openness*. Cambridge: Education Arcade. Retrieved from **http://education.mit.edu/papers/MovingLearningGamesForward_EdArcade.pdf**

Leachman, M., Williams, E., & Johnson, N. (2011, March 21). Governors are proposing further deep cuts in services, likely harming their economies. Center on Budget and Policy Priorities. Available: **http://www.cbpp.org/cms/?fa=view&id=3389**

Lee, J. (2011, March 8). President Obama Talks Education in Boston: A Moral and Economic Imperative to Give Every Child the Chance to Succeed. Retrieved from **http://www.whitehouse.gov/blog/2011/03/08/**

Lenhart, A. (2012). *Teens, smartphones & texting*. Washington D.C.: Pew Research Center's Internet & American Life Project.

Linn, M. (2012). Insights for teaching and learning science. In Dede & Richards: 55-70. *Digital teaching platforms: Customizing classroom learning for each student*. New York: Teachers College Press.

Liu, E. & Lin, C. (2009). Developing evaluative indicators for educational computer games. *British Journal of Educational Technology*. 40(1), 174–178.

Market Data Retrieval(MDR). (2011). *State of the K-12 market 2011; Part II: Educational materials*. Goldberg M., Jay, M., Rappaport, S., Wujcik, A. Connecticut: Market Data Retrieval.

McClean, P., Saini-Eidukat, B., Schwert, D., Slator, B., & White, A. (2001). Virtual worlds in large-enrollment science classes significantly improve authentic learning. In *Selected Papers from the 12th International Conference on College Teaching and Learning*, J. Chambers, Ed.. Center for the Advancement of Teaching and Learning, Jacksonville, FL.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin.

Millstone, J. (2012). *Teacher attitudes about Digital Games in the Classroom*. New York: The Joan Ganz Cooney Center at Sesame Workshop in Collaboration with BrainPOP.

National Staff Development Council. (2011). Professional learning in the learning profession. As cited in Barron, B., Cayton-Hodges, G., Bofferding, L., Copple, C., Darling-Hammond, L., & Levine, M. *Take a giant step: A blueprint for teaching children in a digital age*. New York: The Joan Ganz Cooney Center at Sesame Workshop. Retrieved from **http://www.joanganzcooney-center.org/wp-content/uploads/2012/01/jgcc_takeagiantstep1.pdf**

National School Supply & Equipment Association (2010). NSSEA Retail Market Awareness Study. Retrieved from: **http://www.nssea.org/publications/industryreports.cfm**

National Venture Capital Association, (2011, September 12). *V C Investment (Money Tree)*. 2004-2011. National Venture Capital Association. Retrieved from **http://www.nvca.org/index.php?option=com_docman&task=cat_view&gid=57&Itemid=317.**

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books.

PBS/Grunwald Associates. (2010). Deepening Connections: Teachers Increasingly Rely on Media and Technology Retrieved from PBS Grunwald Study 2010

Prensky, M. (2001). Digital game-based learning. New York: McGraw-Hill.

Resnick, R.M., Sanislo, G. & Oda, S. (2012). *The complete K-12 Report®: Market facts and segment analyses, 2012*. New York: Education Market Research.

Richards, J. & Walters, J. Evaluating products and services. In *Expert's Guide to the K-12 Market. 2nd Edition*. SIIA.

Ricci, L. & Worlock. (2012). *US K-12: 2012 Market Size, Share & Forecast Report*. Burlingame, CA: Outsell.

Shaffer, D.W. (2006). *How video games help children learn*. New York: Palgrave, Macmillan.
SIIA. (2011). *2010 U.S. Educational technology industry market: PreK-12*. Richards, J., Molina, K., & Haraguchi, S. Washington D.C.: Software & Information Industry Association.

SIIA, 2010. *Innovate to educate: System redesign for personalized learning; A Report from the 2010 symposium*. In collaboration with ASCD and the Council of Chief State School Officers. Wolf, M. Washington, DC. Software & Information Industry Association. Retrieved from **http://siia.net/pli/presentations/PerLearnPaper.pdf**

Simba Information. (2011). *PreK-12 learning management systems: A market overview.* Rockville, Maryland: Simba Information

Squire, K., 2008. Open-ended video games: A model for developing learning for the interactive age. *The ecology of games: connecting youth, games, and learning*. Katie Salen (Ed). The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press, 167–198.

Squire, K.; Barnett, M.; Grant, J. & Higginbotham, T. (2004). Electromagnetism supercharged!: Learning physics with digital simulation games. *International Conference on Learning Sciences*.

Squire, K., & Durga, S., in press. Productive gaming: The case for historiographic game play. To appear in R. Ferdig (Ed.) *The handbook of educational gaming*. Hershey, PA: Information Science Reference.

Starr, P. (1994). Seductions of sim: Policy as a simulation game. *The American Prospect*, 17, 19–29.

Stone, R. (2008). *Human factors guidelines for interactive 3D and Games-based training Systems Design*. Retrieved from **http://www.eece.bham.ac.uk/Default.aspx?tabid=154.**

Thai, A., Lowenstein, D., Ching, D., & Rejeski, D. (2009). *Game changer: Investing in digital play to advance children's learning and health*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Tobias, S. Fletcher, J.D. Dai, D.Y. & Wind, A. P. (2011). Review of research on computer games. In Tobias, S. & Fletcher, J.D. (Eds.), 2011. *Computer games and instruction* (pp 127-222). Charlotte, NC: Information Age Press.

Tullis, M. (2008). State instructional material adoptions. In *Expert's guide to the K-12 market* (pp 13-16). 2nd Edition. SIIA.

University of Washington.(2011). Gamers succeed where scientists fail: Molecular structure of retrovirus enzyme solved, doors open to new AIDS drug design. *ScienceDaily*, September 19. Retrieved from **http://www.sciencedaily.com/releases/2011/09/110918144955.htm.**

U.S. Department of Education, Office of Education Technology, NETP 2010. *National education technology plan, 2010: Transforming American education: Learning powered by technology*. Washington D.C.: U.S. Government Printing Office.

U. S. Department of Education, National Center for Education Statistics, NCES 2011. *Digest of education statistics*, 2010. Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Education. National Center for Education Statistics, NCES 2011a. *Projections of education statistics to 2020*. Washington D.C.: U.S. Government Printing Office.

U. S. Department of Education, National Center for Education Statistics, NCES 2010. *Digest of education statistics, 2009*. Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Education, National Center for Education Statistics, NCES 2003. *Overview and inventory of state education reforms: 1990 to 2000*, National Center for Education Statistics, 2003–020.Washington, DC.: U.S. Government Printing Office. Retrieved from: **http://nces.ed.gov/pubs2003/2003020.pdf**

Williams, M., Leachman, E., & Johnson, N. (2011, March 21). Governors are proposing further deep cuts in services, likely harming their economies. Center on Budget and Policy Priorities. Available: **http://www.cbpp.org/cms/?fa=view&id=3389**

Wilson, K.A.,Bedwell, W.L., Lazzara, E.H., Salas, E., Burke, C,S., Estock, J.L., Orvis, K.L.& Conkey, C. (2009). Relationships between game attributes and learning outcomes: Review and research proposals. *Simulation & Gaming*, 40: 217-266.

