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"STEM in Action: Inspiring the Science and Engineering Workforce of Tomorrow"

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Introduction

Chairman Hall, Ranking Member Johnson, and distinguished members of the Committee, I am grateful for the opportunity to testify at this hearing. My name is Michael D. Gallagher, and I am the President and CEO of the Entertainment Software Association (ESA). ESA is the U.S. trade association in service to companies that publish computer and video games for video game consoles, personal computers, the Internet, and mobile phones. The members and staff at ESA appreciate your continued focus on the limitless value of technology in education, and its importance to the American workforce, both today and in the future, and we are grateful to be part of this conversation.

If this country is to thrive in the coming years of the 21st Century and beyond, our nation's children must regain their position as elite students of science, technology, engineering, and math. Those four subjects, known collectively as STEM, are the key to unlocking a future of American prosperity.

Over the past several years, ESA and the video game industry have undertaken several initiatives in an attempt to play a catalytic positive role in engaging children in core STEM subjects. These initiatives, designed to tap into our industry's culture of innovation and children's enthusiasm toward video games, involve wide-ranging public-private partnerships. The initiatives that ESA and its partners have undertaken will hopefully be impactful on a larger scale in terms of engaging American schoolchildren on STEM. While these initiatives are in their infancy and their effect cannot yet be fully measured, three things can be sure about the initiatives: first, research from organizations like the Federation of American Scientists, National Science Foundation and the Joan Ganz Cooney Cetner at Sesame Workshop have highlighted the enormous potential of computer and video games to foster highly engaged, effective learning and motivation for STEM; second the use of games and game-making for education is being greeted by children with tremendous enthusiasm as you will see in the video footage that will be part my testimony and third, all of the ESA STEM video game partnerships have collectively cost the American taxpayers a total of zero dollars.

The various roles of ESA and the entertainment software industry in these initiatives—either as a convener, a financial supporter, or a project manager—are roles that we are honored to play. As the House Committee on Science, Space, and Technology is demonstrating by virtue of this hearing, government at all levels can enlist the further support of private sector experts and examples to improve America's educational performance by drawing attention to initiatives like these.

STEM as the Foundation of the Entertainment Software Industry

The video game industry has a keen understanding of the importance of STEM. We are an innovative and dynamic $25 billion industry that is based almost entirely on STEM.

This is a rapidly expanding nationwide industry that grew 120% over the past 5 years and employs over 120,000 Americans, including engineers, animators, graphic designers, musicians, and writers, who earn an average salary of $90,000. These high tech, high-paying video game jobs are at the forefront of 21st Century, creative "next" economy, and are a real-world manifestation of the importance of quality STEM and arts education programs.

While the Entertainment Software Association represents video game publishers with worldwide large scale presence, it also includes smaller, American video game companies like 38 Studios of Providence, Rhode Island and Her Interactive in Bellevue, Washington. Many companies in our industry started as the idea of a single entrepreneur, then grew into small businesses before blossoming into successful enterprises. One such company, Epic Games, headquartered in Cary, NC, has grown from humble roots into a multinational entity with its own video game engine technology that is used throughout the industry.

American colleges and universities are swiftly realizing that our industry is where the jobs are. Currently, 343 U.S. trade schools, colleges and universities offer courses in video game design and development, including 43 university graduate programs. Mister Chairman and Madam Ranking Member, Texas alone is home to 24 such programs, including prominent programs at your alma maters, Southern Methodist University. Speaking of the Lone Star State, Texas is quickly becoming a major center for high-paying, high-tech video game industry jobs. Thanks to a competitive state tax incentive and the leadership of Governor Perry, Texas recently leapfrogged Washington to become the number two state in the country for video game jobs, adding 1,700 positions in a fourteen month period alone (from April 2009 to August 2010).

Though our industry is strongly represented in places like Austin, Silicon Valley, Seattle, and Los Angeles, we are a nationwide industry with employees in more than 30 states. As the explosion of casual games and online app sales has shown, no single geographic area has a monopoly on creativity; anyone with an idea, a broadband connection, and programming skills can bring the world the next *Angry Birds*. But again, none of these economic growth opportunities are possible without a solid and broadly-based STEM foundation.

