Summit on Educational Games | 2006

Harnessing the power of video games for learning

Federation of American Scientists

Table of Contents

Summary: Findings and Recommendations

Modern video and computer games offer a rich landscape of adventure and challenge that appeal to a growing number of Americans. Games capture and hold the attention of players for hours as they struggle to operate a successful football franchise, help Romans defeat the Gauls, or go through the strict regimen of Army basic training in virtual landscapes.

People acquire new knowledge and complex skills from game play, suggesting gaming could help address one of the nation's most pressing needs — strengthening our system of education and preparing workers for 21st century jobs. Numerous studies of American competitiveness completed in the past few years have emphasized that America's position in the world depends increasingly on maintaining leadership in technology.[1] And they emphasize that this can only be accomplished if American workers are prepared to move quickly in response to technical change, and be ready for new jobs and careers as they emerge.

The success of complex video games demonstrates games can teach higher-order thinking skills such as strategic thinking, interpretative analysis, problem solving, plan formulation and execution, and adaptation to rapid change. These are the skills U.S. employers increasingly seek in workers and new workforce entrants. These are the skills more Americans must have to compete with lower cost knowledge workers in other nations. Games and simulations can also serve as powerful "hands-on" tools for teaching practical and technical skills, from automotive repair to heart surgery. In addition, today's students who have grown-up with digital technology and video games are especially poised to take advantage of the features of educational games.

To explore how the United States can harness the powerful features of digital games for learning, the Federation of American Scientists, the Entertainment Software Association, and the National Science Foundation convened a National Summit on Educational Games, on October 25, 2005 in Washington, DC. The Summit brought together nearly 100 experts to discuss ways to accelerate the development, commercialization, and deployment of new generation games for learning.

1 *Innovate America,* The Council on Competitiveness, 2005; *Rising Above the Gathering Storm,* the National Academy of Sciences, 2005; *TechNet Innovation Initiative,* TechNet; *Losing Competitive Advantage,* American Electronics Association; *Technology Industry at an Innovation Crossroads,* Electronics Industry Alliance; *Tapping America's Potential,* Business Roundtable; *Computational Science: Ensuring America's Competitiveness,* President's Information Technology Advisory Committee; *Sustaining the Nation's Innovation Ecosystems,* President's Council of Advisors on Science and Technology; *Choose to Compete,* Computer Systems Policy Project.

Participants included executives and developers from the video game industry and educational software publishers, researchers and experts on technology and pedagogy, representatives of user communities such as teachers and the U.S. military, R&D funders, and government policy-makers.

The Summit focused on answering four questions:

- What aspects of learning are most amenable to new approaches offered by games?
- What kinds of research are needed to identify features of gaming that can be effective in education and training?
- What makes the education market so difficult for innovative commercial developers?
- What kinds of changes in instructional practices and management of educational institutions are needed to take advantage of the power games could bring to teaching and learning?

Through a series of presentations and panel discussions, the participants shared expertise and knowledge in their fields of interest. Summit participants also provided research and white papers, as well as idea exchanges following the meeting. This report summarizes challenges to developing and using games for learning and outlines a plan to address these challenges.

KEY CONCLUSIONS

There was strong consensus among the Summit participants that there are many features of digital games, including game design approaches and digital game technologies, which can be applied to address the increasing demand for high quality education.

The Summit participants identified key needs and challenges to address, including learning games-related research, product development, and barriers to new product and service introduction.

The major findings are:

Many video games require players to master skills in demand by today's employers. Video game developers have instinctively implemented many of the common axioms of learning scientists. They have used these approaches to help game players exercise a skill set closely matching the thinking, planning, learning, and technical skills increasingly demanded by employers in a wide range of industries.

Unfortunately, today's testing programs fail to assess these types of skills despite widespread agreement that these are skills employers look for in employees. In addition to developing higher order skills, educational games and simulations hold promise for: practical skills training, training individuals for high-performance situations that require complex decision-making, reinforcing skills seldom used, teaching how experts approach problems, and team-building.

There are several attributes of games that would be useful for application in learning. These include:

- contextual bridging (i.e., closing the gap between what is learned in theory and its use);
- high time-on-task;
- motivation and goal orientation, even after failure;
- providing learners with cues, hints, and partial solutions to keep them progressing through learning;
- personalization of learning; and
- infinite patience.

There are differences between games for education and games for entertainment. Developers of an educational game must target the desired learning outcome, and then design a game to achieve that target. Educational games must be built on the science of learning. Educational game designers must also design for third-party users of their applications who support, augment, and monitor player progress.

A robust program of research and experimentation is needed to enhance development of educational games by stimulating transfer of the art and technologies of video games to education and learning systems. Research is needed to develop a sound understanding of which features of games are important for learning and why, and how to best design educational games to deliver positive learning outcomes. R&D is needed to support the development of automated tools to streamline the process of developing educational games, and to reduce development costs.

Poor markets, the exploratory nature of research on educational games, and uncertain returns on developing generic tools inhibit private sector investment. Research should span many research disciplines and different parts of the innovation process. The video game industry has technology, tools, tradecraft and talent that with support can be transferred and applied to the development of games for learning. R&D models should be designed to implement this knowledge and technology transfer.

High development costs in an uncertain market for educational innovations make developing complex high-production learning games too risky for video game and educational materials industries. An adversity to risk-taking is deepened by past experience of firms that lost investments in education technology markets. To spur innovation, a variety of new business and product models should be encouraged for bringing learning games and related technologies to the education and training marketplace.

Several barriers inhibit the markets for education games. These include: market fragmentation (e.g., 16,000 K-12 school districts), schools' unwillingness and limited budgets to abandon textbooks in favor of technology-based

materials, negative attitudes about video games on the part of some parents and educators, and schools' reluctance to purchase educational technologies with unproven efficacy, especially in terms of today's education standards. Some markets could be aggregated to reduce educational game producers' market risk, and some markets may have lower barriers to entry such as home schooling or after school programs.

Educational institutions need to transform organizational systems and instructional practices to take greater advantage of new technology, including educational games. Many companies and industries have transformed themselves by taking advantage of advances in technology, and new management methods and models of organization. As a result, they realized substantial gains in productivity and product quality while lowering costs. No such transformation has taken part in education. Education is not part of the IT revolution.

Educational games are fundamentally different than the prevalent instructional paradigm. They are based on challenge, reward, learning through doing and guided discovery, in contrast to the "tell and test" methods of traditional instruction. Some types of games — such as complex strategy games — are not compatible with the typical 45-minute class length. Effective use of games and other new technologies is likely to be limited unless educational institutions are willing to consider significant changes in pedagogy and content, and rethink the role of teachers and other educational professionals.

Outcome data from large-scale evaluations of educational games are needed to demonstrate that these technologies are equal to or offer comparative advantage vs. conventional instruction methods. Good data will inform and encourage schools to adopt educational games — especially K-12 focused on meeting education standards.

A stronger market for educational games would then encourage private sector investment.

Major Recommendations

The creation, commercialization and adoption of games for learning is a multidisciplinary innovation challenge — involving scientific discovery and technical advancement, creative design and development, a friendly investment climate, changes in pedagogy, and new roles for teachers and students. Each major stakeholder — government, researchers, industry, and education and training institutions — has critical contributions to make.

FEDERAL GOVERNMENT LEADERSHIP:

- The U.S. Departments of Education and Labor should work with groups representing employers to form consensus on specific higher order skills that employers deem a priority, and work to translate these skills into curriculum standards and student assessments.
- Private firms are under-investing in educational games research and development because of poor markets. The public returns to federal research funding in this field would be very high. Funding should be in proportion to the significant promise of the field.
- Research on games in education should be a part of a coherent research program in learning science and technology such as the one described in the Learning Federation Learning Science and Technology R&D Roadmap. A variety of R&D models should be supported, including: investigator-driven basic research at universities, academic research centers for applied research, private sector R&D consortia for generic technology development, public-private R&D partnerships, and government-funded demonstration pilots. Since this research must combine basic and applied research, and evaluations, no existing federal agency appears to have an appropriate mandate to conduct this work.
- Since there is a public good and large social returns to the nation associated with improving education and workforce training outcomes, the U.S. Departments of Education and Labor and the National Science Foundation — in partnership with industry, educators, and the academic community — should support an R&D agenda that would encourage the development of educational and training games for K-12, post-secondary, and adult learners. This includes R&D on tools to make it easy to create and modify games quickly at low cost. These federal agencies should also promote interoperability standards to guide educational game and component development.

- New approaches should be established to involve the gaming industry and its designers in learning research, and in the development of learning games and simulations. Federal R&D investments should be designed to catalyze collaborative efforts between game designers, and educational materials publishers, academic researchers, schools of computer science and engineering, and schools of education.
- R&D should include evaluation of educational outcomes. Given the emphasis on test scores associated with state standards of learning and the No Child Left Behind Act, researchers and educational game developers should focus on positively affecting test scores across a spectrum of subject matter. Research groups should work with the education and business communities to develop improved measures of the sophisticated skills developed through game-based learning that are not currently measured by standards.
- Evaluations should consider how instructional practices, teacher preparation, school environment, and other factors have affected outcomes. Universities should participate with school districts in these studies to ensure: studies are well designed, appropriate data collected and analyzed, and results presented credibly so other districts and schools can use these studies to justify adopting innovations in their own systems. Researchers should convey information about their findings in the language and concepts of those they must convince — teachers, education administrators, parents, and policy-makers.
- Communities of practice — groups able to share software and ideas because they adhere to agreed standards and protocols — will be essential to make full use of games for education. The federal government, for example the Department of Commerce's National Institute of Standards and Technology, can facilitate the emergence of such communities.

THE ROLE OF THE BUSINESS COMMUNITY:

- Business leaders should work with education and training institutions to develop criteria for assessing higher-order thinking skills such as strategic thinking, interpretative analysis, problem solving, plan formulation and execution, and adaptation to rapid change needed for the 21st century workforce.
- Educational materials and educational software publishers should explore developing educational games for K-12 markets where there are perceived to be needs that innovative products may be able to solve.
- Educational materials and educational software publishers should explore opportunities for developing educational games for home-schooling and the expanding informal afterschool market, which may be more receptive to, and serve as important incubators, for these products than the traditional formal classroom market.

- Educational materials publishers should consider developing classroom materials to support the use of off-the-shelf commercial video and computer games for education and training purposes.
- Educational materials publishers, educational software producers, and game companies should explore the economics of developing and marketing browser-based and "downloadable" educational games. This type of game is often simpler and shorter in length of play than retail boxed computer and video games. These games have lower production values and, as a result, take less time and capital to develop, offering less risk to funders and producers.
- Training materials and training software publishers should explore developing learning games and simulations to improve corporate training productivity and reduce time-to-competency, especially where there is a company and industry-wide training need or need for training a key employee group.
- Training materials and training software publishers should explore opportunities for developing training games to serve the nationwide workforce development system, overseen by the U.S. Department of Labor. The Labor Department should identify where there are common training needs across the workforce development system and, thus, represent a potentially large market.

STRUCTURE OF THE VIDEO GAME INDUSTRY

The video game industry basically comprises three types of companies: developers, publishers, and console manufacturers.

Developers are the people or companies who create the games. Development companies can be independent, part owned or wholly owned by a publisher or console manufacturer. Typically, independent developers are funded by a publisher to create a game. Commercial video game developers can range in size from fairly modest, e.g. 25–50 employees, to fairly large, e.g. 100 or more employees.

Publishers both develop games internally and fund external development by independent developers, and then bring the finished product to market. The majority of commercial video games are funded, published and distributed by the major publishers. In addition to funding and managing the development of games, publishers are responsible for marketing, public relations, sales and manufacturing of the game. Large video game publishers also distribute the games they publish, while some smaller publishers hire distribution companies (or larger video game publishers) to distribute the games they publish.

Console manufacturers make video game consoles and handheld devices such as Sony's *Playstation,* Microsoft's *Xbox 360,* and Nintendo's *Game Cube* and *Game Boy.* Console makers also develop and publish software for their hardware systems, and license third parties to publish software to run on their systems.

- Game companies should look at education as a secondary market for their technology. To help mitigate the high costs of educational game development, game companies should identify technologies in their portfolios — such as AI, character rendering/avatar technology, or user interfaces — that may be useful for educational applications. They should develop and be assisted in developing methods for making these available for use in alternative markets. This would include partnerships to make available game engines and other technologies at nominal cost for use in education. Similarly, game companies should consider licensing their game engines — even second or third generation engines — for non-competing educational applications.
- Open source initiatives should be established to encourage a wide range of individuals and companies to self-construct learning games or components for them. Similarly, potential educational game producers should consider how they could encourage learning software "mod-makers", modeled after the game players that create content and software modifications for commercial video games.
- With video game consoles in more than 45 million homes, game companies or educational materials and educational software producers should explore developing educational games and simulations for home use. This is important because often in lower-income households, a video game console is the ONLY computing device (advanced cell phones notwithstanding) in the household. True digital-divide progress could be made if there were acceptable methods to industry and non-industry partners to make use of this incredibly large base of installed computing power.

THE ROLE OF EDUCATION AND TRAINING INSTITUTIONS:

- Education and training institutions should create incentives for innovative approaches in education through better tests and metrics. They should work with employers and others to develop tests that adequately measure the kinds of sophisticated educational outcomes required in today's economy — such as higher-order skills.
- Each major educational institution should develop and execute a strategy for changing instruction to reflect the kinds of innovations in games and other areas expected in the coming decade. Schools should redesign their instructional practices and formal learning environments to take advantage of technology-enabled exploration, interactivity, and collaboration encouraged by digital games and simulations.
- Schools of education should engage the learning games community to develop new and revamp old pedagogy to take advantage of these new educational tools.