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, 61-89.

endotes

1 PBS/Grunwald Associates (2010.) and Bill and Melinda Gates Foundation (2012).

2 http://www.youtube.com/watch?v=lwQgAkHC7NE

3 http://making-history.com

4 http://www.knowledgeadventure.com

5 http://motionmathgames.com

6 http://www.studyisland.com

7 Study Island is a division of Archipelago Learning. Archipelago Learning recently merged with Plato Learning and is now a portfolio company of Thoma Bravo LLC.

8 http://fold.it/portal

9 http://www.brainpop.com

10 http://www.oregontrail.com/hmh/site/oregontrail

11 http://www.icivics.org

12 http://www.ket.org/missionus

13 http://rivercity.activeworlds.com

14 http://forensics.rice.edu

15 http://www.secondavenuelearning.com

16 http://www.civilization5.com

17 http://making-history.com

18 http://scratch.mit.edu

19 http://minecraftedu.com

20 http://www.joanganzcooneycenter.org/publication/national-survey-and-video-case-studies-teacher-attitudes-about-digital-games-in-the-classroom/

21 http://mw.concord.org/modeler

22 http://www.middleburyinteractive.com/products/middleburyprep.php

23 http://www.whiteboxlearning.com

24 http://ecomuve.gse.harvard.edu

25 www.pbslearningmedia.org

26 http://www.explorelearning.com

27 http://teacher.scholastic.com/math-fact-fluency/fastt-math-next-generation

28 www.skillstutor.com

29 http://www.mangahigh.com

30 www.timetoknow.com

31 http://www.discoveryeducation.com/techbook

32 http://read180.scholastic.com

33 http://new.livestream.com/g4c/jamespaulgee

[34] There are a couple of notable exceptions to this generality. For example Quest to Learn in New York City is a school with a games-based curriculum.

[35] NCES, 2011. Public school data tables 70, 85, 91, 92, 2009/2010. Private school data table 63 65, Fall 2009; Home school data table 40, 2007.

[36] Source NCES 2011 tables 35, p.68 and 180, p.260.

[37] From NCES 2010, p. 614 Table 425, NCES 2011 p. 173, Table 108—trend line from 2009 to 2014 interpolated.

[38] The historical data is generally accepted in the industry, and was confirmed in the industry interviews (in particular, Richard Casabonne, CEO Casabonne Associates and former President Leapfrog Education and SVP at Harcourt, CS4Ed interview, May 2012). Data for 2010 and 2011 are from Resnick, Sanislo & Oda, 2012, and Ricci and Worlock, 2012 (Outsell). Note that the definitions of "supplemental" vary across these sources. For our analysis, we have included testing, assessment, and reference material (in contrast with Outsell), and excluded furniture/fixtures and equipment (in contrast with Resnick et al., 2012).

[39] The sales channel analysis in TABLE 7 is adapted from information produced originally by Kevin Custer, Partner in ARC, Capital Development and an industry veteran. Custer's original analysis was adjusted by CS4Ed based on interviews and conversations with more than a dozen experienced professionals who have a history of selling to the institutional market.

[40] Source: Hoovers (Dun & Bradstreet) accessed June 7, 2012 and annual reports. HMH filed and reported out of bankruptcy in 2012. Some of these revenues are for International sales.

[41] Associated Press, 2012.

[42] http://www.gamedesk.org

[43] http://www.instituteofplay.org/2012/06/2498glass-lab-press-release

[44] http://www2.ed.gov/policy/elsec/leg/blueprint/index.html

appendix a: game map: institutional requirements

A. Institutional Requirements	Motion Math	Study Island	FutureU	Math Blaster	Physlets	Poptropica	Foldit	Manga High	Oregon Trail	Midd World	Whitebox	Civilization V	River City	iCivics	CSI	Labyrinth	Minecraft	Gamestar Mechanic	Whyville
	Short Form						Long Form												
	Drill- Practice	Drill- Practice	Drill- Practice (with Adventure)	Drill- Practice	Simulation (Short)	Interactive Learning Tools	Puzzle	Puzzle	Simulation	Simulation	Simulation	Simulation & Strategy	Role Playing & Simulation	Role Playing	Role Playing	Puzzle & Action/Adventure	Sandbox	Puzzle & Adventure (Long Form)	Role Playing
1. Role Played in School																			
Basal/Core Curriculum	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Supplemental/ After School/At Home	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Test Prep	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Professional Development	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N
2. Grade Level																			
Pre-K-2	N	N	N	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
Grade 3-5	N	Y	Y	Y	N	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y
Grade 6-8	N	Y	Y	6th Only	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Grade 9-12	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	N
Teachers	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N
3. Content Area																			
Reading/ELA	N	N	Y	N	N	Y	N	N	Y	N	N	N	N	N	N	Y	N	N	Y
Math	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y
Science	Y	N	N	N	Y	Y	Y	N	N	N	Y	N	Y	N	Y	N	Y	Y	Y
Social Studies	N	N	Y	N	N	N	N	N	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y
Phys.Ed/Hlth	Y	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y
Art - Visual and Performance	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y
Assessment	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Foreign Languages	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
21st C. Skills/Tech	N	N	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Vocational Training	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
Re-use with different subjects e.g. Starlogo	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	Y	N
Combines two or more subjects	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	Y	Y	Y	N

appendix a: game map: institutional requirements (continued)

A. Institutional Requirements	Short Form						Long Form												
	Drill- Practice	Drill- Practice	Drill- Practice (with Adventure)	Drill- Practice	Simulation (Short)	Interactive Learning Tools	Puzzle	Puzzle	Simulation	Simulation	Simulation	Simulation & Strategy	Role Playing & Simulation	Role Playing	Role Playing	Puzzle & Action/Adventure	Sandbox	Puzzle & Adventure (Long Form)	Role Playing
	Motion Math	Study Island	FutureU	Math Blaster	Physlets	Poptropica	Foldit	Manga High	Oregon Trail	Midd World	Whitebox	Civilization V	River City	iCivics	CSI	Labyrinth	Minecraft	Gamestar Mechanic	Whyville
4. School Integration																			
Alignment with Standards	Y	Y	Y	N	N	N	N	Y	N	N	Y	N	Y	Y	N	Y	N	N	Y
Pedagogy Built In	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Gaming Literacy Required	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N
Teacher Facilitation Needed	N	N	N	N	N	N	Y	N	N	N	Y	N	Y	N	Y	Y	Y	N	N
Time involved in playing: < 1 class period or > 1 class period	< 1	< 1	< 1	< 1	< 1	< 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1	> 1
5. Platform																			
CD-ROM or Download Application	N	N	D	BOTH	N	N	D	N	CD	D	N	BOTH	CD	N	N	N	D	N	N
Online - Web/LMS/Social Networking Site	N	Y	Y	Web	Y	Y	N	Y	N	W	W	N	N	Web	Y	Y	Y	Y	Y
Video Game Console	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N
Handheld Game Console (e.g. PSP, DS)	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Mobile (Tablet, Phone)	Y	Y	Y	N	N	under dev.	N	N	N	N	N	N	N	N	Y	N	N	N	N
Hardware Requirements	iPad/ iPhone	PC/Mac	Handheld & PC/Mac	PC/Mac	PC/Mac	PC/Mac	PC/Mac	N	PC/Mac/ iPad/iPhone	PC/Mac	PC/Mac	PC/Mac	PC	PC/Mac	Handheld & PC/Mac	PC/Mac	PC/Mac	PC/Mac	PC/Mac
Internet Connection Needed	N	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	N	Y	Y