Presidential Acknowledgement of the Importance of STEM

In order for Americans to access such high-tech, high paying careers, they need the proper skill sets for these opportunities. The fundamental necessity of STEM education has not gone unnoticed by the White House's two most recent occupants.

In 2007, President George W. Bush noted that "(w)e want to make sure we strengthen math and science, because we can't be a competitive nation without more scientists and more mathematicians. Because in order for us to make sure the best jobs are in America requires us having mathematicians and scientists and engineers and physicists."

Similarly, in September of last year, President Obama announced his initiative aimed at stimulating the private sector's recruitment of 10,000 STEM teachers over the next two years,

when he stated that "(s)trengthening STEM education is vital to preparing our students to compete in the 21st century economy and we need to recruit and train math and science teachers to support our nation's students."

This past April, President Obama spoke again about STEM's importance at Facebook's Palo Alto headquarters, emphasizing that STEM education — especially to girls and minority students — is one of the most important investments the U.S. can make if it hopes to produce college- and career-ready students.

The Educational Power of Video Games

Although there is general agreement that STEM education is a key to rekindling America's global economic competitiveness, we nevertheless face a critical STEM skills shortage. The current unemployment crisis is not simply a jobs problem, it is a skills problem, and it is our nation's challenge to train people to qualify for the high-skilled positions necessary to compete and thrive in the global economy. According to the Bureau of Labor Statistics, the August 2011 unemployment rate for those with bachelor's degrees or higher was 4.3%. For those that were just high school graduates, it was 9.6%. To give one example in our industry, Microsoft recently reported that it has 4,551 unfilled job openings, more than half of which are for computer science positions.

The United States must educate and develop its own supply of talent for the 21st century ideas-based economy, and STEM is essential to filling the workforce of the future. However, education experts tell us that children increasingly lose interest in core STEM subjects because students do not find these subjects engaging, and they don't see the relevance of STEM to their lives.

Since video games enjoy such high nationwide levels of adoption and enjoyment, they can be important educational tools to help bridge the current STEM gap. They are ubiquitous in children's lives—46 million children between 5 and 17 years old are currently gamers, according to The NPD Group. As the Pew Trust and MacArthur Foundation recently found, "(f)ully 97% of teens ages 12-17 play computer, web, portable, or console games."
http://www.macfound.org/atf/cf/%7BB0386CE3-8B29-4162-8098-E466FB856794%7D/PEW_DML_REPORT_080916.PDF

Researchers and educators are increasingly arriving at the conclusion that computer and video games are one of the most effective ways to reach America's children. "Digital technologies are helping us to re-imagine learning," stated Connie Yowell, MacArthur's Director of Education. "In the digital age, the learning environment is turned on its head — it's no longer just the dynamic of the student, the teacher and the curriculum. Today, kids learn and interact with others — even from around the world — every time they go online, or play a video game, or engage through a social networking site."
http://www.macfound.org/site/c.lkLXJ8MQKrH/b.6035061/k.43F1/Digital_Media__Learning_Co

mpetition.htm. MacArthur is currently funding a $50 million, 5 year digital media and learning initiative.

They help address many of the challenges confronting our current education system -- a lack of student engagement, for example. Educators want to take advantage of the enthusiasm of our children for gaming and many are using our technology as teaching devices. New programs that incorporate video games into traditional education engage students of all demographic groups and academic inclinations.

This approach makes intuitive sense: our economy is increasingly digital, and our education system should map to it. Video games promote the skills needed to effectively operate in a global economy – complex systems thinking, critical analysis, strategic planning, creativity, and collaboration. The workplaces of today are radically different from those of the 1950s; however, our classrooms are largely the same.

The key question is how to tap into the natural passion of youth for playing and making video games, and connect this passion to building a motivation for STEM and other core curriculum subjects and developing critical 21st century skills and job pathways. There is enormous power and potential in the medium. To fully realize this potential, we will need innovative public private partnerships, and I applaud the leadership of this committee in this regard.