- Schools of education and teacher professional development providers should create new training materials and make developing skills to support game-based learning an integral part of new and incumbent teacher training. This includes training teachers on how to best coordinate between virtual and real world learning activities.
- Efforts should be made to aggregate markets among states with common interests — for example, programs for students for whom English is a second language or remedial mathematics — so that developers can bid on a market large enough to justify a major investment in product development. Educational materials publishers should also encourage the aggregation of markets.

"Everywhere we turn, we hear more about visionary people recognizing how games can help train first responders, how they can help prepare surgeons, how they can help kids manage pain, how they can help prepare air traffic controllers and software engineers. Does it make any sense to you that we can acknowledge all of this, but we can't acknowledge that games can help kids learn about the American Revolution, of the Middle Ages, that they can help kids learn about biology or physics, or they can help kids understand economics?"

Doug Lowenstein, *President, Entertainment Software Association*

Introduction

Modern video and computer games offer a rich landscape of adventure and challenge that appeal to a growing number of Americans. These games capture and hold the attention of players for hours as they struggle to operate a successful football franchise, help Romans defeat the Gauls, or go through the strict regimen of Army Basic training in virtual landscapes. People acquire new knowledge and complex skills from game play, suggesting that gaming could help address one of the nation's most pressing needs — strengthening our system of education. In addition, today's students who have grown-up with digital technology are especially poised to take advantage of educational games.

Some organizations with significant education and training needs are experimenting with games for learning. For example, the U.S. military released *America's Army* in July 2002, a game designed to attract and teach potential recruits about the Army. More than six million users have registered as *America's Army* players, about three million have completed the game's basic combat training, and some three million players have taken the three lecture Combat Medic Course embedded in the game and tested their skills by playing that role in *America's Army.* In another example, the *Tactical Language Trainer*[2] for teaching language skills and foreign culture includes a simulation in which learners interact with virtual characters using a speech recognition interface. All branches of the U.S. military have learning games under development.

Some off-the-shelf commercial computer games are being used in high-school classrooms. For example, *Civilization III*[3] — a computer game about the development and growth of world civilizations — is used in classrooms around the world to teach history, geography, science, the arts, and other subjects, though the game designers did not intend for it to be used in this way.[4] Other commercial video games that have been used in K-12 schools include: *SimCity,* a city planning game; and *Roller Coaster Tycoon,* a game used in classrooms to teach physics concepts such as gravity and velocity.[5]

[2] Center for Advanced Research in Technology for Education, www.isi.edu/isd/carte/proj_tactlang/

[3] www.firaxis.com

[4] *Changing the Game: What Happens When Video Games Enter the Classroom?* By Kurt Squire, Innovate, August 2005; www.firaxis.com.

[5] *Use of Computer and Video Games in the Classroom.* Proceedings of the Level Up Digital Games Research Conference, by J.K. Kirriemuir and A. McFarlane, 2003, Universiteit Utrecht, Netherlands, 2003.

Education and workplace skill acquisition are not objectives of games designed for entertainment. However, features associated with commercial games hold promise for developing games that are effective tools for education and training. Such games could break the "test and tell" instructional paradigm prevalent in education today, potentially:

- Increasing the speed at which expertise is acquired and depth of understanding achieved;
- Increasing learner ability to transfer expertise acquired to the solution of practical tasks;
- Decreasing the range of outcomes among learners; and
- Making learning more motivating, if only to get more time-on-task.

Despite this potential, digital educational games have not had wide adoption in mainstream education and training.

THE GAMES FOR LEARNING SUMMIT

To explore how the United States can harness the powerful features of digital games and simulations for learning, the Federation of American Scientists, the Entertainment Software Association, and the National Science Foundation invited approximately 100 experts to craft a plan of action to realize the potential of educational games to address the nation's education and training needs. Participants included: executives from the video gaming industry and educational software publishers, researchers and experts on technology and pedagogy, game developers, representatives of user communities such as teachers and the U.S. military, R&D funders, and government policy-makers. They met in a National Summit on Educational Games, on October 25, 2005 in Washington, DC.

The Summit focused on four questions:

- What features of video and computer games can be used to improve education and training, and what aspects of learning are most amenable to the new approaches offered by games?
- What kinds of research are needed to identify the features of gaming that can be effective in education and training?
- What makes education such a difficult market for innovative commercial developers?
- What kinds of changes in instructional practices and management of educational institutions are needed to take advantage of the power that games could bring to teaching and learning?

Summit panelists (Appendix A) presented findings and views on these questions. Summit participants (Appendix B) offered their reactions, additional knowledge, and advice on the information and issues highlighted by panelists. This report captures the findings and recommendations participants made to foster the development, commercialization, and adoption of games for learning. Literature and other studies are used to amplify and reinforce the Summit findings.

"Game developers have instinctively implemented a lot of the recommendations of learning scientists and used them to help players acquire a skill set that closely matches the kind of thinking, planning, learning, and technical skills that seem to be increasingly demanded in business. In the game world, the measure of a player's success is complex and practical. Can you use your knowledge? Can you feed your people? Can you cure the patient? Can you beat Dan Snyder at his own football franchise?"

***Henry Kelly**, President, Federation of American Scientists*

Why Should the United States Focus on Digital Games and Learning?

"There's a global war for talent... So if we can't compete on cost any more, we have to compete on innovation. It's people who innovate, it's people who imagine, it's people who create."

Deborah Wince-Smith, President, Council on Competitiveness

The United States confronts a world of rapid change, intense global competition, and rapidly advancing technology. These forces are affecting what people need to know and be able to do on the job.

Rapid technological advancements — including revolutions in information technology, biotechnology and nanotechnology — will have profound, disruptive, and unpredictable effects. These technical advances drive, indeed demand, profound changes in the organization of work in the industries affected and redefine the skills required for successful employment. Numerous studies of American competitiveness completed in the past few years have emphasized that America's position in the world depends increasingly on maintaining leadership in technology.[6] And they emphasize that this can only be accomplished if American workers are prepared to move quickly in response to technical change, and be ready for new jobs and careers as they emerge.

Workforce globalization is rapidly expanding, driven by economic reforms in developing nations, widespread deployment of high-speed telecommunications, and the global delivery models of multinational businesses. The United States cannot compete in this highly connected system of global commerce on the basis of low wages, commodity products, and standardized services. It must compete by taking the lead in the next generation of knowledge creation, technologies, products and services, business models, and dynamic management systems. Businesses must be able to translate innovations into new products, services, and processes quickly in response to rapidly changing markets. In short, the new competitive realities suggest the United States must move to what former Federal Reserve Chairman Alan Greenspan calls a "conceptual economy", in which the key resource is thinking, creative people and their good ideas.

The nature of work in a leading-edge conceptual or innovation-based economy is already emerging, and characterized by:

- Fast pace, new situations, and changing priorities;
- Distributed development, production, and service delivery;
- Diverse, global customer base;

[6] *Innovate America,* The Council on Competitiveness, 2005; *Rising Above the Gathering Storm,* the National Academy of Sciences, 2005; *TechNet Innovation Initiative,* TechNet; *Losing Competitive Advantage,* American Electronics Association; *Technology Industry at an Innovation Crossroads,* Electronics Industry Alliance; *Tapping America's Potential,* Business Roundtable; *Computational Science: Ensuring America's Competitiveness,* President's Information Technology Advisory Committee; *Sustaining the Nation's Innovation Ecosystems,* President's Council of Advisors on Science and Technology; *Choose to Compete,* Computer Systems Policy Project.

- Constant exploitation of technological advancements;
- Continuous improvement of products, services, and solutions;
- Multidisciplinary team environments in agile organizations; and
- Teams, companies, suppliers linked in virtual enterprises that span the globe.

As this more demanding work environment emerges, many employers have signaled that the skill curve is moving upscale. The *basic* skills employers now frequently require include excellent oral and written communications, and the ability to work in teams. However, employers increasingly demand higher-order thinking and doing skills. Exhibit A lists some of the skills employers increasingly seek.

Studies of how people can best master the kinds of expertise demanded by the new economy emphasize the importance of learning through experiences that can make the power of new ideas come alive. Students remember only 10 percent of what they read; 20 percent of what they hear; 30 percent, if they see visuals related to what they are hearing; 50 percent, if they watch someone do something while explaining it; but almost 90 percent, if they do the job themselves, even if only as a simulation.[7]

When individuals play modern video and computer games, they experience environments in which they often must master the kinds of higher-order thinking and decision-making skills employers seek today. In addition, educational games that incorporate simulations provide a way to bridge the gap between abstract concepts or theoretical knowledge and practical skills, an important way to translate what is learned in training to application in the workplace.

"Employers obviously need people with an increasing range of skills and knowledge, but they also need a more complex set of skills; how do you analyze problems, how do you acquire information quickly, how do you make decisions under uncertainty, how do you build teams, how do you adapt to change rapidly? And these are skills that are required, not just by senior managers and engineers, but by truck drivers who are trying to figure out how to use GPS and inventory control systems, sales and repair, and maintenance people who are wrestling with products that didn't even exist 18 months ago."

Henry Kelly, *President, Federation of American Scientists*

EXHIBIT A

Examples of Skills Employers Want in Higher Wage Workers

- Interpersonal Skills
- Adaptation to Rapid Change
- Team Building
- Decision-making
- Learning on the Fly
- Strategic Thinking
- Rapid Information Acquisition
- Determining What Needs to Be Done
- Ability to Assess Time, Cost and Resources Required
- Develop/Implement Work Processes and Procedures
- Analytical Thinking
- Problem Identification
- Information Synthesis
- Solution Development
- Plan Development/Execution
- Self-Direction
- Work Independently
- Multiple Task Prioritization
- Creativity
- Negotiation and Influencing
- Focus on the Customer

[7] Menn, Don. "Multimedia in Education: Arming Our Kids For the Future." *PC World* 11 (October, 1993).

Clearly, game techniques are not a universal solution to all education and training challenges. Their power depends on skillful integration with traditional teaching methods and other technical innovations. They do, however, appear to offer enormous power to meet a key national challenge in education.

DIGITAL NATIVES ARE POISED TO TAKE ADVANTAGE OF EDUCATIONAL GAMES

"This ability to harness certain features of digital game playing in order to develop higher order thinking skills in students and workers, and create a bridge between abstract knowledge and its application, is absolutely exciting and profound."

Deborah Wince-Smith, President, Council on Competitiveness

"The MTV generation is a different generation. As my old boss used to say, 'They're wired differently.' They think differently, they act differently, they want to be engaged, they're more engaged than ever before, their attention span is quicker, they are not inclined to sit down and spend hours quietly reading a book. They're more inclined to be reading three or four books at one time while they multi-task on their Palm Pilots."

Eugene Hickok, Advisor, DutkoWorldwide, former Deputy Secretary of Education

The power of gaming is particularly relevant to today's K-12 students — the so-called "digital natives" — who have grown up with interactive digital technologies. These students are not merely technology savvy, they are approaching their lives differently as they integrate digital technologies — such as computers, the Internet, instant messaging, cell phones, and e-mail — seamlessly throughout their daily activities. Time spent using digital media by children aged 13–17 has now surpassed the time they spend watching television.[8]

The digital natives use digital tools in support of their schoolwork. For example, students aged 6–17 who go on-line, report that educational activities such as homework and research are among their top five daily uses of the Internet.[9] One in five children who use the Internet at home report that they go on-line every day for educational purposes.[10]

Many of these young people play digital games. More than eight in ten young people have a video game console at home, and a majority has two or more. Just over half have a handheld video game player. Thirty percent of children ages 6–17 go on-line to play individual or multiplayer games at least once a week.[11] Video games are not just a pursuit of the young, however; 50 percent of all Americans and 75 percent of American heads of households play computer and video games.[12]

These individuals spend a significant amount of time playing digital games. On average, kids aged 8–18 spend about 50 minutes per day playing video games.[13] The average adult male spends 7.6 hours per week playing video games, and the average adult female spends 7.4 hours per week.[14]

Thirty-five percent of computer and video game players are under 18 years of age, the age at which they participate in elementary and secondary education. And 43 percent of game players are 18–49 years of age, the age at which

[8] *Connected to the Future: A Report on Children's Internet Use,* Corporation for Public Broadcasting, March 2003.

[9] *Connected to the Future A Report on Children's Internet Use,* Corporation for Public Broadcasting, March 2003.

[10] *Connected to the Future A Report on Children's Internet Use,* Corporation for Public Broadcasting, March 2003.

[11] *Connected to the Future A Report on Children's Internet Use,* Corporation for Public Broadcasting, March 2003.

[12] *Top Ten Industry Facts,* Entertainment Software Association.

[13] *Generation M: Media in the Lives of 8-18 Year Olds,* The Henry J. Kaiser Family Foundation, March 2005.

[14] *Facts & Research,* Entertainment Software Association, www.theesa.com

individuals participate in post-secondary education and work training.[15] These individuals represent a potentially important market for games and simulations designed for education and training purposes.

While the digital natives have embraced new technologies, including video gaming, they are largely disconnected in their classrooms. Most student educational use of the Internet occurs outside of the school day, outside of the school building, and outside the direction of their teachers. For example, among students aged 12–17 who go on-line from more than one location, 83 percent say they go on-line mostly from home, and only 11 percent say they go on-line mostly from school.[16] Students are frustrated and increasingly dissatisfied by the digital disconnect they experience at school. They cannot conceive of doing schoolwork without Internet access and they are not given many opportunities in school to take advantage of the Internet.[17]

In addition, interactive games are the medium of attention for youth, who spend large numbers of hours playing these games. While playing video games, students perform complicated tasks within rich multimedia-driven, interactive environments. Such tasks include: running political campaigns and football franchises, building environmentally sensitive communities, navigating virtual worlds they create, managing complex social relationships, and negotiating treaties and trade agreements with neighboring countries while assuming the role of a national leader.