appendix a: game map: game characteristics

B. Game Characteristics	Motion Math	Study Island	FutureU	Math Blaster	Physlets	Poptropica	Foldit	Manga High	Oregon Trail	Midd World	Whitebox	Civilization V	River City	iCivics	CSI	Labyrinth	Minecraft	Gamestar Mechanic	Whyville
	Short Form						Long Form												
	Drill- Practice	Drill- Practice	Drill- Practice (with Adventure)	Drill- Practice	Simulation (Short)	Interactive Learning Tools	Puzzle	Puzzle	Simulation	Simulation	Simulation	Simulation & Strategy	Role Playing & Simulation	Role Playing	Role Playing	Puzzle & Action/Adventure	Sandbox	Puzzle & Adventure (Long Form)	Role Playing
1. Game Origin																			
Consumer	N	N	Y	N	N	Y	N	Y	Y	N	N	Y	N	Y	N	N	N	N	N
Institution	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y
Both Consumer and Institution	Y	N	N	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	N
2. Game Rules/Structure																			
Practice Without Penalty?	N	N	N	N	Y	N	Y	Y	N	N	Y	N	Y	N	Y	Y	Y	Y	Y
Help/Hints/Instructional Supports	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Controlled (as Opposed to Open Ended)	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	N	N	Y
Single or Multi-player	S	S	S	BOTH		BOTH	S	BOTH	BOTH	M	BOTH	BOTH	M	S	M	BOTH	M	BOTH	BOTH
Turn-based	N	N	N	N		N	N	N	N	Y	N	Y	N	N	N	N	N	N	N
Finite Answers e.g. Multiple Choice	Y		Y	Y		N	Y	Y	N	Y	N	N	N	N	N	Y	N	N	Y
Immediate Feedback on Failures/Successes	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
Goal Completion vs. Expansion of Play	GC		GC	GC		GC	GC	GC	GC	GC	E	GC	GC	GC	GC	GC	E	E	GC
3. Gamification/Reinforcers																			
Points as End Goal	Y	Y	Y	Y		N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N
Points as Currency	N	N	N	N		Y	N	N	Y	N	N	Y	N	Y	N	Y	Y	N	Y
Badges/Awards/Trophies	N	Y	N	Y		Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y	Y
Rankings and Leaderboards	Y	Y	N	N		Y	Y	Y	N	N	Y	N	N	Y	N	N	N	Y	N
Levels	Y	Y	N	Y		Y	Y	Y	N	Y	N	N	N	N	N	Y	N	Y	N
Exchange of Virtual Goods	N	N	N	N		Y	N	N	N	N	N	Y	N	N	N	Y	Y	Y	Y
Produces an Artifact	N	N	N	N		N	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y	N

B. Game Characteristics	Short Form						Long Form												
	Drill- Practice	Drill- Practice	Drill- Practice (with Adventure)	Drill- Practice	Simulation (Short)	Interactive Learning Tools	Puzzle	Puzzle	Simulation	Simulation	Simulation	Simulation & Strategy	Role Playing & Simulation	Role Playing	Role Playing	Puzzle & Action/Adventure	Sandbox	Puzzle & Adventure (Long Form)	Role Playing
	Motion Math	Study Island	FutureU	Math Blaster	Physlets	Poptropica	Foldit	Manga High	Oregon Trail	Midd World	Whitebox	Civilization V	River City	iCivics	CSI	Labyrinth	Minecraft	Gamestar Mechanic	Whyville
4. Degree of Collaboration/Social																			
Social Network Supported	N	N	N	N		Y	N	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	Y
Develops & Encourages Mentoring Relationships	N	N	N	N		N	N	N	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y
Social/Friending Component	N	N	N	N		Y	N	Y	N	Y	N	N	N	N	N	N	Y	Y	Y
Conflict or Competition Present	Y	Y	N	N		Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	N
5. Simulation Characteristics																			
Strong Resemblance to Real World	N	N	N	N		N	Y	N	N	Y	Y	N	Y	Y	Y	N	N	N	N
Augmented Reality	N	N	N	N		N	N	N	N	N	N	N	N	N	Y	N	N	N	N

appendix a: game map: type of learning

C. Type of Learning	Short Form						Long Form												
	Drill- Practice	Drill- Practice	Drill- Practice (with Adventure)	Drill- Practice	Simulation (Short)	Interactive Learning Tools	Puzzle	Puzzle	Simulation	Simulation	Simulation	Simulation & Strategy	Role Playing & Simulation	Role Playing	Role Playing	Puzzle & Action/Adventure	Sandbox	Puzzle & Adventure (Long Form)	Role Playing
	Motion Math	Study Island	FutureU	Math Blaster	Physlets	Poptropica	Foldit	Manga High	Oregon Trail	Midd World	Whitebox	Civilization V	River City	iCivics	CSI	Labyrinth	Minecraft	Gamestar Mechanic	Whyville
1. Basic																			
Physical Skills (visual or motor)	Y	Y	N	Y		Y	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N
Skill Practice	Y	Y	Y	Y		Y	N	Y	N	Y	N	N	N	N	N	Y	N	N	N
Pattern and Rule Recognition	Y	N	N	N		Y	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
2. Advanced																			
21st Century Skills (critical thinking, problem solving, collaboration, creativity, communication)	N	N	N	N		Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
Social/P.O.V./Empathy Development	N	N	N	N		N	N	N	Y	N	N	Y	Y	N	Y	Y	N	N	N
Distributed Cognition/xpertise in developing knowledge cultures	N	N	N	N		N	Y	N	N	N	N	N	Y	N	Y	Y	Y	Y	N
Habit of Mind (e.g. scientist at work - probing, observing environment.)	N	N	N	N		N	Y	N	N	N	Y	N	Y	Y	Y	N	Y	Y	N
Conceptual Skills	Y	N	N	N		N	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y
Executive Function/Orgnizational	N	N	N	N		Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N

appendix a: game map: business model

D. Business Model	Short Form						Long Form												
	Drill- Practice	Drill- Practice	Drill- Practice (with Adventure)	Drill- Practice	Simulation (Short)	Interactive Learning Tools	Puzzle	Puzzle	Simulation	Simulation	Simulation	Simulation & Strategy	Role Playing & Simulation	Role Playing	Role Playing	Puzzle & Action/Adventure	Sandbox	Puzzle & Adventure (Long Form)	Role Playing
	Motion Math	Study Island	FutureU	Math Blaster	Physlets	Poptropica	Foldit	Manga High	Oregon Trail	Midd World	Whitebox	Civilization V	River City	iCivics	CSI	Labyrinth	Minecraft	Gamestar Mechanic	Whyville
Site License	N	Y*	N	N		Y - free or $2.99/mo	Free	Free	Y**	New release not avail.	Y - $495	N	Student Class $250	Free	Free	Free	Y - $20	Free	Free
Single Use	Y	N	Y	Y		Y	N	N	Y	Not avail.	N	Y	N	Free	N	Y	N	Y	Free
Freemium	Y	N	N	Y		Y	N	N	Y	N	N	N	N	N	N	N	Y	Y	N
Tech Support	N	Y	N	N		N	N	N	N	N	N	N	Y	N	N	N	N	Y	N
Professional Development	N	Y	N	N		N	N	N	N	N	N	N	Y	N	Y	Y	N	Y	N

* E.g. $5,000/year for middle school reading & math

** 6 Installs: $163
50 User Network: $700

Games & Learning Literature Review

Leslie Stebbins, M.Ed., MLIS
John Richards, Ph.D.

September 2012

Games & Learning Literature Review

Leslie Stebbins, M.Ed., MLIS
John Richards, Ph.D.

September 2012

Introduction

Research on game-based learning is still in its infancy, but initial studies and anecdotal findings suggest enormous potential for engaging students and improving learning. Early forays into the educational arena by games such as "The Oregon Trail" and "Where in the World is Carmen Sandiego?" became widely popular in the 1980s, but other successes in the past twenty years have been rare. Challenges related to distribution, acceptance, and financial sustainability have led educational game developers to shift their efforts to the consumer side of the gaming industry. A number of changes in the past few years have led researchers and industry leaders to grow increasingly encouraged about the potential for learning games in schools, as the attitudes of parents and educators appear to be shifting and recent studies and pilots of new learning games have seen positive results.

This annotated bibliography focuses on recent research and reports related to the learning game industry, the issue of sustainability, the effectiveness of games for learning, design properties of effective games, and the barriers and opportunities ahead.

Scaling Game-Based Learning

Bringing game-based learning to scale: The business challenges of serious games. Mayo, M. (2011). Kaufman Foundation/MIT. http://www7.nationalacademies.org/bose/Gaming_Sims_Commissioned_Papers.html

Computer and video games have enormous potential to transform both informal and formal learning, but this potential is not being realized due to business challenges including distribution, consumer acceptance, and financial sustainability. See also: "Response to Merrilea Mayo's Paper Bringing Game Based Learning To Scale: The Business Challenges of Serious Games" by Alan Gershenfeld, and "Bringing Game Based Learning To Scale: A Response" by Scot Osterweil. (Both available at URL listed above.)

Summit on educational games: Harnessing the power of video games for learning. Federation of American Scientists. (2006). http://www.fas.org/gamesummit/

This article includes a full report, fact sheet, PowerPoint, R&D challenges report, and roadmap. The roadmap is designed to raise awareness of key research challenges and opportunities for educational games, to provide stakeholders with a coordinated understanding of them and to encourage dialog and interdisciplinary partnerships.

Bringing simulations and games to scale. Chapter 6, pages 105–188, in National Research Council. (2011). *Learning science through computer games and simulations.* Committee on Science Learning: Computer Games, Simulations, and Education, Margaret A. Honey and Margaret L. Hilton, Eds. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. http://www.nap.edu/openbook.php?record_id=13078&page=R1

This chapter considers the potential to scale up the use of simulations and games for science learning. It includes an overview of current market penetration of games in formal and informal learning contexts, identifies barriers to increased distribution and sales, and discusses alternative future pathways to scale.

Conclusions reached: (chapter excerpt):

- Several barriers slow large-scale . . . use. . . . There is not yet a coherent market for either games or simulations in schools that is analogous to the textbook market. Increased use of games and simulations in schools . . . will require clear alignment with curriculum and professional development support for teachers. These issues are dealt with primarily at the local level in highly decentralized structures, posing a serious barrier to scaling up the use of games and simulations. If districts, schools, and universities express interest, this will encourage the development and use of these new learning technologies.
- There appear to be two basic . . . models for reaching scale: (1) a traditional top-down model of sales and distribution . . . to schools and school districts and (2) a model of sales and distribution to parents, students, and individuals for informal learning. Success in the second model, elements of which could be emerging, could prove to be a way to enable access to the first model.
- Parents of K-6 students concerned about their children's educational progress could constitute a large and important initial market for increased sales and use of . . . games. However, parents may have questions about the educational value of . . . games, and these questions could potentially be addressed through the creation of a respected, independent, third party system to evaluate and certify educational effectiveness.
- Simulations and games for science learning require a sustained approach. Because a game or simulation needs to be updated and improved on an ongoing basis, it is not enough to simply develop and launch a standalone game or simulation. An ongoing development, research, and support effort is required for dissemination at scale.
- Partnerships that include industry developers, academic researchers, designers, learning scientists, and educational practitioners could play an important role in scaling up research and development of games and simulations.

Moving learning games forward: obstacles, opportunities & openness

Klopfer, E., Osterweil, S., and Salen, K. (2009) Cambridge: MIT, The Education Arcade.
http://education.mit.edu/papers/MovingLearningGamesForward_EdArcade.pdf

This white paper provides an overview of the current state of the field of game-based learning and proposes strategies for those wishing to enter the domain.

Getting serious games into the K-16 Classroom

Van Voorhis, V. (November 2010). GoogleTechTalks.
http://www.youtube.com/watch?v=q7_aOnFRnkc

Van Voorhis discusses the "challenges in taking learning games and interactive media from the margins to the mainstream across the K-16 spectrum." Her essential question is why, given the efficacy data that we have about serious games, aren't they being integrated into the educational experience of today's students? Drawing on her years as a classroom educator, a leader in creating new media for integration into school curricula, and a business strategist, she offers a unique and multi-faceted perspective. Van Voorhis believes that solving the challenges of design and implementation in serious games are essential to scaling the potential learning outcomes. More importantly, she observes that serious games have not been developed with business models informed by effective publishing and financial sustainability strategies. Van Voorhis provides suggestions for addressing these issues while focusing on the proven learning outcomes games offer K-16 educators and students" (abstract from GoogleTalks).

The more we know: NBC news, educational innovation, and learning from failure
Klopfer, E. and Haas, J. (2012). Cambridge: MIT Press.