Digital natives want learning experiences that parallel the exciting and engaging digital formats in which they routinely participate. Yet, most instruction is still "tell and test", in which students take in information passively from reading and lectures, reciting it back in the form of work sheets, reports, and tests. Commercial games are vivid and action oriented, compared to teachers in classrooms using chalkboards. Given these contrasts, educational games might improve students' attitudes about learning even difficult subjects, including those who are not attracted to studying mathematics and science.

Given the digital natives' affinity for digital technologies, digital games for learning could be potentially powerful tools for teaching them the skills they will need to succeed in the new global economy.

"Perhaps the most fatal flaw in the education of young people is that we apprentice young people into 19th century science rather than letting them play 21st century scientist. There's a need to be able to ask the hypothetical. They need to be able to ask the questions why, what if, why not?"

Don Thompson, Assistant Director Education and Human Resources, National Science Foundation

[15] *Facts & Research,* Entertainment Software Association, www.theesa.com

[16] *Parents, Kids, and the Internet,* Princeton Research Associates for the Pew Internet in American Life Project, June 2001.

[17] *The Digital Disconnect: The Widening Gap Between Internet-Savvy Students and Their Schools,* Pew Internet and American Life Project, August 2002.

Game Attributes for Application in Learning

"When I looked at the America's Army game, I thought, 'Why don't we build math and science skills into those games, so that in order to get to the next level, you've got to know math and science.' "

Deborah Wince-Smith, President, Council on Competitiveness

GAME FEATURES ATTRACTIVE FOR LEARNING APPLICATIONS

Given that today's video and computer games are so engaging to many people, are there features of these games that could be exploited to improve the outcomes of education and training?

Advances in cognitive and learning science have identified features of optimal learning environments.[18] Game developers have instinctively implemented many of these features in game play:

Clear learning goals: In a good game, goals are clear; you know why you are learning something and there are opportunities to apply what you learn.

Broad experiences and practice opportunities that continue to challenge the learner and reinforce expertise: In games and simulations, learners are presented with a broad set of experiences and practice opportunities — you can operate powerful equipment or fly through the interior of a cell — learning from a world that has color, complexity, and challenge, rather than a set of abstract facts devoid of real world context. The "lesson" can be practiced over and over again until mastered.

Continuous monitoring of progress, and use of this information to diagnose performance and adjust instruction to learner level of mastery: Games continually monitor progress, and feedback is clear and often immediate. A good game moves at a rate that keeps the player at the edge of his or her capabilities, moving to higher challenges as mastery is acquired.

Encouragement of inquiry and questions, and response with answers that are appropriate to the learner and context: Compelling games often motivate their players to seek out information on game strategies and concepts from other gamers, friends, tip guides, web sites, and other resources.

These types of learning environments are unaffordable and impractical in today's standard classroom situation. However, game technologies may make these learning environments affordable.

Summit panelists described other features of games and simulations that could be applied to improve education and training.

Contextual Bridging: Games and simulations can close the gap between what is learned and its use. For example, one can learn theories of business management

[18] *How People Learn,* National Research Council, 1999.

— supply, demand, pricing, and budget — but they come alive in the "owners mode" of a popular video game as players manage an NFL football franchise.

The Tactical Language Trainer, a simulation funded by DARPA, is designed to teach spoken communications skills in the context of how they might be used in the real world, for example, by a soldier deployed in Iraq. The learner is given a set of objectives, such as: build trust with a local person, then get directions to the person in charge, and find out how you can help them. The simulation teaches language in a cultural context; for example, making eye contact, non-verbal expression, and gestures will affect how characters in the simulation respond to the learner. Negative feedback is offered when the learner goes wrong, for example, failing to take leave politely by saying goodbye.

Many workers prefer to receive their training in real-world contexts, rather than as abstract concepts or theories. For example, in a recent study, information technology workers said they preferred hands-on training led by instructors with real-world experience, who have applied what they are teaching in an industrial setting. These workers also preferred a focus on teaching in the context of a project or solving a business problem, rather than teaching just the IT tool itself. These workers said they needed to be able to put new skills to work soon after training; if they did not use the new skills, they said they forgot them.[19]

Time on Task: The ability to hold the attention of players is a hallmark of modern video and computer games (time-on-task). Some game players spend hundreds of hours mastering games. Game designers understand how to keep an audience engaged, while delivering critical information for attaining the game's objectives.

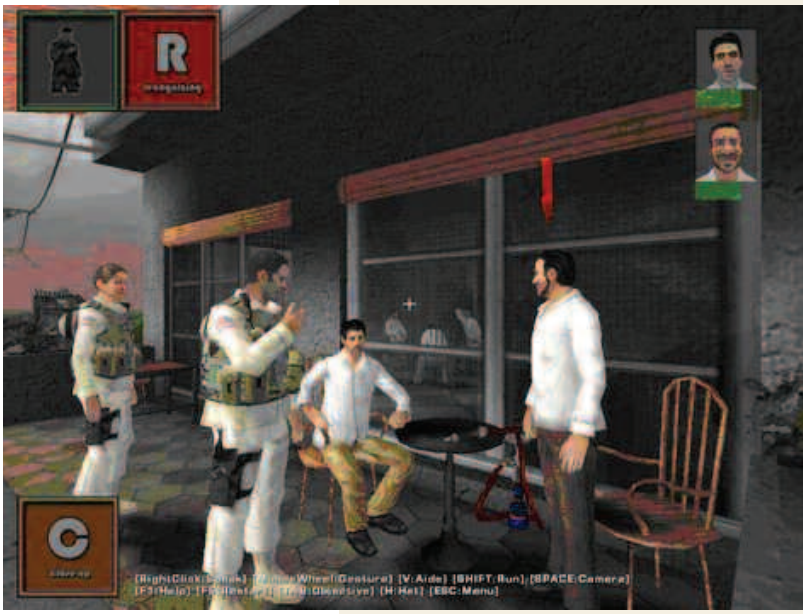
Motivation and Strong Goal Orientation: Games also have features that are highly motivating; that is, game players continue to play games, even after failure, to get better and better at them. This is an attribute that could contribute significantly in the teaching and learning of difficult and complex material. For example, Scholastic developed an elementary-level reading product in partnership with game designers. The company borrowed elements from a popular commercial game — including the motivating reward structure, both predictable and surprise rewards — to incorporate into the reading product.

Scaffolding: Games and simulations can offer scaffolding, providing learners with cues, prompts, hints, and partial solutions to keep them progressing through learning, until they are capable of directing and controlling their own learning path.

Personalization: There is significant interest in how technology can be used to tailor learning to the

"We are teaching culture, not just the use of language. We tell you that it's important to make eye contact, so we allow you to take off your glasses to really reinforce that particular part of the culture lesson. This will, in turn, have an effect on how the characters respond to you."

Hannes Vilhjalmsson, University of Southern California



Tactical Language and Culture Trainer, University of Southern California, supports individualized language learning.

[19] *Education and Training for the Information Technology Workforce,* Report to Congress from the Secretary of Commerce, U.S. Department of Commerce, June 2003.

"We have a human factor where impatience starts being a component in the equation. And that impatience from an adult to a student is an intimidating one, and it starts influencing how they perceive themselves. One of the beauties of the computer or the video game is that it's really try, try again. After 100 times it doesn't say, maybe math's just not for you. It's going, hey, you can do it again."

Lorne Lanning, OddWorld

individual. For example, while there are divergent views over the existence of or the need to adapt to "learning styles", there is strong belief in the learning style concept in the education community. As a result, schools want to adapt material to the student, rather than teach students to work with different modes of knowledge and skill acquisition. Differences in other factors — such as prior knowledge, general ability, and motivation — may have an even more important effect on how materials need to be presented. Nevertheless, it appears that games and simulations could offer educational experiences and materials in a number of different formats that may appeal to different learners.

Infinite Patience: Another feature of games and simulations that is valuable for learning is infinite patience. Teachers lose patience, and may conclude that a student "just isn't cut out for math". The teacher's impatience may intimidate a learner or influence how the learner perceives himself or herself. Machines — such as computers and video games — don't lose patience, and offer learners innumerable opportunities to "just try and try it again".

WHAT COULD EDUCATIONAL GAMES TEACH?

Many game features, combined and designed effectively into educational gaming, could teach many things in an engaging and motivating manner. Games could be used for the expansion of cognitive abilities, as well as a platform for developing new or practicing existing skills in the context of real world goals, rules, and situations. Games could also be used to teach old subjects in new ways. For example, in the civilization-building games, players may explore subjects such as math, how computers work, and geography within the rules structure of the game.

Summit participants highlighted the kinds of knowledge and skills that might be taught effectively with games and simulations, including knowledge and skills that are hard to teach and train in other ways.

Higher Order Skills: When individuals play many commercial video and computer games, they must employ a wide range of higher-order skills. This suggests that games may be effective in teaching these skills. For example, in various games players must:

- Think strategically about their positioning, analyze opponent strengths and weaknesses, plan how to achieve game goals, and execute those plans;
- Master resource management — managing people, money, food, and natural resources — and learn to acquire and apply force multipliers such as knowledge and technology;
- Interact with systems and understand the interaction of variables;
- Multi-task, manage complexity, respond to rapidly changing scenarios, and make decisions;
- Learn compromise and trade-off in satisfying the needs of diverse constituencies;

- Manage complex relationships; and
- Exercise leadership, team building, negotiation, and collaboration.

Practical Skills Training: Through games and simulations, learners can exercise practical skills — such as operating sophisticated aircraft, building a bridge, tinkering with chemical reactions in living cells, experimenting with marketing techniques, performing surgery, or controlling scientific equipment — in a safe, low consequence-for-failure environment. This allows learners to move up the learning curve, without risking life, limb, or damage to expensive equipment in the early part of training and practice. If learners fail in the tasks they are learning, little harm is done, and they can try repeatedly to gain mastery of the required knowledge and skills.

High Performance Situations: Games and simulations show promise in training individuals for high-performance situations that require complex and multi-component decision-making. Characteristics of such situations include: rapidly evolving, ambiguous scenarios; time and performance pressures; the need for judgment; and high consequence for errors.

Rarely Used Skills: Simulations are particularly important for reinforcing skills that are seldom used. For example, *Incident Commander* — a simulation to train first responders — allows crisis managers to practice their responses to terrorist attack, school shooting, and natural disaster scenarios.

Developing Expertise: Games offer a way to "walk in the shoes" of experts, and learn how experts approach problems. For example, to win the game *Full Spectrum Warrior,* players must learn to think and act like a professional soldier.[20] Knowledge is compiled over time and organized in the minds of experts, creating mental models, or templates that they apply to different situations in their work. Among the most important applications of their mental models is situation or problem assessment — how an expert takes in cues and comes to a correct assessment of the situation. Experts may confront new situations, but they are able to make sense of them by drawing on experiences encoded in their mental models.

Games and simulations provide an opportunity to develop mental models more quickly. They can augment real-world experiences and offer those in training frequent opportunities to practice their developing knowledge and skills.

Team Building: Some elements of multiplayer games — such as the popular commercial games *Everquest* and *World of Warcraft* — may be attractive in the corporate world. These games foster information sharing, goal-directed cooperation, and the spontaneous formation of networks, all of critical importance in business today.

Games and simulations hold promise for training team members to work effectively as a team, especially in decision-making, exercising judgment, and

"We know that in many, many environments today, people do not work as individuals… If we can build realistic environments in which team members need to share resources, need to coordinate, can give each other feedback, can develop their own mechanisms, they can begin to develop intra-team feedback mechanisms, self-correction mechanisms."

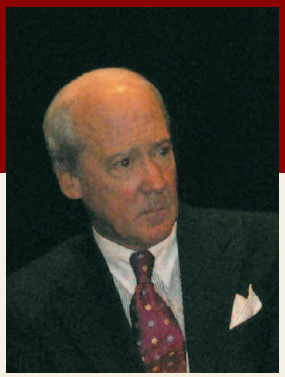
Jan Cannon Bowers,
University of Central Florida

[20] What Would a State of the Art Instructional Video Game Look Like?, J.P. Gee, *Innovate,* September 2005.

solving problems under pressure. They offer opportunities for teams to develop shared knowledge, and shared mental models that support implicit communications. They can help teams improve communications among members by allowing them to develop information flows and practice task sequencing. In game play, team members can provide feedback to one another, as well as practice role switching and the reallocation of workload among team members. These basic features of team training may have widespread applicability, since teamwork skills are among the skills most in demand by employers today.

Recognizing the need for teamwork skills in the workplace, some schools are adopting more group project-based learning. Games and simulations could offer the ability to develop team-building and collaborative skills through virtual experiences.

Learning Games Research, Development, and Design



"One of the great challenges we have in American education is that we spend no money as a nation on R&D, which is really quite stunning. There are those of us who have made the case, and will continue to make the case that surely if there's a major role at the federal level of education, R&D might be it by most measures."

Eugene Hickok, Advisor, DutkoWorldwide, former Deputy Secretary of Education

Gaming and simulation environments offer an opportunity to break the "tell and test" instructional paradigm prevalent in education today, and improve the motivation to learn, the outcomes from learning experiences, and the transfer of what is learned to practical application.

However, exploiting games and simulations for education and training must be based on a sound understanding of which features of these systems are important for learning and why, and how to best design these systems to deliver positive learning outcomes.

Among the most critical development challenges is the need for tools that make it easy to create learning games and simulations quickly, and at low cost. Flexible tools would give the nation's diverse education and training institutions the ability to tailor instructional systems to meet local needs. Such tools could also reduce development costs for educational product and service providers. This includes developing standards and protocols that enable interoperability among game and simulation environments, chunks of learning content, individual objects within the game environment, etc. For example, a digital frog developed by one designer, should be able to swim in a pond developed by a different designer.