This book is a story about the collaboration between NBC and MIT in launching iCue, an interactive learning venture that combined social networking, online video, and gaming into one multimedia learning site. iCue was an exciting project that provided NBC with the possibility of reaching younger viewers, and MIT with the venue to test new educational methods. iCue was ultimately a failure. In the book, the authors, members of the MIT development team, review the lessons learned about new media and the challenges of bringing innovation to the K-12 space. Included are the challenges of an education system overly focused on "teaching to the test," television producers uncomfortable with innovative media, and confusion about the educational market and how it works.

Game changer: Investing in digital play to advance children's learning and health.
Thai, A. M., et al. (2009). New York: The Joan Ganz Cooney Center at Sesame Workshop.
http://www.joanganzcooneycenter.org/publication/policy-brief-game-changer-investing-in-digital-play-to-advance-childrens-learning-and-health/

Children as young as 4 are immersed in a new gaming culture, but many parents, educators, and health professionals, concerned over violence, sexual content, and reports of addiction, do not consider games to be a positive force in children's lives. "Game Changer" addresses this critique, offering a new framework to use games to help children learn healthy behaviors, traditional skills such as reading and math, and 21st-century skills such as critical thinking, global learning, and programming design. The report specifies how increased national investment in research-based digital games might play a cost-effective and transformative role and provides comprehensive action steps for media industry, government, philanthropy, and academia to harness the appeal of digital games to improve children's health and learning.

Market Data—Gaming Industry

Essential facts about the computer and video game industry.
Entertainment Software Association (2011).

http://www.theesa.com/facts/pdfs/ESA_EF_2011.pdf

This report discusses sales, demographic, and usage data about video and computer games in the United States. For example, the report states that:

- 72% of American household play computer games
- The average player is 37
- 58% of video game players are male
- 47% most often play puzzles, board games, game shows, trivia, or cards online
- 55% play on phone or handheld devices
- 91% of parents are present when their children's games are purchased
- 45% of parents play video games with their children at least weekly
- $25.1 billion was spent by consumers on games in 2010.

The US market for self-paced eLearning products and services: 2010–2015 forecast and analysis.
Ambient Insight Market Report.
http://www.ambientinsight.com/Reports/eLearning.aspx

The US market for self-paced eLearning products and services reached $18.2 billion in 2010. The demand is growing by a five-year compound annual growth rate (CAGR) of 5.9% and revenues will reach $24.2 billion by 2015. However, growth is much higher in specific segments. For example, growth rates in the PreK-12, healthcare, and association segments are 16.8%, 16.3%, and 14.3% respectively. (Though not the same as learning games, the market for self-paced eLearning products has relevance to the learning games market.)

Video games in the 21st century: The 2010 report.
Siwek, S. Entertainment Software Association. (2010).
http://www.theesa.com/facts/pdfs/VideoGames21stCentury_2010.pdf

- From 2005 to 2009, the entertainment software industry's annual growth rate exceeded 10 percent. Over the same period, the entire U.S. economy grew at a rate of less than two percent.
- In 2009, the entertainment software industry's value added to the U.S. Gross Domestic Product (GDP) was $4.9 billion.
- For the four-year period of 2005–09, direct employment for the industry grew at an annual rate of 8.6 percent. Currently, computer and video game companies directly and indirectly employ more than 120,000 people in 34 states. The average salary for direct employees is $90,000, resulting in total national compensation of $2.9 billion.

Infographic: Video game industry statistics.
Jackson, N. *The Atlantic*. (June 3, 2011).

- Sixty-seven percent of U.S. households hold individuals who play video games.
- The average age of a video game player is 34, and he or she (probably he: 60 percent are male) spends an average of eight hours every week playing video games.
- Seventy-six percent of parents believe that

the parental controls available in all new video game consoles are useful. Further, parents impose time usage limits on video games more than any other form of entertainment. Eighty-three percent of parents place time limits on video game playing, whereas 75 percent place limits on Internet usage.

Research on Effectiveness of Learning Games

Learning science through computer games and simulations.
National Research Council. (2011). Committee on Science Learning: Computer Games, Simulations, and Education, Margaret A. Honey and Margaret L. Hilton, Eds. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.
http://www.nap.edu/openbook.php?record_id=13078&page=1

This book reviews the "available research on learning science through interaction with digital simulations and games. It considers the potential of digital games and simulations to contribute to learning science in schools, in informal out-of-school settings, and everyday life. The book also identifies the areas in which more research and research-based development is needed to fully capitalize on this potential. Learning Science will guide academic researchers; developers, publishers, and entrepreneurs from the digital simulation and gaming community; and education practitioners and policy makers toward the formation of research and development partnerships that will facilitate rich intellectual collaboration. Industry, government agencies and foundations will play a significant role through start-up and ongoing support to ensure that digital games and simulations will not only excite and entertain, but also motivate and educate."

Video games and learning: Teaching and participatory culture in the digital age.
Squire, K. (2011) New York: Teachers College Press.

"The book explores what the best ways to teach the younger generations of gamers might be. [Squire] is particularly interested in whether video games themselves might be among one of the more effective mediums to teach through. Incorporating ten years of his own research as well as work done by other researchers, academics, and game designers, Squire makes the case for game play as a way of learning and presents it in an accessible manner. He also makes predictions for the future of education and how games and other digital media forms will fit into learning practices" (abstract).

Educational video game design: a review of the literature.
Dondlinger, M. J. (Spring/Summer 2007). Journal of Applied Educational Technology, 4(1).
http://www.eduquery.com/jaet/JAET4-1_Dondlinger.pdf

Much attention has been directed to the use of video games for learning in recent years, in part due to the staggering amounts of capital spent on games in the entertainment industry, but also because of games' ability to captivate player attention and hold it for lengthy periods of time as players learn to master game complexities and accomplish objectives. This review of the literature on video game research focuses on publications analyzing educational game design, namely those that present design elements conducive to learning, the theoretical underpinnings of game design, and learning outcomes from video game play.

Motivating children to learn effectively: Exploring the value of intrinsic integration in educational games.
Habgood, M. P. J. and Ainsworth, S. E. (2011). Journal of the Learning Sciences, 20(2), 169–206.

"The concept of intrinsic motivation lies at the heart of the user engagement created by digital games. Yet despite this, educational software has traditionally attempted to harness games as extrinsic motivation by using them as a sugar coating for learning content. This article tests the concept of intrinsic integration as a way of creating a more productive relationship between educational games and their learning content. . . . The results showed that children learned more from the intrinsic version of the game. . . . [T]hese studies offer evidence for the genuine value of an intrinsic approach for creating effective educational games. The theoretical and commercial implications of these findings are discussed" (abstract).