In connection with the Summit on Educational Games, a research and development roadmap was drafted to raise awareness of key research challenges, and to encourage dialogue and partnerships in carrying out an R&D agenda that supports the development and design of educational games. Summit participants discussed the research challenges identified in the draft roadmap, as well as other research needs. A revised roadmap reflecting this discussion is online and summarized in Exhibit B. The full report, R&D Challenges in Designing Games and Simulations for Learning, is available at: http://www.fas.org/gamesummit/.

U.S. PUBLIC RESEARCH ON LEARNING TECHNOLOGY

The United States spends about $780 billion on elementary, secondary, and post-secondary education and billions more on workforce training.[21] Yet, it spends little on research and development to improve the productivity and effectiveness of learning.

The federal government does invest in some research on learning science and educational technologies. The U.S. military funds most Federal R&D activity in the games for learning area. Thus, the U.S. military and its missions — rather

[21] *Statistical Abstract of the United States,* 2006, U.S. Census Bureau.

than broad national education and workforce development goals — are driving the development of educational game and simulation technology.

At the Educational Games Summit, the National Science Foundation (NSF) reported that it is funding several games for learning projects, including: massively multiplayer games for science education, building biologically-based immune system simulations for education and training, and game-based learning in chemistry. It also supports several "Science of Learning Centers", but none focus specifically on applying the features of games and simulations to learning. However, Summit participants said that the small grants NSF provides to universities are too small for the experiments and developments needed to foster significant advancements in games and simulations for learning.

"We need rigorous research programs that allow us to investigate the features of games and simulations that lead to effectiveness, and I say this because if we take a haphazard approach, we'll waste money."

Jan Cannon Bowers, University of Central Florida

"What we really need is knowledge convergence, where the two skill sets are put together. In games, it is the challenge and reward delivery system. Education, from what I hear, is the tell-and-test system. Game designers understand keeping an audience engaged and how to deliver critical information for mission objectives. Educators are losing the audience to entertainment media, but they understand the principles of learning that game designers don't. Both are necessary to create compelling educational software that is engaging as well as informative."

Lorne Lanning, OddWorld

PRIVATE SECTOR INVESTMENT IN EDUCATIONAL GAMES RESEARCH

Video game companies are focused on developing new products for the entertainment market. Publishers of educational materials have not identified a market opportunity large enough to make investments in educational games research worthwhile. In addition to poor markets, the exploratory nature of research on educational games, and uncertain returns to individual firms who develop generic tools further discourage the private sector from making these R&D investments.

MODELS OF R&D PERFORMANCE

The research challenges outlined in the learning games roadmap (R&D Challenges in Designing Games and Simulations for Learning) and highlighted in the following pages, span multiple research disciplines — education, psychology, cognitive science, communication, game design, human-computer interaction, software engineering and design, and information science — just to name a few. Unfortunately there is no established community of researchers, industrial participants, educators, and educational institutions from which to mobilize the teams needed to undertake the research identified in this roadmap.

In addition, the development of educational games and simulations spans different parts of the innovation process, from basic and applied research, to technology and prototype development. Since the needed research must combine basic and applied research, technology development, and evaluations, no existing federal agency appears to have an appropriate mandate to conduct this work.

Different R&D models are appropriate for different R&D tasks. These include:

- Publicly-funded, investigator-driven basic research at universities and government-funded research centers (such as the National Science Foundation Science of Learning Centers);
- Private R&D consortia for pre-competitive, generic technology development;
- Focused research center(s) on educational games;
- Demonstration pilots funded by federal or state governments;

- Demonstrations carried out in government-supported education and training programs (such as NSF's Advanced Technology Education program, the Department of Defense K-12 schools, or Department of Labor workforce training programs);
- Learning game development funded by states with common needs;
- Consortia of non-competitors for proprietary technology development;
- Private company R&D;
- R&D funding from federal agencies in support of mission needs (such as the Departments of Defense and Homeland Security); and
- Grants in NSF education and human resource programs for prototype development (such as instructional material development).

EXHIBIT B

Highlights: R&D Challenges in Designing Games and Simulations for Learning

Gaming and simulation environments offer an opportunity to break the "tell and test" instructional paradigm prevalent in education today, and improve the motivation to learn, the outcomes from learning experiences, and the transfer of what is learned to practical application. However, exploiting games and simulations for education and training must be based on a sound understanding of which features of these systems are important for learning and why, and how to best design these systems to deliver positive learning outcomes. In addition, R&D is needed to support the development of automated tools to streamline the process of developing games and simulations, and to reduce development costs.

The R&D challenges highlighted here are drawn from the Games for Learning R&D Roadmap (www.fas.org/gamesummit) and discussions at the Summit on Educational Games:

Role of Games and Simulations in Learning: Different types of games and simulations may teach different knowledge and skills more effectively. In addition, different game and simulation environments, structures, and sequences are likely to be needed for different learning tasks and learning groups (Pre-K, primary, secondary, adult learners, etc). Research is needed to better understand when games and simulations should be used for learning and for what learning objectives. In addition, greater knowledge is needed about transitioning back and forth between traditional instruction, and new forms of learning such as games and simulations. This includes how to move among game scenarios, web-based resources, on-line discussion groups, live discussion groups, and classroom activities. Similarly, evidence suggests that good games motivate learners to seek knowledge outside of the game in order to improve their performance. How curricula could be designed to exploit this quality should be explored.

Designing the Pedagogical Process in Games and Simulations: Research is needed to underpin the development of games and simulations that approximate the ways in which human teachers and their students interact in the learning process. This includes: how to determine if the student is learning or not, and at what difficulty level; how to adjust the learning experience to the learner's level of performance or mastery; how to present material tailored to learner's preferences, or how best he or she learns; and the design of assessment tools that provide information on what is learned and analysis of student performance.

(continued)

EXHIBIT B *(cont.)*

Highlights: R&D Challenges in Designing Games and Simulations for Learning

Identifying the Best Features of Games to Apply to Learning: Games have numerous features that work together to create compelling play and experiences, and high levels of time-on-task. Comparative analyses of learner performance when conjectured key features of games are systematically removed, added or altered would help identify the features of games that show promise for transfer to learning applications.

Understanding Features of Challenges that are Crucial for Motivation and Learning: Studies have shown that incorporating challenges into learning has motivational benefits. Many of today's commercial video and computer games demonstrate this feature through players' high levels of time-on-task. The nature of challenges, competition, and why they motivate should be explored. This includes better understanding of the motivational and engagement aspects of games at the neurobiological, cognitive, and socio-cultural levels. Research needs include studies on how to structure challenges in terms of difficulty (and other features) to optimize learning, resulting in guidelines for implementing challenges across learner tasks, domain types, and learner characteristics.

Understanding How Stories/Scenarios Contribute to Motivation and Learning: Learning is enhanced when it occurs in a context that is meaningful to learners. "Anchored" or situated instruction is preferable because new learning can be integrated more easily into existing knowledge and mental models. Research is needed to refine theories regarding how stories-scenarios contribute to motivation and learning, resulting in guidelines for developing compelling and appropriate stories for learning.

Educational Density: Educational density refers to the amount of learning that takes place per unit of time. Due to the high levels of time-on-task they can generate, games could potentially have a large impact on learning, even if they were not as "educationally-dense" as classroom instruction. Research may be able to identify how to strike a balance between the entertainment or "fun factor" — how long learners stay at the game — and the educational density required to attain a significant impact on learning.

Understanding the Effect of Immersion and Engagement on Learning Motivation: Learning may be influenced by the degree to which trainees experience feelings of immersion in virtual environments. In addition, the tendency to experience immersion seems to be an individual difference. How immersion affects learners and learning needs to be explored. Research should lead to psycho-metrically sound techniques for assessing immersion and engagement, and identification of game features that foster them. This includes understanding the potential negative effects of immersive and multi-media learning environments such as overemphasis on "eye candy" to the detriment of learning goal attainment.

Linking Gaming Features to Goal Orientation: Goal setting involves establishing a standard or objective for performance. The tendency for games to "keep score" may trigger a performance-oriented strategy, since the learner's attention is focused on how he or she is performing. Efforts are needed to better understand score-keeping and its relationship to goal orientation, as well as to develop guidelines for developing games that encourage learner attention to goal attainment.

Understanding the Degree of Authenticity Needed to Support Learning: Summit participants concluded that the authenticity of a game or simulation should be tied to learning objectives. Research is needed to demonstrate how physical, functional, and cognitive authenticity drive learning, leading to a better

(continued)

EXHIBIT B *(cont.)*

Highlights: R&D Challenges in Designing Games and Simulations for Learning

understanding of the level of authenticity that is appropriate for different learning goals and tasks, as well as techniques for enhancing authenticity, based on specific tasks and learner characteristics.

Designing Simulated Actors with Specific Skills, Knowledge, or Personalities: Simulated actors (also known as intelligent assistant agents or avatars) can heighten the authenticity of the learning experience by allowing learners to practice skills with realistic actors who behave in an accurate, believable manner. These computer-generated actors can provide a low cost alternative to more traditional role-playing strategies by reducing the need for human actors. These virtual humans have also been used in intelligent tutoring systems to aid learning, to guide and assist learners in real-time, as well as to serve as learners' representatives in virtual learning environments. Research is needed to understand how humans interact with simulated actors in order to inform design criteria for their development. In addition, the knowledge gained would guide design of simulated actors, their characteristics, and behavior for specific learning applications.

The Role of Gender and Socio-Cultural Differences in the Design of Games and Simulations: Research is needed to better understand how socio-cultural differences should be reflected sensitively in the design of games for learning, without reinforcing negative stereotypes. Such research would inform the design of game metaphors, graphical worlds, and avatars so they are familiar and attractive to different learners. Individual and socio-cultural differences may also need to be taken into consideration in designing rewards built into games, since rewards are relative to the user. Similarly, research is needed to better understand if and how gender should be accounted for in learning game and simulation design. For example, boys play more video games than girls, and generally prefer a different kind of game than girls enjoy. The research should result in guidelines for game design and evaluations that take into account appeal and effectiveness with various subgroups.

Incorporating Educational Scaffolding: Scaffolding provides learners with cues, prompts, hints, and partial solutions to keep them progressing through learning, until they are capable of directing and controlling their own learning path. For example, game-like assignments would be filled with questions and exercises that actively engage and motivate the learner with interactive tasks. Work is needed to determine how and when scaffolding should be incorporated into educational games and simulations, including studies and demonstrations of techniques that optimize the introduction, format, timing, and fading of scaffolding in the learning environment. This research should lead to automated tools that can adjust scaffolding strategies automatically based on the learner's characteristics and performance.

Reporting and Use of Assessment and Learner Modeling Data: Feedback and guidance are essential components of a learning environment. They point out performance errors, correct them, and allow the learner to proceed to mastery. There are many dimensions of feedback and guidance that can be varied: timing, content, amount, specificity, medium, and control. Research is needed to understand how to integrate feedback and guidance into educational games and simulations. Based on this understanding, authoring software is needed to facilitate entry of feedback in a variety of media such as text or spoken by a character.

Assessing the Attainment of Higher-Order Skills: Games and simulations may be especially useful in developing higher-order skills such as strategic thinking, problem identification and solving,

(continued)

"[We] put together a team, and the team had to include educators who were going to run the show, but we had to get entertainers involved. And we had to get the technology people involved, and we had to learn to speak each other's language, because what the educators had to understand is these people have a talent that we need. We can call them the enemy all we want, but they're winning the war."

Joe Irby, President, BestQuest

TRANSFERRING TECHNOLOGY AND KNOW-HOW FROM THE COMMERCIAL GAME INDUSTRY TO EDUCATIONAL GAMES

The gaming industry has technology and game designers have craft knowledge that should be transferred and applied to the development of educational games. For example, the gaming industry uses sophisticated game engines that could be easily adapted to non-competing education applications. Other game industry technologies ripe for transfer to the education and training arena include: intelligent avatars, computer-generated characters that can simulate dialogue and conversation, physical environments that are richly depicted virtually, and artificial intelligence programs that help govern game play.

Game designers are highly skilled at developing motivating game play that produces high levels of time-on-task. They know how to deliver critical information needed to obtain mission objectives, and they understand how to move players from an easy level of game play to harder levels of play. They also could bring a new creative dimension to educational software development. Educators understand the principles of learning that game designers do not. Both skill sets are necessary to create compelling educational software, including games and simulations, which are engaging, informative, and effective.

New approaches are needed to involve the gaming industry and its designers in learning research, and educational games and simulations development. For example, in the information sciences program at the University of Southern California's Viterbi School of Engineering, game developers from industry teach during some of the courses. This not only provides training to students, but also adds a new dimension to the knowledge of school faculty.

Federal agencies that support research and development, such as the National Science Foundation, may welcome multi-disciplinary research teams that involve the gaming industry along with academia and K-12 educators. There may be

EXHIBIT B *(cont.)*

Highlights: R&D Challenges in Designing Games and Simulations for Learning

decision-making, task prioritization, and adaptation to rapid change. Research is needed to better understand how to identify and measure the attainment of higher-order skills, resulting in guidelines and measures for assessing learner performance in this skill domain.

Understanding Change in Education and Training Institutions: There is growing consensus that slow adoption of technology in educational institutions has less to do with the technology, and much more to do with the institutions' organizational structures, instructional practices, incentives, and other systems that are strongly resistant to major change. Because they may require concomitant changes in these areas, promising technology-enabled innovations may be introduced inappropriately, if introduced at all. Research is needed to better understand the barriers to technological, organizational, and systems change in educational institutions.

other institutional approaches — such as multidisciplinary centers — that could bring together educators and game designers to share and merge their knowledge.

DESIGN OF EDUCATIONAL GAMES

There was consensus at the Summit that educational games are not the same as today's commercial video games. Instruction, rather than entertainment, is the purpose of educational games. Educational game design must target the desired learning outcomes, and design a game to achieve the specific learning goals.

Educational games must be built on the foundation of learning science. This requires expertise beyond the specialists that design commercial entertainment games. For example, the development and design of *Immune Attack*[22] — a game to teach basic concepts of immunology to high school and college students — has involved experts in instructional design and immunology, educators, game developers, and medical illustrators. Exhibit C illustrates the expertise required for educational game design.

In short, educational games represent a new type of product — where the knowledge of pedagogy is integrated with the features of games that are so motivating, engaging, and rewarding to users. It is necessary to design a product

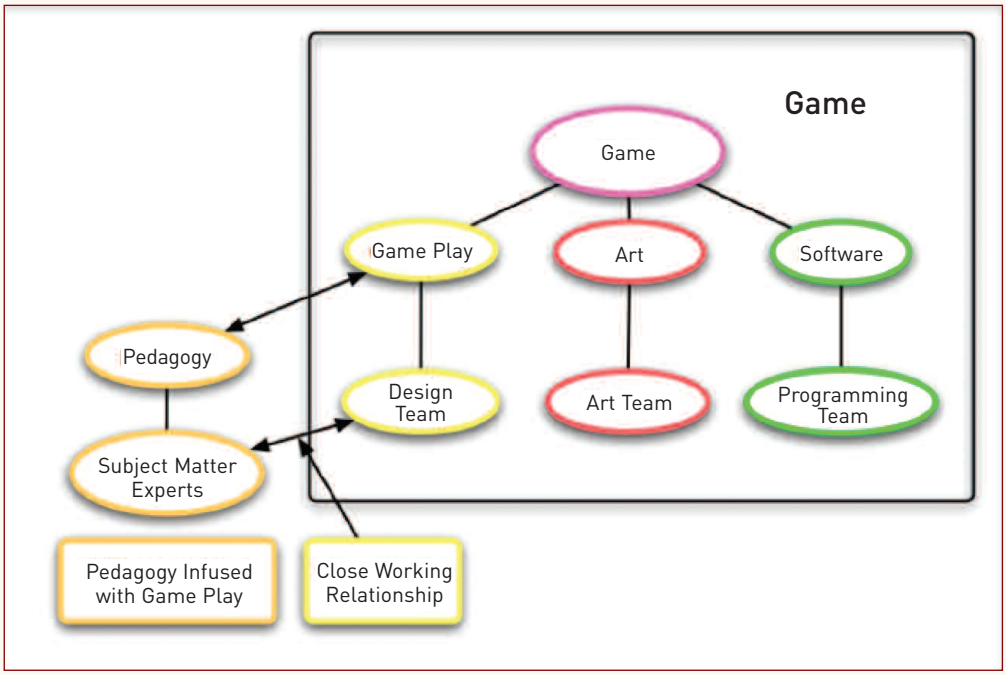
"How do we involve the fabulous skills and, in a sense, craft knowledge that members of the game community have. How do we get them engaged in these (government research) grants? What is it that needs to happen to make a research agenda actually take advantage of those rich skills, as opposed to trying to train educators or cognitive psychologists up from ground zero."

Bror Saxberg,
Chief Learning Officer, K12

EXHIBIT C

Sample Educational Games Development Team

(Courtesy of Michael Zyda, University of Southern California)



[22] Federation of American Scientists, www.fas.org.

with the instructional goal in mind, rather than turning an entertainment game into education or turning traditional classroom educational material into a game.

Summit panelists described characteristics of good games, features that could be applied to educational games and simulations. These are described in Exhibit D.

Summit panelists highlighted the need to design educational games that are culturally sensitive, and take into consideration a learner's gender, cultural background, how an avatar or intelligent agent might be presented, or the best cultural metaphors to apply with a particular learner. For example, females are more attracted to *Sims*-type community, home, and relationship building games than males are.

Educational game designers also need to consider the role of the teacher, and the need to keep a game's professional development requirements low. While teachers may not have to participate directly in a learning game, performance data, other forms of feedback, and opportunities for monitoring should be provided to the teacher in support of his or her leadership and developmental role.

Summit panelists discussed the degree of authenticity required in educational games. In some cases, games and simulations should be realistic, authentic, and believable, holding the interest of the learner because the environment is familiar and relevant. In other cases, realism in a game or simulation may not be necessary. For example, if individuals need to learn how to react to new circumstances and unexpected situations, fantasy games may provide a platform for developing this type of generic skills, knowledge, and self-knowledge. Or, elaborate realism may mask and make too complicated the specific learning that needs to take place. A simplified learning environment may make the learning objective more explicit. What may be authentic is not necessarily realism (because it may be a simplified version), but rather that the game's story or scenario makes sense and, thus, the metaphor seems authentic. In addition, metaphors can be powerful devices for learning things that are abstract or new to our understanding. Summit participants agreed that the instructional goal should inform whether the game or simulation is realistic or not.

"The definition of games is story, art and software. In serious games, we start putting in pedagogy and subject matter experts, and we think about pedagogy infused with game play where the intent really is to build an immersive game that is infused with this learning that the student is going to get, and we can actually measure it. And there's a research agenda here; we don't really know how to do this right now."

Mike Zyda, University of Southern California

Immune Attack, *Federation of American Scientists, Brown University, and University of Southern California. A PC-based game to teach basic immunology concepts.*

SUMMARY FINDINGS AND RECOMMENDATIONS

A public investment in educational games research is needed because there is little incentive to induce the private sector to invest in the needed R&D. Research is needed to develop a sound understanding of which features of games are important for learning and why, and how to best design educational games to deliver positive learning outcomes. In addition, R&D is needed to support the development of automated tools to streamline the process of developing educational games, and to reduce development costs.

Recommendations:

- Since there is a public good and large social returns to the nation associated with improving education outcomes, the U.S. Department of Education and the National Science Foundation — in partnership

with industry, educators, and the academic community — should support an R&D agenda that would encourage the development of educational games for K-12, post-secondary, and adult learners. This includes R&D on tools to make it easy to create and modify games quickly at low cost. These federal agencies should also promote interoperability standards to guide educational game and component development.

- The U.S. Department of Labor — with its large investment in and oversight of the nation's public workforce training system — should take a lead role in developing and funding an R&D agenda on workforce training-related games.

A variety of models should be used to perform educational games R&D. R&D on educational games spans many research disciplines and different parts of the innovation process, from basic and applied research, to technology and prototype development. Different R&D models are appropriate for different R&D tasks.

Recommendation:

- The U.S. Departments of Education and Labor, and the National Science Foundation in cooperation with industry leaders, and business and trade associations, should encourage the formation of and participate in these research models and partnerships.

The gaming industry has technology and game designers have craft knowledge that should be transferred and applied to the development of games for learning.

Rather than thinking about existing classroom activities, and figuring out how we can somehow wrap a game around it, we need to think out of the box about ways that we can create integrated learning scenarios using game structures, that then fit somewhere within the teacher's curriculum for the day."

Howard Phillips, Microsoft

EXHIBIT D

Important Attributes For Design of Educational Games

(summarized from participants' discussions)

- User centricity
- Novelty
- Rewards
- Intuitive control
- Bite-sized chunks of gaming
- Diagnostic
- Enticing
- Measurable progress
- Cool factor
- Immediate feedback
- Moves a learner through multiple levels of achievement
- Keep players at the edge of his or her skills but don't over-challenge
- Emulate familiar patterns
- Build both generic and specific skills
- Self-directed play
- Adaptive
- Provide tasks to fill gaps in knowledge or skill
- Provide sense of mastery
- Requires active problem solving
- Delivery of some ambient information
- Build skills that can be carried forth in new games
- User assistance, but not heavy-handed assistance
- Motivate learner to move toward the goals and the learning experiences

"Training for the unexpected — the only thing we can be sure of is that the war de jour is going to be different than the war we trained for…why don't you just put the people in front of a standard computer game and let them learn for themselves as they're going into unexpected situations. We put 20 soldiers against 20 other soldiers of their unit playing Never Winter Nights, *and the sergeant and the lieutenant were the commanders of both. They fought a game in which there were griffins, which they quickly called UAVs because that was their surveillance tool. And the point of it was not that they could fly griffins around, but that they learned how to work with themselves in a new circumstance."*

Ralph Chatham, DARPA

Recommendations:

- New approaches should be established to involve the gaming industry and its designers in learning research, and in the development of learning games and simulations. Federal R&D investments should catalyze collaborative efforts between game designers, and educational materials publishers, academic researchers, schools of computer science and engineering, and schools of education.
- Private sector developers of educational games should form development teams that include expertise in games for entertainment, cognitive science, and pedagogy, as well as subject matter specialists.

Communities of practice — groups able to share software and ideas because they adhere to agreed upon standards and protocols — will be essential to make full use of games for education.

Recommendation:

- The federal government — for example, the U.S. Department of Commerce's National Institute of Standards and Technology — should facilitate the emergence of such communities.

Business Climate for the Development and Commercialization of Digital Games for Learning

"If games are so great, the ideas so powerful that they can transform the educational landscape, why isn't it happening? Why isn't the marketplace dragging these ideas into this huge and diverse educational market?"

Henry Kelly, President, Federation of American Scientists

The U.S. market for computer and video games is large and growing, more than doubling since 1996 to $7.3 billion in 2004.[23] While action and sports games dominate the video console genre, strategy, family, and children's games dominate the genre of games played on computers. Puzzle, board, game show, trivia, and card games are popular on-line game pursuits.

The K-12 and post-secondary educational market is also large with educational materials publishers' net sales reaching $7.7 billion in 2004.[24] There are two markets for materials in K-12: basal (core or textbook) and supplemental. A large percentage of the K-12 educational materials dollars go to the basal market. The supplemental materials market gets the funds that are left after purchases of textbooks and hardware. The K-12 market is big, fragmented, conservative, slow moving and trailing edge and, thus, challenging for new product introduction.

Despite the large and growing market for video and computer games, and educational materials, as well as some public preference for games that have potential educational value, educational software producers have, for the most part, produced game-like products only for niche markets.

INDUSTRY PLAYERS AND THEIR BUSINESS MODELS

The video game industry and educational materials publishers are both potential candidates for developing and marketing high quality educational games. However, their business models do not favor entry into the educational games market.

Video Game Industry: Game publishers are largely the only companies that finance video and computer game development today. The game industry is highly market-driven, with educated, demanding buyers. The market supports a wide range of titles from games that feature realistic conflict or competition to sports and racing titles to simulation and strategy games.

Like any industry where the costs of R&D are rising and prices are stable, the video game industry has become more selective — some would say conservative — in choosing the types of games they will develop and market. Game publishers are drawn to game genres with a track record of sales that they have experience in marketing. Also, the potential size of a market for a game concept is scrutinized heavily. Niche products and "creative" games have a higher risk profile and are viewed more skeptically compared to games in market-proven segments.

[23] Entertainment Software Association, www.theesa.com.

[24] Association of American Publishers, www.publishers.org.

"It's creating highly-adaptive, textured layered games with multiple entry points, lots of choice, but lots of deep structure. You're guiding kids along a path that they may not be aware they're being guided to. That takes a type of expertise that's not normally found amongst educational developers, and it takes an infusion of capital that's rare to find in this market."

"The bigger more traditional states, the states that have the statewide adoptions, are in very few places willing to give up the text or willing to give up the print, so we're looking at adding the cost of developing technology components to the already huge cost of developing the print."

Midian Kurland, Vice President, Technology and Development, Scholastic

These business realities are shaped by the escalating cost of game development. These costs have risen 300 percent since 1999 as more advanced hardware technology and powerful processors allow developers to build much more sophisticated games that provide richer and more immersive user experiences. Today, developing and launching a new video or computer game can cost as much as $10 million, and experts forecast that high end games for the new console systems will cost $15–25 million. Given the fact that most games do not recoup their R&D costs, it is easy to see why publishers are focused on lower risk, higher return franchises and genres.

Educational Materials Publishers: Educational materials producers have not been in the "games for learning" business. Often their software work is an outgrowth or supplement to the printed material they sell. Most producers appear to lack market incentives or the millions of dollars needed to invest in research and game development, as well as in the large-scale evaluation studies that would be needed to support the marketing of new game-based products.

The skill base for creating cutting edge games and simulations is not well represented in the educational material publishing houses or the companies that produce educational software. The business model for producing education material does not allow for the size of budgets and kinds of payments needed to attract the talent that creates products for the commercial entertainment game market.

For example, in the video game industry, a lead video game artist might make $85,000 per year, a lead video game programmer $100,000, and a lead game designer $110,000. A highly talented video game artist, designer, or programmer could command salaries ranging from $120,000 to $300,000. In addition, these employees may receive other benefits such as bonuses, royalties, profit sharing, and stock options. In contrast, in the publishing industry, mean annual wages for computer programmers are $73,170, for software engineers $82,000–$87,000, for instructional coordinators $59,900, and multi-media artists and animators $59,900.[25]

MARKET CHALLENGES

There are several challenges that represent potential barriers to success that must be overcome in the market for educational games.

Preference for Textbooks: Few school systems — including the larger, more traditional states that have statewide adoption of education materials — are willing to give up textbooks and printed materials. This means that educational games would just add more costs for the schools — and for the industry that produces educational materials. The industry would have to invest additional funds for developing educational games, on top of the large investments it already makes in developing printed materials.

[25] *National Industry-Specific Occupational Employment and Wage Estimates,* Bureau of Labor Statistics, U.S. Department of Labor, November 2004.