Computer games and learning—where next? The breadth and scope of the use of computer games in education.
Royle, K. and Colfer, S. (2010) Developmental and Applied Research in Education (CeDARE) and British Educational Communications and Technology Agency (BECTA).
http://www.wlv.ac.uk/default.aspx?page=25083

This document provides a comprehensive overview of the use of computer games in education. Issues covered include the prevalence of games in our culture, the challenges to integrating educational games into the current curriculum, and current gaps in the research literature. An example of the successful integration of gaming in education is the work of Consolarium, which uses games as the center of a curriculum topic and serves as stimuli to support learning investigations.

Relationships between game attributes and learning outcomes: Review and research proposals.
Wilson, K. A., et al. (2009). Simulation Gaming, 40, 217–66.

"Games are an effective and cost-saving method in education and training. Although much is known about games and learning in general, little is known about what components of these games (i.e., game attributes) influence learning outcomes. The purpose of this article is threefold. First, we review the literature to understand the 'state of play' in the literature in regards to learning outcomes and game attributes--what is being studied. Second, we seek out what specific game attributes have an impact on learning outcomes. Finally, where gaps in the research exist, we develop a number of theoretically based proposals to guide further research in this area" (abstract).

Committee for learning science: Computer games, simulations, and education workshop.

National Research Council. (October 2009). http://www7.nationalacademies.org/bose/Gaming_Sim_October_Agenda.html

These workshop papers and presentations represent current knowledge on learning games and simulations from prominent researchers.

See especially:

- Kafai, Y. B. State of evidence: How can games and simulations be used to increase science learning? http://www7.nationalacademies.org/bose/Kafai_Gaming_Presentation.pdf
- Horwitz, P. (2009). Interactive curriculum and assessment: The road to scaling?
- Quellmalz, E. S., Timms, M. J., and Schneider, S.A. (2009). Assessment of student learning in science simulations and games. http://www7.nationalacademies.org/bose/Schneider_Gaming_CommissionedPaper.pdf
- Dede, C. Learning context: Gaming, gaming simulations, and science learning in the classroom. http://www7.nationalacademies.org/bose/Dede_Gaming_CommissionedPaper.pdf
- de Jong, T. Learning with computer simulations: Evidence and future directions.
- Clark, D.B., Nelson, B., Sengupta, P., and D'Angelo, C. Rethinking science learning through digital games and simulations: Genres, examples, and evidence. http://www7.nationalacademies.org/bose/Gaming_Sims_Commissioned_Papers.html
- Barab, S.A. The Quest Atlantis project: A 21st century curriculum. http://www7.nationalacademies.org/bose/Gaming_Sims_Commissioned_Papers.html

The effectiveness of instructional games: A literature review and discussion.

Hays, R. T. (2005). (Technical Report No. 2005-004). Orlando, FL: Naval Air Warfare Center Training Systems Division. http://www.dtic.mil/dtic/tr/fulltext/u2/a441935.pdf

This report documents a review of 48 empirical research articles on the effectiveness of instructional games. It also includes summaries of 26 other review articles and 31 theoretical articles on instructional gaming. Based on this review the following 5 conclusions and 4 recommendations are provided. Conclusions: (1) The empirical research on the instructional effectiveness of games is fragmented, filled with ill-defined terms, and plagued with methodological flaws. (2) Some games provide effective instruction for some tasks some of the time, but these results may not be generalizable to other games or instructional programs. (3) No evidence indicates that games are the preferred instructional method in all situations. (4) Instructional games are more effective if they are embedded in instructional programs that include debriefing and feedback. (5) Instructional support during play increases the effectiveness of instructional games. Recommendations: (1) The decision to use a game for instruction should be based on a detailed analysis of learning requirements and tradeoffs among alternate instructional approaches. (2) Program managers and procurement officials should insist that instructional game developers demonstrate how their game will support instructional objectives. (3) Games should be used as adjuncts and aids, not as stand-alone instruction. (4) Instructor-less approaches (e.g., web-based instruction) must include all 'instructor functions'" (abstract).

Our princess is in another castle: A review of trends in serious gaming for education.
Young, M. F. et al. (March 2012) Review of Educational Research vol. 82 (1), 61–89.

This review article analyzes the findings of over 300 research articles related to video games and academic achievement. While some encouraging evidence was found to support learning games for language learning, history, and physical education, there was little research evidence at this point in time that video games impact learning in science and math. The authors call for researchers to distinguish between simulations and games and focus their research questions on the "situated nature of game-player-context interactions, including meta-game social collaborative elements" (abstract).

References and resources for using education games and simulations in the classroom.
SIIA/FETC (2008).
http://tinyurl.com/3pstoju

Comprehensive annotated bibliography on learning games and simulations including research, case studies, and links to learning games and key websites related to learning games.

Design Properties of Effective Games

Deep learning properties of good digital games: How far can they go?
Gee, J. P. (2009). Arizona State University.
http://www.jamespaulgee.com/node/37

This study by noted educational games researcher James Paul Gee discusses the merits of good digital games and their design along with the learning that can accompany them. Gee notes that "the most important properties of entertainment digital games that allow them to achieve powerful learning effects, in the sense both of learning to play the game (and the content and skills thereby involved) and of creating commitment and attachment to play and learning in the game. I would argue that if we are to make deep serious games that really use the power of gaming, then these features will have to be present and implemented well. In the end, I am not sure this can always be the case when we leave the domains (content) usually covered in entertainment games, though this is a matter for future research. That it can be done in some domains is certainly suggested by the fact that it has already been done to a certain extent in entertainment games like Civilization or SimCity, games that connect to domains (e.g., history, geography, urban planning) that we think of as serious. How far this paradigm can be extended is, again, an open question."

Gee elaborates on the following properties in *this work:*

- **Property 1:** Does game play allow and encourage the player to "psych out" and take advantage of an underlying rule system to accomplish personally held goals to which the player is emotionally attached?
- **Property 2:** Does the game allow the player microcontrol that creates either a sense of embodied intimacy or a feeling of reach in power and vision?
- **Property 3:** Does the game offer the player experiences that meet the conditions for good learning?
- **Property 4:** Does the game allow, encourage, and help players find and use effectivity–affordance matches between smart bodies or tools and worlds?
- **Property 5:** Does the game use modeling or models to make learning from experience more general and abstract?
- **Property 6:** Does the game allow and encourage the player to enact his or her own unique trajectory through the game, thereby creating his or her own story?"

Good video games and good learning.

Gee, James Paul (2007).
http://www.academiccolab.org/resources/documents/Good_Learning.pdf

Gee asks the question: How can we make learning in and out of school, with or without using games, more game-like in the sense of using the sorts of learning principles young people see in good games every day when and if they are playing these games reflectively and strategically?

Gee explains the following learning strategies that good games incorporate:

1. Identity
2. Interaction
3. Production
4. Risk Taking
5. Customization
6. Agency
7. Well-Ordered Problems
8. Challenge and Consolidation
9. Just in Time and On Demand
10. Situated Meanings
11. Pleasantly Frustrating
12. System Thinking
13. Explore, Think Laterally, Rethink Goals
14. Smart Tools and Distributed Knowledge
15. Cross Functional Teams
16. Performance Before Competence

The ecology of games: Connecting youth, games, and learning.