If large school districts would allow core instructional funds to be spent for technology on par with textbooks, the market may become more favorable for technology-enabled learning products. Data from studies that show positive outcomes from technology-based solutions may encourage states to open this funding for non-print materials. But unless this happens, companies cannot afford to develop first-class print *and* first-class software for reading, math and science.

Market Fragmentation: The markets for educational games are highly fragmented and diverse. In the K-12 market alone, there are 16,000 school districts to which a company could potentially market its products, although a small number of large school systems — California, New York, Texas, and Florida — dominate the K-12 educational products market. If a product is adopted in these states, large investments in developing educational materials will generate an adequate return and materials adoption will be influenced in the rest of the country as well. That makes these large "adoption" states a key market target.

In addition to school districts, the 120,000 schools within those districts and the teachers in those schools can also be viewed as part of the market. There are also markets for pre-K, post-secondary, as well as adult learners and workforce training. Education markets now include large numbers of students for whom English is a second language, as well as a diverse cultural and ethnic mix.

The fragmented market means that potential producers of educational games and simulations must face the risky proposition of selling to many smaller markets, or hitting the jackpot with adoption states.

Education Standards: K-12 curriculum standards — such as state standards of learning and the *No Child Left Behind Act* progress measures — are exerting a major influence on classroom instruction and, as a result, what schools will buy and the types of products educational materials publishers will produce. Striving to meet these standards, schools, especially public schools, may be reluctant to adopt innovations that cannot demonstrate a track record of effectiveness. Some schools may even be prevented from purchasing unproven technology products.

However, where students in need of remediation are not meeting the federal *No Child Left Behind* standards, schools are at risk of losing their autonomy and, thus, may be more open to an unproven solution. As one Summit panelist suggested, "Where's the pain in the education market?" Remedial mathematics and reading were suggested as areas ripe for technology-enabled interventions.

School Schedules: In K-12, educational materials must be designed to accommodate a class schedule segmented into 45-minute blocks of learning. Most games are not designed with schedule in mind. As a result, it makes little sense for some games companies, such as the civilization building game companies, to develop games and market them to K-12, since those games take many hours to learn and to play.

Culture and Attitudes: There are misconceptions about the effects of games on children, even open antagonism and distrust about games. Some parents and

"You've got a big fragmented, conservative, slow-moving market with a very long sale cycle, and lots of pressure coming from NCLB, and annual yearly or adequate yearly progress requirements, all of which is making, particularly the public schools, incredibly conservative in what they're willing to look at, and resistant to a lot of innovation, particularly innovation that can't show a track record, can't show efficacy data. In fact, in many cases, schools are prevented from using their dollars to buy unproven technology products."

"The bell schedule rules. The world operates in 45 minute blocks, and when that bell goes off, you drop whatever you were doing and you move on to the next."

Midian Kurland, Vice President, Technology and Development, Scholastic

teachers feel that kids get enough games at home, and need to do something serious at school. As a result, publishers may incorporate design elements from games into educational software, or market a program's motivational theory or ability to engage learners. But, regardless of a program's game-like features, publishers are reluctant to market educational software as games.

Many children have a different view about video and computer games. While parents and educators are more likely to view a game favorably if it is marketed as "educational", children often view that label negatively. In addition, children's tastes in video games change as they age; by the age of nine or ten, children appear to prefer games designed for adults.

"The fastest way to make a venture capitalist fall on the floor laughing is to come in and say you want money to create a game company. The only thing that makes him laugh harder is if you tell him that you want money to make a game company for education."

Doug Whatley, CEO, BreakAway Games

INVESTMENT CLIMATE FOR EDUCATIONAL GAMES DEVELOPMENT AND COMMERCIALIZATION

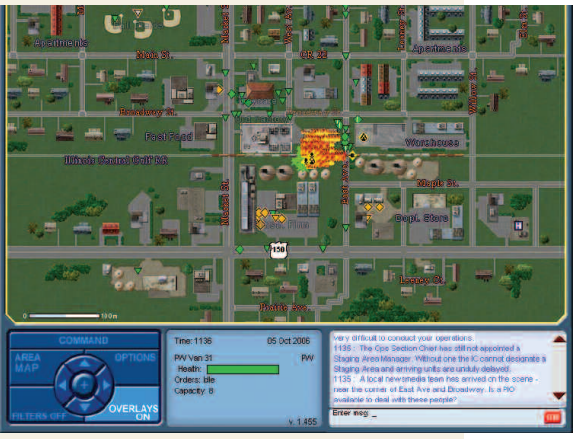
The high cost of game development and uncertain markets for educational innovations make investments too risky for both the video game and educational materials industries. There is also no funding for educational game development or educational game companies from venture capitalists, mezzanine funders, or banks. This adversity to risk-taking is deepened by past experience of firms that lost investments in the education technology markets.

Government grants are too small and take too long to administer to support educational game development or educational game companies. In addition, the gaming industry is reluctant to develop educational games when the prevalent "tell and test" instructional paradigm does not favor the use of these products.

Despite the challenging investment environment, there are examples of successful educational products that use game features. For example, *Scholastic* commercialized a reading intervention product with features modeled after a video game, generating revenues of over $100 million. The development costs for this product — $9 million — were much higher than previous projects. The company continues to integrate game-like features into their products. However, their development costs are rising and the product development cycle is lengthening. As a result, *Scholastic* must choose their market investment opportunities carefully.

A variety of new business and product models could bring learning games and related technologies to the education and training marketplace:

- **Supporting the Use of Off-the-Shelf Commercial Games in Learning:** Classroom materials that support use of commercial off-the-shelf computer and video games for education and training purposes should be developed. This could include developing a learning component on top of entertainment games. Some commercial games — such as *Civilization* and *Rollercoaster Tycoon* — are already being used in classrooms.
- **Modifying Popular Commercial Games for Learning Applications:** Game companies could modify or license for modification some of



Incident Commander, *BreakAway Games, is used for training at the management level for a critical incident.*

their current and older commercial games for use in education and training. For example, the popular game *The Sims* has been modified to teach the German language.[26]

- **Secondary Markets for Game Technologies:** Game companies should look at education as a secondary market for their technology. To help mitigate the high costs of educational game and simulation development, game companies could identify technologies in their portfolios — such as avatar technology or user interfaces — that may be useful for educational applications. They could sell these at low cost for use in education. Similarly, game companies could license their game engines — even second or third generation engines — for non-competing educational applications.
- **Downloadable Games:** Educational materials publishers and game companies should explore the economics of developing and marketing "downloadable", Shockwave-type educational games. This type of game — typically down-loaded in about ten minutes for play on a personal computer — is simpler and shorter in length than games developed for video consoles. These games have lower production values and, as a result, take less time and are less costly to develop, and involve less risk to producers. Due to their simplicity, they would also have low teacher development requirements.
- **Open Source Models:** Open source initiatives could encourage a wide range of individuals and companies to self-construct educational games and simulations or components for them. For example, thousands of residents of *Second Life* — an open source virtual world — use authoring tools to construct the *Second Life* world, creating its places, businesses, objects, and events. Similarly, potential educational games producers could encourage learning software "mod-makers", modeled after the players that create add-on modules for commercial video games.
- **Learning Games for Home Use:** With video game consoles in 45 million homes, game companies, educational materials publishers, and educational software producers might explore developing learning games and simulations for home use.

In addition, some markets may have lower barriers to entry for educational games. One Summit panelist suggested that the market for K-12 materials is splitting into products for school and products for use after school. The informal, after school market may be easier to penetrate and more receptive to innovations. Virtual schools may be another market with lower barriers since they already deliver digital-based learning products on-line. Similarly, 30 percent of all learning content delivered in the business sector for workforce training is delivered via technology, with self-paced distance learning growing fast.

"We can provide educators with the tools to use the software that we have already created. For example, Civilization III is very modable. Civilization IV is going to be even more modable for smart teachers out there to take the tools that we provide and make software of their own that they can use in their own classrooms."

Jeffery Briggs, Founder, President and CEO, Firaxis

Civilization 4, Firaxis. *Educators have used the Civilization series of games to teach politics, civics, and history.*

[26] *Using the Sims to Teach Language,* Inside Mac Games, January 4, 2005.

"We spend millions of dollars on game engines, and if the game is not a hit, we typically just throw it out, maybe try to salvage a few pieces of code and algorithms. These are massive development budgets — five to fifteen million dollars — and these are powerful pieces of software. The secondary market potential is, in my opinion, huge, and [could] probably get bargain rates from game publishers and developers to buy that software and adapt it to applications that would teach people how to lead, read, how to do physics, how to learn math, things of that nature."

Lorne Lanning, OddWorld

SUMMARY OF FINDINGS AND RECOMMENDATIONS

High development costs and an uncertain market for educational innovations make investments in developing complex learning games with high production values too risky for both the video game and educational materials industries. This adversity to risk-taking is deepened by past experience of firms that lost investments in education technology markets. To spur innovation, a variety of new business and product models should be encouraged for bringing learning games and related technologies to the education and training marketplace.

Recommendations:

- Educational materials publishers should consider developing classroom materials to support the use of commercial off-the-shelf video and computer games for education and training purposes.
- Game companies should modify or license for modification their current and older commercial games for use in education and training.
- Game companies should look at education as a secondary market for their technology. Game companies should identify technologies in their portfolios — such as avatar technology or user interfaces — that may be useful for educational applications and consider selling them at low cost for use in education and training. Similarly, game companies should license their game engines for non-competing educational applications.
- Game companies, educational materials publishers, and educational software producers should explore the economics of developing and marketing "downloadable", Shockwave-type educational games.
- Open source initiatives should be established to encourage a wide range of individuals and companies to self-construct learning games or components for them. Similarly, potential educational game producers should consider how they could encourage learning software "mod-makers".
- Game companies, educational materials publishers, and educational software producers should explore developing educational games and simulations for home use.

Several barriers inhibit the markets for education games. These include: market fragmentation (e.g., 16,000 K-12 school districts), schools' unwillingness to abandon text books in favor of technology-based materials, limited budgets for educational materials other than text books, negative attitudes about video games on the part of some parents and educators, and schools that are reluctant to purchase educational technologies that have not proven their efficacy, especially in terms of today's education standards. However, some markets could be aggregated to reduce educational game producers' market risk, and some markets may have lower barriers to entry.

Recommendations:

- The U.S. Department of Education, state government associations, and educational materials publishers should work to aggregate markets among states with common interests — for example, programs for students for whom English is a second language or remedial mathematics — to reduce producers' market risk.
- Educational materials publishers should explore developing educational games for K-12 markets where there are perceived to be problems that innovative products may be able to solve.
- Educational materials and educational software publishers should consider developing educational games for use with the infrastructures and technologies being used for virtual schools and on-line learning.
- Educational materials and educational software publishers should explore opportunities for developing educational games for the informal afterschool market.
- Training materials and training software publishers should explore opportunities for developing training games to serve the nationwide workforce development system, overseen by the U.S. Department of Labor. The U.S. Department of Labor should identify where there are training needs that are common across the workforce development system and, thus, represent a potentially large market.

Better information about educational games' potential may reduce market uncertainty for investors and attract customers.

Recommendations:

- Potential educational game developers should consider presenting market data — such as surveys of parents who think schools are failing

"Kids spend about 316 hours a year playing video games, that includes console games and PC games, and hand-held. If you add up the number of hours that you get in an average high school class, 42-minute period, 180 day school year, that's about 126 hours. You could develop a video game that is 15 times less educationally dense than our software (Cognitive Algebra Tutor), and if you developed that game and made it fun enough that students spend their 316 hours playing that game, you'd have as much impact on that student's level of knowledge as we have within our classroom."

Steve Ritter, Carnegie Learning

THE POTENTIAL FOR GAMES AND SIMULATIONS IN CORPORATE TRAINING

"How do we introduce more simulations and games into this high-paced fast changing business context? Focus on the value proposition, and align the value proposition with what they need right now—increased competence and reduced time to expertise, learning by doing, content that is fairly stable with a large enterprise wide audience."

– Brenda Sugrue, Vice President for Research, American Society for Training and Development

The private sector increasingly looks to technology to enable flexible, effective, low cost training. Today, due to workforce globalization, training solutions must be flexible enough to transcend cultural and geographic boundaries, as well as to bring workers in developing nations up to an acceptable level of performance, while also supporting workforce groups that are more advanced. In addition, many firms seek to increase the speed at which employees learn. For example, business units must get up-to-speed on new products, services, and processes more quickly in response to rapidly changing markets. Technology-enabled learning can respond to some of these challenges by offering the ability to

(continued)

their children, and data on how much parents would spend to acquire high quality learning games for their children — to help in-house and external investors better gauge market potential and risk.

- Educational materials publishers should help customers understand how educational games can support the standards-driven learning environment.

Brenda Sugrue,
Vice President for Research, American Society for Training and Development

THE POTENTIAL FOR GAMES AND SIMULATIONS IN CORPORATE TRAINING (cont.)

customize training programs, and to deliver training in more remote locations, at more convenient times for individual employees, and in ways that shorten time-to-competency. Thirty percent of all learning content delivered in the business sector is delivered via technology, with self-paced learning growing fast.

Greater business use of learning games and simulations requires products and services that are aligned with what firms need now. Leaders of internal corporate learning organizations seek to: integrate learning operations across the company, plan and manage the training investment like any other corporate investment, and align learning with business goals. There is a focus on efficiency through technology, standardization, reducing time-to-competency, integrating learning with work, and rapid development to keep up with the pace of change in business strategies and processes. Businesses may find learning games and simulations attractive if they: increase competence with reduced time-to-competency, offer hands-on learning by doing, focus on content that is fairly stable with a large enterprise-wide audience, and address a competency gap or employee group that is critical to corporate strategy.

Marketing training innovations is more difficult in companies in which training budgets have been decentralized and are controlled by business units. More promising markets are where training budgets are centralized, and there are opportunities for common cross-enterprise training such as leadership or sales.

Many companies use games and simulations to prepare employees for management, customer service, and sales roles. For example, some companies are using Virtual Leader (www.simulearn.net), a simulation that allows employees to practice their leadership skills in a series of increasingly complex and realistic scenarios. These training approaches are under utilized, and cost is perceived as a barrier to greater use. However, there may be creative ways to reduce the cost per organization by: sharing the cost of developing simulations for key skills needed in many organizations, embedding short game-like activities into traditional e-learning programs, or providing off-the-shelf programs that have broad appeal.

Recommendation:

- Training materials and training software publishers should explore developing learning games and simulations that improve corporate training productivity and reduce time-to-competency, especially where there is a company-wide training need or need for training a key employee group.

Digital Games, Schools, and Instructional Practices

The use of games for learning represents a departure from traditional "tell and test" instructional practices. The structure of instruction and instructional practices would need to change, if schools are to take full advantage of games, simulations, and their features for learning. However, educational and training institutions do not have a history of making the organizational and systems changes needed to make full use of new technologies.

RESISTANCE TO FUNDAMENTAL CHANGE

Over the past few decades, in response to competitive pressures and new opportunities, many companies and industries have transformed themselves by taking advantage of advances in technology, and new management methods and models of organization. Manufacturing industries, service industries such as banking and insurance, even governments undertook substantial business process redesign and technology adoption, realizing substantial gains in productivity and product quality while lowering costs. In the process, they underwent a deep examination of their processes, services, products, and what their customers wanted.

The education sector has not undertaken such a transformation. Despite some reforms, the way education is conducted has not changed fundamentally; in today's digital age, schools still operate on an obsolete industrial model and agrarian calendar.

The education sector has not been part of the IT revolution. In a recent Commerce Department analysis of 55 industries, the educational services industry had the lowest information technology-intensity.[27] Yet, educational services is arguably one of the most knowledge- and information-intense industries in the country.

Most schools' adoption of technology has focused on integrating technology into existing organizational and instructional systems. This mirrors the first corporate attempts to use new digital technologies by focusing largely on automating existing work, without recognizing that dramatic improvements in business models, systems, and processes were possible. It was only after rebuilding corporate processes around the new tools and their economics did these companies and industries begin to show substantial productivity gains.

"It's unfair to think that American education can change by itself. Most organizations don't. They change because of pressures from outside. They change when the world in which they exist demands they adapt, because if they don't adapt, they cease to exist."

"There have been changes in education and reforms to education, and some improvements to education, but as a series of structures and institutions, the way we conduct the business of education — if I can use that term — hasn't changed much."

Eugene Hickok, Advisor, DutkoWorldwide, former Deputy Secretary of Education

"It's not integration that we're necessarily talking about. Business learned that when they gave the first word processors and e-mail programs to the secretary. It wasn't until that paradigm changed and the computer was given to each individual that productivity shot way up. We're talking about transformation here — what we're asking is to bring the education eco-system into alignment; we need to do the kinds of things that businesses are doing to transform themselves."

Don Blake, Senior Technologist, National Education Association

[27] *Digital Economy 2003,* Economic and Statistics Administration, U.S. Department of Commerce, December 2003.

"As an institution, the schooling system we have is almost perfectly organized. It's evolved over time, almost perfectly organized to sustain and maintain itself. The way it is put together makes it very difficult to encourage the kind of innovation and changes that you have been talking about that really has sparked most of the other public sectors."

"There is an emerging market in educational alternatives for American kids: charter schools, magnet schools, some school choice in non-public and public schools; alternative settings, home schooling, cyber schools. It's exploding. That creates a new dynamic that you need to recognize plays to your advantage because you've now got individuals who have to be able to attract students, and to attract investments, and to make the case for a bottom line."

Eugene Hickok, Advisor, DutkoWorldwide, former Deputy Secretary of Education

Susan Patrick, former Director of Education Technology at the U.S. Department of Education observed, "The ed-tech community loves the term 'integration.' But our schools need transformation, not integration." New technologies will not have a significant effect on learning outcomes unless they are accompanied by systematic changes in approaches to instruction and organization.

Schools have been built as systems, designed and organized to maintain the status quo. In the perfect system, processes, rules and procedures, culture, organizational form, and the roles of people are all designed to work together and reinforce each other. That means fundamental change — which undermines the very basis of a system and its components — is so challenging and disruptive that organizations resist it.

In addition, policies outside of the institution may reinforce the status quo. Existing educational institutions that resist change and innovation (as opposed to a small number of innovators) are still likely to receive the lion's share of government funding, due to their large student populations and long-term footprint on the educational scene.

Often pressure from outside the institution is needed to spur innovation and fundamental change. Organizations change when the world in which they exist demands they adapt because, if they don't adapt, they will cease to exist.

The *No Child Left Behind* Act is bringing national and local attention to the performance of schools and creating momentum for change. Parents, teachers, and administrators are all concerned about education's bottom line. Citizens are beginning to examine the returns to the public investment in schools, and there are consequences for poor performing schools.

In addition, competition in education is increasing, with expanding consumer choices at every level — private schools, charter schools, magnet schools, alternative-settings, home schooling, virtual schools, on-line learning, and commercial education and training services. There are early signs that competition may expand to a global scale. For example, India already offers e-tutoring services in the United States at convenient times, and at a cost significantly lower than what a U.S.-based tutor charges.[28] Educational content design is being outsourced to overseas producers, and some training service providers already have overseas IT development facilities.

With increasing competition and expanding choices for the consumer, public schools and universities must increasingly demonstrate their value. These pressures may encourage education and training institutions to change.

CHANGING THE INSTRUCTIONAL PARADIGM TO TAKE ADVANTAGE OF EDUCATIONAL GAMES

Educational games and simulations are fundamentally different than the prevalent instructional paradigm. For example, games are based on challenge,

[28] *American High Schoolers Receive Help from India*, www.cnn.com, October 26, 2005.

reward, learning through doing and guided discovery, in contrast to the "tell and test" methods of traditional instruction. The *No Child Left Behind* Act, and the education and testing standards it has engendered, is linked to traditional "tell and test methods" of instruction. As a result, the progressive instructional approaches associated with educational games and simulations are not well aligned with the current climate in K-12.

Many games — such as the civilization-building games being used in some classrooms today — are not generally compatible with the traditional fixed 45-minute segmented class schedule. For example, *Civilization* takes several hours to learn and 10–20 hours to play, and could not be completed in the time span of several classes in school. This is in contrast to instructional systems geared around books, focused on taking a chapter of a book for each class period, working through it, and then doing the next chapter in the next day's class.

In addition, teachers have not been trained on integrating modern games and game features into their curricula, nor how to coordinate between virtual and real activities. Learners need to be able to move seamlessly among game scenarios, web-based and print resources related to concepts in the game scenarios, and on-line and classroom discussion groups employing these scenarios.

With much riding on the high-stakes testing associated with NCLB and state education standards, preparation for meeting these standards is the main focus of teaching. The school day is already 100 percent accountable, so there is little room for innovation or experimenting with new forms of instruction.

ASSESSING WHAT STUDENTS LEARN FROM EDUCATIONAL GAMES

Developing effective methods to measure and assess what students learn from educational games and simulations is a key challenge.

Educational games and simulations may be especially effective in developing higher-order skills — such as strategic thinking, interpretative analysis, problem solving, and decision-making. For example, in games, players are making decisions continually, in contrast to low levels of decision-making in traditional learning. Educational games and simulations may also be effective in developing complex aspects of expertise, not simply short-term memory of facts.

These higher-order knowledge and skills are typically not revealed by tests of facts, or standards of learning-types of examinations. Instead of concrete measures of learning outcomes, what is available is typically strong anecdotal evidence — kids that participate in game- and simulation-like learning are very excited, they're motivated, they're immersed, and they seem to do better. In addition, games and simulations tend to blur the line between education and training, as they involve learning-by-doing. For example, decision-making may be best assessed in a test of its practical use.

If assessments are not measuring the right skills and knowledge — the higher-order skills that games may be able to develop — then the use of educational games and simulations may be viewed as having poor efficacy. In reality, the

"If you look at the innovations that have crashed and burned over the years, one of the surest paths to failure is to exclude the teacher. And one of the things teachers hate more than anything is if the kids are doing something that's opaque to the teachers…That doesn't necessarily mean the teacher has got to be in there playing, but there's got to be a way the teacher can look inside or get reports, or keep track of what the kids are doing."

Midian Kurland, Vice President, Technology and Development, Scholastic

"I think much of what we're talking about here hinges on teachers, and if teachers aren't part of the conversation, if professional development isn't an important part of all of this, I think it's going to be a very difficult sell in PreK-12."

Barbara Olds, Education and Human Resources Directorate, National Science Foundation

"We know that employers are demanding higher-order thinking and problem solving. They want workers who are self-directed, who can work independently, who can prioritize and multi-task…We need significant improvements in the performance of the learning enterprise at every level from K to gray. Change has to go beyond revving up reading, math, and science education."

Deborah Wince-Smith, President, Council on Competitiveness

"The video game console machine is the highest powered, highest durability, lowest price, lowest maintenance super computer in the world today. You don't need a tech op. You just put in a disk, it works. Fifty to a hundred million of these are going to wind-up in the landfill in the next few years. And my belief is that they're ideal for the classrooms."

Lorne Lanning, OddWorld

assessment is designed to measure something other than what the game is designed to teach.

In addition, games like *Civilization* involve a rich chemistry of components or "mechanics"; they do not involve a standard play path, so the game never unfolds the same way twice. Thus, what is learned, what skills are used, and outcomes could be different every time the game is played. This creates a challenge for assessment, when the skills used and game outcomes are different each time the game is played, or different with each player based on his or her choices.

The difficulty in assessing higher-order skills, or what has been learned in a game or simulation, presents a barrier to their introduction to the classroom. In the absence of measures, teachers may have little concrete in the way of measured outcomes to point to when they are held accountable for their instructional time, and meeting the state and national education standards. Nevertheless, educational and training institutions need to respond to employers' increasing demands for workers with higher-order thinking and doing skills.

ACCESS TO AND INTEGRATION OF TECHNOLOGY FOR LEARNING

Information technology should be an integral part of the classroom experience. However, in some schools, access to computers in the classroom — both the number of computers available and the time students are given to use them — is too small to play a mainstream role in learning.

Meaningful use of learning games and simulations will require an adequate number of up-to-date classroom-based computing resources, and a willingness on the part of teachers to use it routinely in their teaching. This includes addressing digital divide concerns and providing low-cost delivery options and interfaces to support learners with diverse linguistic abilities and those with disabilities. In addition, different virtual structures will be needed to support the very young in pre-K, primary and secondary learners, as well as adult learners.

In addition to using desktop, laptop, and notebook computers for learning, today's video game console is the highest powered, most durable, lowest cost, lowest maintenance, and easiest to use supercomputer in the world today. As new generations of these consoles enter the marketplace, millions of the previous generation game consoles are headed for the landfill and, instead, could be put to use in classrooms and other learning environments.

PROVING THAT EDUCATIONAL GAMES ARE EFFECTIVE TO ENCOURAGE USE

There are few reports of clear and unequivocal outcomes for using educational games, an absence of information that might encourage educators to try new and unconventional approaches to instruction. And, there is also an absence of exemplar products that could demonstrate benefits that would encourage educational institutions to adopt them.

This creates a "chicken and egg" dilemma. When schools cannot or will not use unproven educational innovations, there may be no population of students using

the innovation to test its efficacy. And without data to prove efficacy, the technology or innovation is unlikely to be adopted.

In addition to discouraging adoption, this dilemma inhibits industry in making a large investment in developing and commercializing innovations, such as educational games, because it creates uncertainty about the level and timing of returns on investment. Many potential developers of games and simulations for learning may not have the financial resources or influence in school systems to conduct large-scale evaluations of their products.

The federal government has placed strong emphasis on using science-based methods for evaluating instructional approaches, technologies, and materials supported by federal funds. It has turned to large-scale field tests for evaluating federally supported education programs and interventions to ensure they improve achievement. The federal government's approach is premised on the belief that pedagogy and other methods of instruction should be proven using a rigorous scientific standard of evaluation involving systematic methods, statistical soundness, transparency, and peer review.

The federal evaluations require large samples (such as 40 schools or 200 classrooms), and both experimental and controls groups (different groups of students and teachers using different curricula or practices). The federal government believes that nothing else can identify the "true" effects of a program or policy; before-after comparisons do not identify what would have happened in the absence of the intervention.

The federal government is conducting evaluations of 16 educational technology-based products in regular classrooms. These products — focused on reading and mathematics — are being tested in 34 school districts, involving 132 schools and 439 teachers. The studies are focused on outcomes such as reading test scores, math test scores, student attendance, promotion to the next grade, as well as more subjective indicators such as how teachers responded, the adequacy of vendor training and support, and classroom observations. These results are due to be published in 2006.[29]

More evaluation data from trials of educational games and simulations are needed, especially for K-12, to provide proof that these technologies are equal to or better than more conventional instructional methods. Summit participants recommended that such evaluations take place in: public schools; in big school districts where there is high visibility; in high- and low-performing schools; and where the education community faces challenges, for example, where there is an influx of non-native English speakers. Summit participants believed an adequate number of students to participate in evaluations could be found.