Ed. Salen, K. Cambridge: MIT Press.
http://mitpress.mit.edu/solr/The%20ecology%20of%20games

This book "aims to expand upon and add nuance to the debate over the value of games—which so far has been vociferous but overly polemical and surprisingly shallow. Game play is credited with fostering new forms of social organization and new ways of thinking and interacting; the contributors work to situate this within a dynamic media ecology that has the participatory nature of gaming at its core. They look at the ways in which youth are empowered through their participation in the creation, uptake, and revision of games; emergent gaming literacies, including modding, world-building, and learning how to navigate a complex system;

and how games act as points of departure for other forms of knowledge, literacy, and social organization." (from abstract)

Design factors for educationally effective animations and simulations.
Plass, Ja. L., Homer, B. D., and Hayward, E. O. (2009). *Journal of Computing in Higher Education*, 21, 31–61.

"This paper reviews research on learning from dynamic visual representations and offers principles for the design of animations and simulations that assure their educational effectiveness. In addition to established principles, new and revised design principles are presented that have been derived from recent research. Our review focuses on the visual design and interaction design of these visualizations and presents existing research as well as questions for future inquiry" (abstract).

Best practices for using learning games & simulations in the classroom: Guidelines for K-12 educators.
Wilson, L. (2009). SIIA.
http://tinyurl.com/lerpeo

This report provides a blueprint for successful implementation of learning games in classrooms including getting support from teachers and administrators, addressing issues related to technical infrastructure and professional development, and implementation using appropriate pedagogies.

Designing assessments and assessing designs in virtual educational environments.
Hickey, D., Ingram-Goble, A., and Jameson, E. (2009). *Journal of Science Education and Technology*, 18(2), 187–208.
http://www.gamesforchange.org/images/uploads/Hickey,_Jameson,__Ingram-Gobel_2009.pdf

"This study used innovative assessment practices to obtain and document broad learning outcomes for a 15-hour game-based curriculum in Quest Atlantis, a multi- user virtual environment that supports school-based participation in socio scientific inquiry in ecological sciences. Design-based methods were used to refine and align the enactment of virtual narrative and scientific investigations to a challenging problem solving assessment and indirectly to achievement test items that were independent of the curriculum. In study one, one-sixth grade teacher used the curriculum in two of his classes and obtained larger gains in understanding and achievement than his two other classes, which used an expository text to learn the same concepts and skills. Further treatment refinements were carried out, and two forms of virtual formative feedback were introduced. In study two, the same teacher used the curriculum in all four of his classes; the revised curriculum resulted in even larger gains in understanding and achievement. Gains averaged 1.1 SD and 0.4 SD, respectively, with greater gains shown for students who engaged more with formative feedback. Principles for assessing designs and designing assessments in virtual environments are presented" (abstract).

Reality is broken: Why games make us better and how they can change the world.
McGonigal, J. (2011). New York: Penguin Press.

"As addictive as Tetris, McGonigal's penetrating, entertaining look into gaming culture is a vibrant mix of technology, psychology, and sociology, told with the vision of a futurist and the deft touch of a storyteller. For the nearly 183 million Americans who will spend an average of 13 hours a week playing games, McGonigal's book is a welcome validation of their pursuits. But for those who don't understand, or who may worry that our growing preoccupation with games is detrimental to society and culture, McGonigal argues persuasively that games are in fact improving us. 'Game design isn't just technological craft,' she argues, 'it's a 21st Century way of thinking and leading.' And games, she argues, particularly the new wave of Alternative Reality Games, are not about escapism but a powerful new form of collaboration and community building. The book moves effortlessly from Herodotus to Halo, stitching together an intellectually stimulating view of human culture past, present, and future. And while not downplaying the potential for negative consequences, such as 'gamer addiction,' McGonigal makes an inspiring case for the way games can both enhance our personal happiness and help society" (from review by *Publishers Weekly*, November 22, 2010).

Barriers & Opportunities: Children, Parents, and Teachers

Digital media: New learners of the 21st century.
PBS Learning Matters.
http://www.pbs.org/teachers/digitallearners/watch/

This one-hour PBS documentary "takes viewers to the frontlines of what is rapidly becoming an education revolution. The film explores how exceptional instructors are increasingly using digital media and interactive practices to ignite their students' curiosity and ingenuity, help them become civically engaged, allow them to collaborate with peers worldwide, and empower them to direct their own learning. The documentary dives into cutting-edge educational and cognitive research to explore how increasingly powerful forms of digital media impact today's learner. Viewers meet some of the country's most noted educational experts and thought leaders in the digital education realm, including Nichole Pinkard, Henry Jenkins, Katie Salen, and Mimi Ito. The film criss-crosses the nation to showcase real-life examples of how digital media is exploding in educational environments, from the innovative Quest 2 Learn public school in Manhattan that employs game-based learning to a Wisconsin classroom that uses mobile devices and location-based networking to model civic activity and teach history" (from abstract).

Fear, apprehension, stereotypes, oh, my! Exploring teachers' reactions to virtual gaming.
Sprague, D. R. and Kayler, M. (2011). Proceedings of Society for Information Technology & Teacher Education International Conference 2011 (2248–2253). Chesapeake, VA: AACE.?

Researchers have begun to explore the impact of game-based learning. Most of this research has focused on what children learn while engaged in virtual games. This study looks at what 61 teachers learned as they explored a Massively Multiplayer Online (MMO) virtual gaming environment of their choice over a four-week period. Data included individual reflective logs, web-based group discussions, and individual narratives written at the conclusion of the experience. Teachers discussed reactions to the games. The results show that teachers were fearful and had difficulty trusting strangers they encountered. They were goal-oriented and found the open-endedness of the MMOs to be overwhelming.

A framework for addressing challenges to classroom technology use.

Groff, J., and Mouza, C. (2008). *Association for the Advancement of Computing in Education Journal,* 16(1), 21–46.

The authors discuss six central factors, each with its own critical variables, that interact with one another to produce barriers to implementing technological innovations in the classroom: (a) Research & Policy factors, (b) District/School factors, (c) factors associated with the Teacher, (d) factors associated with the Technology-Enhanced Project, (e) factors associated with the Students, and (f) factors inherent to Technology itself.

Families matter: Designing media for a digital age.

Takeuchi, L. (June 2011) Joan Ganz Cooney Center. **http://www.joanganzcooneycenter.org/publication/families-matter-designing-media-for-a-digital-age/**

The report profiles how parents' personal experiences with media are one of the key factors shaping the approaches they take in guiding their children's media consumption. A national survey . . . found that nearly two-thirds [of parents] limit media consumption on a case-by-case basis. . . . 57% recognize that digital media presents ways for children to converse and connect with friends and family, but two-thirds of parents restrict their children from chatting online and visiting social networking sites. . . . [O]nly half of parents are playing with their kids on newer platforms such as video game consoles: They report spending more time with their children engaged in traditional activities . . . watching television, reading books and playing board games. More than half of parents are concerned about the effect of media usage on their children's health, but fewer than 1 in 5 parents think their kids spend too much time with digital media. . . . Lack of exercise and online privacy are parents' greatest concerns. Most believe that video games help children foster skills that are important to their academic achievement. Rule setting peaks at age 7. Parents with children older than 7 are more likely to set parent controls on their computers.