Some schools may be more inclined to serve as test beds for educational games and simulations. These include virtual schools that already use Internet delivery for instruction, or schools that have demonstrated that they are adopters of

"In terms of embracing games, who teaches the teacher? The teacher is the one that's going to have to figure out, 'how does that match the standards that I'm going to be held accountable for, and how can I control the fidelity to make sure that my students are actually learning something that's actually real, and that can be measured?' Clear reports, clear and unequivocal outcomes...How do you measure high order skills? I mean you don't ask them a question of what is two plus two and demonstrate that subjective knowledge."

Don Blake, Senior Technologist, National Education Association

"Accountability and testing related to No Child Left Behind is really sort of limiting what is measured. What is easiest to measure is often what is predominantly measured. There are a number of efforts underway to broaden the skills that we're seeking to teach to our students. So for a lot of the advanced skills and knowledge that educational games would bring forward to be appreciated, especially at the elementary and secondary level, it will take a change in what we're assessing."

Mark Schneiderman, Software and Information Industry Association

[29] www.ed.gov/rschstat/eval/resources/studyplans.html

innovative practices. For example, in K-12, there are now about 20,000 students participating in virtual schools.

To respond to *No Child Left Behind* and state education standards, these evaluations should focus specifically on proving that educational games can positively affect test scores across a spectrum of subject matter. Teachers and administrators cannot ignore higher test scores, and the personal rewards of improving test scores in their schools may overcome negative attitudes toward games.

It is important to note that evaluations could find considerably different outcomes — derived from the same technology-based intervention — due to differences in how the technology was implemented. Evaluations should consider how instructional practices, teacher preparation, school environment, and other factors have affected outcomes.

Another evaluation challenge is the rapid advancement of gaming and simulation technology, the rapidly growing technical sophistication of young people, and the time it takes to perform studies of learning efficacy. If evaluations cannot keep pace with the rate of technical change and the growth of students' technical skills, by the time the studies are completed, their findings may already be obsolete.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Educational institutions need to transform their organizational systems and instructional practices to take greater advantage of new technology, including educational games.

Recommendations:

- Education institutions should undertake a "transformation" process involving the adoption of new technology, new management methods, process redesign, and new models of organization.
- The U.S. Department of Education or the National Science Foundation should identify lessons already learned in applying learning game technologies, for example in the U.S. military, or among first responders, for transfer to formal education such as K-12.
- Advocates for educational games should promote the use of these innovations to taxpayers, parents, and employers since they increasingly will hold schools accountable for the expenditure of public resources.

Educational games are fundamentally different than the prevalent instructional paradigm. They are based on challenge, reward, learning through doing and guided discovery, in contrast to the "tell and test" methods of traditional instruction. In addition, some types of games — such as complex civilization building games — are not compatible with the typical 45-minute class length. The use of educational games must be integrated with other classroom activities and materials such as web-based and print resources, and on-line and classroom discussion groups.

"We were targeting seven- to nine-year-olds, last year. They said you can only use the left mouse button...We have validated that kids seven to nine can only understand a single mouse click. And I said how old is that study? And they said five years old. They had done a thorough study, and it showed seven-year-olds couldn't do double clicks, seven-year-olds couldn't understand doing both mouse buttons. So I began asking around. Most three-year-olds in fairly high tech households can do those things...They're already teaching themselves using this technology. They're not waiting for us, so we're going to have to get caught up. And this is a problem, because they're not learning in 18 months, or 36 months, or five years. And as we said, we cannot get things done unless it's validated. You can't sell it unless it's proven. To do that study takes longer than the OODA (Observe, Orient, Decide, and Act) loop of the people we are targeting, so we have a fundamental problem here. And we can't solve it by making tweaks and changes."

Doug Whatley, CEO, BreakAway Games

"The key issues of quality and accountability are still there, the idea that you have to clearly articulate the outcome of that experience, of that game, and the standards to which they map."

Don Blake, Senior Technologist, National Education Association

Recommendations:

- Schools should redesign their instructional practices and formal learning environments to take advantage of the technology-enabled exploration, interactivity, and collaboration encouraged by educational games and simulations. For example, educators should rethink the fixed 45-minute segmented class schedule to accommodate student use of educational games. However, until changes are made to the schedule, learning games must be designed with the current schedule in mind.
- Schools of education should engage the learning games community to develop new and revamp old pedagogy to take advantage of these new educational tools.

Teachers should be trained to support game-based learning. This includes training teachers on how to best coordinate between virtual and real world learning activities.

Recommendation:

- Schools of education, and teacher professional development providers should create new training materials and make developing skills to support game-based learning an integral part of new and incumbent teacher training.

Many video games require players to master skills in demand by today's employers. National initiatives, such as the Secretary of Labor's Commission on Achieving Necessary Skills (SCANS) and the Partnership for 21st Century Skills, have identified many of these skills. Unfortunately, today's testing programs fail to assess these types of skills, although many employers agree that these are skills they look for in employees.

Recommendations:

- The U.S. Departments of Education and Labor should work with groups representing employers to form consensus on specific higher order skills employers deem a priority, and work to translate these skills into curriculum standards and student assessments.
- Research groups should work with the education and business communities to develop improved measures of the sophisticated skills developed through game-based learning.

Information technology should be an integral part of the classroom experience. However, in some schools, access to computers in the classroom is too small to play a mainstream role in learning.

Recommendations:

- Schools should make available an adequate number of up-to-date classroom-based computing resources to integrate educational games into student learning. Teachers should use these computing resources as a mainstream teaching tool.

"What struck me more than anything is, not the use of computers and software in that environment, but the way that having that and having all the staff development that went with it, had really invigorated project-based and inquiry-driven curriculum in the State of Maine."

Midian Kurland, Vice President, Technology and Development, Scholastic

"I do think you need to find the incentives. Change is brought about by incentives. That's what public policy is all about, incentives that get people to do things they normally wouldn't do, and to reward them when they do things the way you want them to. Well, what are the incentives you offer in terms of performance for faculty, students, and systems?"

Eugene Hickok, Advisor, DutkoWorldwide, former Deputy Secretary of Education

- Schools should give students greater access to computers while in school to take advantage of the learning opportunities afforded by educational games.
- Schools and other education venues such as community centers should explore the use of video game consoles — high-powered, durable, low cost, low maintenance computing devices — for learning applications. This includes game consoles discarded because they have been replaced by a new generation of technology.

Outcome data from large-scale evaluations of educational games are needed to demonstrate that these technologies are equal to or better than more conventional instruction methods. These data are needed to encourage schools to adopt educational games, especially K-12 schools that are focused on meeting education standards. A stronger market for educational games would, in turn, encourage private sector investment in the development and commercialization of games for learning.

Recommendations:

- Of R&D dollars available for investment in educational technologies, some should be used to fund field studies to test whether or not learning game innovations improve educational outcomes.
- Given the emphasis on test scores associated with state standards of learning and the *No Child Left Behind* Act, researchers and educational game developers should focus on proving they can positively affect test scores across a spectrum of subject matter. Universities should participate with school districts in these studies to ensure: studies are well designed, appropriate data collected and analyzed, and results presented credibly so other districts and schools can use these studies to justify adopting innovations in their own systems. Researchers should convey information about their findings in the language and concepts of those they must convince — teachers, education administrators, and policy-makers.
- Evaluations should consider how instructional practices, teacher preparation, school environment, and other factors have affected outcomes. In addition, when superior implementation practices are identified, those should be linked more formally to the technology intervention. Evaluations should also focus on why innovations failed, identifying lessons learned from the ways in which the failed innovations were implemented, any mismatches between products and the school system, and the effects of the school culture.

Appendix A: Meeting Agenda & Panelists

THE SUMMIT ON EDUCATIONAL GAMES

October 25, 2005

Federation of American Scientists

Marriott Metro Center
775 12th Street, NW, Washington, DC

7:30 **Continental Breakfast**

8:30 **Welcome**

Henry Kelly, President, Federation of American Scientists

Douglas Lowenstein, President
Entertainment Software Association

Donald Thompson, Acting Assistant Director of EHR
National Science Foundation

9:00 **Keynote Address: What Do Games Offer for Learning?**

Deborah Wince-Smith, President, Council on Competitiveness

9:30 **Panel on Games and Learning** *(Specific attributes of games attractive for applications in learning; areas of knowledge and skill development to which game features could be effectively applied.)*

David Dockterman, Vice President and Chief Academic Officer, Tom Snyder Productions

Jan Cannon-Bowers, University of Central Florida

Howard Phillips, Microsoft

10:45 **Break**

11:00 **Panel on Research and Development** *(Examination of games for a learning R&D roadmap and models for R&D performance)*

Mike Zyda, University of Southern California

Phoebe Cottingham, Commissioner, National Center for Educational Evaluation

Steve Ritter, Cognitive Scientist, Carnegie Learning

Barbara Olds, Division Director, National Science Foundation

Lorne Lanning, OddWorld

12:30 **Lunch**

1:00 **Panel on Demonstrations: Using Games for Education and Training**

Incident Commander, Breakway Games – **Doug Whatley**

Tactical Language Trainer, University of Southern California – **Hannes Vilhjalmsson**

Civilization 4, Firaxis – **Deborah Briggs**

Immune Attack, Federation of American Scientists – **Henry Kelly**

2:00 **Panels on Innovation: The Development, Commercialization, and Adoption of Games and Gaming Features in Learning:**

Innovation Panel 1: **Why is product and service innovation stalled in education and training markets?**

Midian Kurland, Vice President, Technology and Development, Scholastic

Douglas Whatley, CEO, BreakAway Games

Jeffery Briggs, Founder, President and CEO, Firaxis

Joe Irby, President, BestQuest

Lorne Lanning, OddWorld

3:45 **Break**

4:00 *Innovation Panel 2:* **Why is management, organizational, and learning process innovation stalled in education and training institutions?**

Eugene Hickok, former Deputy Secretary of Education

Brenda Sugrue, Vice President for Research, American Society for Training and Development

Don Blake, National Education Association

5:30 **Wrap-Up**

Appendix B: Participants List

SUMMIT ON EDUCATIONAL GAMES OCTOBER 25, 2005

Satoshi Amagai	Howard Hughes Medical Institute
Monica Amarelo	Federation of American Scientists
Tony Amato	Office of Naval Research
Jeff Aron	Federation of American Scientists
John Bailey	Department of Commerce
Ruzena Bajcsy	University of California, Berkeley
Sean Biggerstaff	Office of Secretary of Defense, DDR&E
Don Blake	National Education Association
Matt Bostrom	Mindshare Interactive Campaigns, LLC
Deborah Briggs	Firaxis
Jeffery Briggs	Firaxis
Judy Brown	University of Wisconsin – Madison
Marland Buckner	Microsoft
Merryl Burpoe	Council on Competitiveness
Adam Burrowbridge	Federation of American Scientists
Jan Cannon-Bowers	University of Central Florida
Shelley Canright	NASA
Ralph Chatham	Defense Advanced Research Projects Agency
Milton Chen	Lucas Foundation
John Cherniasvky	National Science Foundation
Alex Chisholm	ICE3
Phoebe Cottingham	National Center for Educational Evaluation
David Dockterman	Tom Snyder Productions
Mike Freeman	Advanced Distributed Learning
Jason Freeman	NASA
Garry Gaber	Escape Hatch Entertainment, LLC
Eitan Glinert	Federation of American Scientists
Larry Grossman	Digital Promise
Stefan Gunther	Federation of American Scientists
Robert Hickmott	Entertainment Software Association
Eugene Hickok	DutkoWorldwide
Loring Holden	Brown University
Kay Howell	Federation of American Scientists
Joe Irby	BestQuest
Carol Jackson	Maryland Public Television
Surya Jayaweera	WolfeTech
Susan Jenson	National Endowment for the Humanities

Rick Kelsey	Institute of Urban Game Design
Henry Kelly	Federation of American Scientists
Tom Kowalczk	KMRM, LLC
Paul Kozemchak	Defense Advanced Research Projects Agency
Midian Kurland	Scholastic
Lorne Lanning	OddWorld
Linda Lannon	CTB/McGraw-Hill
Daniel Laughlin	NASA GEST UMBC
Gail Porter Long	Maryland Public Television
Cynthia Long	National Education Association
Michael Long	ORC Macro
Doug Lowenstein	Entertainment Software Association
Merrilea Mayo	National Academy of Sciences
Carol Ann Meares	Federation of American Scientists
Alfred Moye	Hewlett-Packard Company
Anne Murphy	Digital Promise
Lisa Nayman	NASA
Barbara Olds	National Science Foundation
Lucien Parsons	Breakaway, Ltd
Ray Perez	Office of Naval Research
Marc Prensky	Digital Natives
Robert Raben	The Raben Group
Joyce Ray	Institute of Museum and Library Services
Dave Rejeski	Woodrow Wilson Policy Center
Jason Rhody	National Endowment for the Humanities
Steve Ritter	Carnegie Learning
Michelle Roper	Federation of American Scientists
Ben Sawyer	Digital Mill
Bror Saxberg	K12
Mark Schleicher	Federation of American Scientists
Mark Schneiderman	Software and Information Industry Association
Russ Shilling	Office of Naval Research
Alicia Smith	The Smith-Free Group
Brenda Sugrue	American Society for Training and Development
Elizabeth Z. Sweedyk	Harvey Mudd College
Suzy Tichenor	Council on Competitiveness
Donald Thompson	National Science Foundation
Hannes Vilhjalmsson	University of Southern California
Mark Weiss	Office of Science & Technology Policy, Executive Office of the President
Douglas Whatley	BreakAway Games
Deborah Wince-Smith	Council on Competitiveness
Jeff Woodbury	Entertainment Software Association
Mike Zyda	University of Southern California

The Summit on Educational Games was funded in part by the National Science Foundation under award #REC-0428259.

Federation of American Scientists
1717 K Street, NW, Suite 209, Washington, DC 20036
www.fas.org