Recommendations from the report include:

- Tailor media platforms that take into account children's social, cognitive, and physical development.
- Investigate co-viewing for video games,

e-books, tablet devices, and other media that will encourage adults to engage with children to further enhance their learning.

- Foster teamwork—Digital media are often faulted for children spending less time socializing face-to-face with peers and family. Producers should design content that drives participants to interact and play together.
- Design for healthy development including exercise, imaginative play, and socializing.
- Develop Industry Educational Standards including recent work by Common (Summary from report.)

Learning by playing: Video games in the classroom.
Corbett, S. (September 15, 2010). *New York Times Magazine.*
http://www.nytimes.com/2010/09/19/magazine/19video-t.html

This article provides an overview of the role of games in learning focusing on "Quest to Learn," a pilot school in New York organized around the idea that digital games are central to the lives of today's children and are becoming powerful tools for intellectual exploration. The school is the creation of Katie Salen, a professional game designer and professor of design and technology and Robert Torres, a learning scientist, as well as a small group of curriculum and game designers. The school hopes to make learning feel more relevant to students and more connected to the world beyond school by using game-based learning. The article provides a snapshot of current thinking and reactions to game-based learning including the ideas and experiences of Michael Levine of the Cooney Center, James Gee a faculty member at Arizona State University, E.O. Wilson, Michelle Obama, and others.

Engineering Play: A Cultural History of Children's Software.
Ito, M. (2009). Cambridge: MIT Press.
http://mitpress.mit.edu/catalog/item/default.asp?tid=11869&ttype=2

"In Engineering Play, Mizuko Ito describes the transformation of the computer from a tool associated with adults and work to one linked to children, learning, and play. Ito gives an account of a pivotal period in the 1980s and 1990s, which saw the rise of a new category of consumer software designed specifically for elementary school aged children. 'Edutainment' software sought to blend various educational philosophies with interactive gaming and entertainment, and included such titles as Number Munchers, Oregon Trail, KidPix, and Where in the World Is Carmen Sandiego?

Drawing from observations of kids' play, interviews with software developers, and advertising and industry materials, Ito identifies three educational philosophies and genres in children's software that connect players in software production, distribution, and consumption: instruction, focused on transmission of academic content; exploration, tied to open-ended play; and construction, aimed at empowering young users to create and manipulate digital media.

The children's software boom (and the bust that followed), says Ito, can be seen as a microcosm of the negotiations surrounding new technology, children, and education. The story she tells is both a testimonial to the transformative power of innovation and a cautionary tale about its limitations" (from abstract).

Using civilization simulation video games in the world history classroom.
Whelchel, A. (February 2007). World History Connected. http://www.historycooperative.org/journals/whc/4.2/whelchel.html

This articles examines three particular titles, Civilization III, the Age of Empires series, and Rise of Nations, in order to discuss why it is important to recognize that these games have a substantial impact on the layman's understanding of history, how they present topics important to the world historian, and methods by which these games can be used to not only teach historical concepts but also instruct students how to critically evaluate and deconstruct historical representations found in popular culture. The article traces the history of gaming in education including successful programs in the 1980s and provides an analysis of what history games "got right," what they did not, and how to use these games in the classroom.

Making learning meaningful: An exploratory study of using multi-user environments (MUVEs) in middle school science.
Clarke, J. and Dede, C. (2005). Paper prepared for the American Educational Research Association Conference, April, Montreal, Quebec. http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.115.5609

Many researchers are exploring the types of learning that occur in informal out-of school technology use (such as video game play), yet the content of these environments tends not to align to national standards for academic content. This paper presents research on how a multiuser virtual environment centered on content related to national standards and assessments in biology and ecology offers new types of immersive learning for engaging grades 7 and 8 students in learning science.

Games and Learning Publishing Council Members:

About the Authors:

John Richards, PhD is Founder and President of Consulting Services for Education, Inc. (CS4Ed). CS4Ed (www.cs4ed.com) works with publishers, developers, and educational organizations, as they negotiate the rapidly changing education marketplace to improve business-planning processes, to find funding to help schools purchase products and services, and to develop, evaluate and refine products and services. He is Adjunct Faculty at the Harvard Graduate School of Education teaching Entrepreneurship in the Education Marketplace.

Leslie Stebbins is the Director for Research at Consulting Services for Education. She provides research and analysis on issues relating to K–12 education, higher education, and publishing. She has more than twenty years of experience in higher education with a background in library and information science, instructional design, and teaching. She has an M.Ed. from the Technology Innovation & Education Program at the Harvard Graduate School of Education and a Masters in Information Science from Simmons College.

Kurt Moellering, PhD, serves as the Editorial Supervisor at Consulting Services for Education and oversees all company online and print publications. He has provided editorial oversight for CS4Ed publications including white papers and reports for the Department of Education, the Software & Information Industry Association, Time to Know, and other companies. Most recently at CS4Ed, he was the copy editor for Digital Teaching Platforms published in 2012 by Teacher's College Press. Kurt is also the editor of The Thoreau Society Bulletin and the former Book Review Editor for Studies in American Fiction.

The mission of the Joan Ganz Cooney Center is to foster innovation in children's learning through digital media. The Cooney Center catalyzes and supports research, development, and investment in digital media technologies to advance children's learning, and is committed to the timely dissemination of useful research. Working closely with its Fellows, national advisors, media scholars, and practitioners, the Center publishes industry, policy, and research briefs examining key issues in the field of digital media and learning.

A full-text PDF of this report is available for free download from www.joanganzcooneycenter.org.

Attn: Publications Department
The Joan Ganz Cooney Center
Sesame Workshop
1900 Broadway
New York, NY 10023
p: (212) 595-3456
cooney.center@sesameworkshop.org

Suggested citation:
Richards, J., Stebbins, L., & Moellering, K. (2013). *Games for a Digital Age: K-12 Market Map and Investment Analysis*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

This report has been produced in partnership with E-Line Media with generous support from the Bill and Melinda Gates Foundation and the John S. and James L. Knight Foundation. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of E-Line Media, the Bill and Melinda Gates Foundation and the John S. and James L. Knight Foundation.

advancing children's learning in a digital age

the Joan Ganz Cooney Center at Sesame Workshop

1900 Broadway
New York, NY 10023
(212) 595-3456
cooney.center@sesame.org
www.joanganzcooneycenter.org

Managing Editor: Catherine Jhee
Design: Goat & Bear Partners
Copy Editor: Kendra Rainey