There is great opportunity for highly engaged STEM learning not only in having students play well design game, but also in having them *make* them. As Alan Gershenfeld, founder of E-Line Media (one of ESA's STEM Challenge partners), points out, "(d)esigning a digital game requires one to think analytically and holistically about games as systems, to experiment and test out theories, to solve problems, to think critically, and to effectively create and collaborate with peers and mentors. These are all skills that will be needed in a twenty-first century where virtually every job will involve navigating a complex, ever- changing, digitally networked global landscape and where many of the future jobs have yet to be invented. Designing and developing video games is certainly a very complex process—and yet many kids can't wait to jump in and start."

There is an aspirational aspect to this discussion that must be considered, one that taps into the notion of which careers children aspire to undertake when they reach adulthood. If children see video game design as a "cool" and viable career path, and STEM as the foundation of that path, then these subjects will become more compelling and relevant to them. The space program (and children's fascination with astronauts) spawned two generations of aerospace engineers. We believe that video games can provide a similar role as a catalyst for future generations of members of the high-tech sector; a sector that represents a critical component of this country's path to economic growth.

In June 2009, the Joan Ganz Cooney Center at Sesame Workshop released a report, supported by the Robert Wood Johnson Foundation, titled *Game Changer: Investing in Digital Play to Advance Children's Learning and Health* which concluded that computer and video games provide "an important, untapped opportunity" to support learning, particularly when children and

adults play together. That same year, the Center launched its Innovation in Children's Digital Media prize program, providing incentives for university media labs as well as the entertainment software industry to develop research-based games that promote learning through digital media.

Games also use new technologies to incorporate principles crucial to human cognitive learning. University of Arizona education professor Dr. James Paul Gee recently concluded that video games intertwine instruction and demonstration, a more effective learning technique. In his book, *What Video Games Have to Teach Us About Learning and Literacy,* Gee points out that video games, unlike the U.S. Education system, are designed to effectively engage youth because video games are interactive, customized, and "pleasantly frustrating." http://newlearningonline.com/new-learning/chapter-9-learning-communities-at-work/james-gee-on-video-games-and-learning/ Therefore, video games are great assessment tools in learning; you don't advance or "level up" if you haven't internalized the appropriate knowledge. Moreover, students who design video games around core academic subjects like STEM, by becoming not just consumers but producers of educationally beneficial content, are more interested in pursuing careers in these fields, as LiveScience reported in its recent article "Video Game Design Program Boosts Interest in Science Careers". http://www.livescience.com/10197-video-game-design-program-boosts-interest-science-careers.html

The Information Technology & Innovation Foundation highlighted the educational benefits of game play in a 2010 report on the need to transform education in STEM subjects as a way of refueling the U.S. innovation economy. The report stated that "videogames are well structured to be learning experiences," because they provide players with significant feedback, feature embedded rewards systems, instant assessment, engage a variety of senses, allow a user to determine the pace of play, and encourage collaborative learning in instances of multi-user play.

Real World Examples

A recent example of an innovative approach to utilize video games in a learning environment, is the iCivics initiative, in which former Supreme Court Justice Sandra Day O'Connor collaborated with Georgetown University Law School and Arizona State University to develop an online, game-based learning platform to teach students about civics. First launched in 2009, iCivics now features five games about constitutional law and the branches of U.S. government, each of which also comes with suggested lesson plans that are tailored to meet state-specific learning standards. In 2011, the ESA Foundation awarded a grant to iCivics to develop its newest offering, an international relations focused, multiplayer game available on the iCivics website and Facebook.

An example of putting these beliefs into practice is Quest to Learn, a New York City public school grounded in principles of game design, the first of its kind. Chicago Quest, following the Quest to Learn model, just opened for the current school year. http://articles.chicagotribune.com/2011-03-29/news/ct-met-video-game-school-0330-20110329_1_video-game-elizabeth-purvis-charters Quest to Learn is the first public school in

the nation based on the principles of game design. http://www.360kid.com/blog/2010/01/salen-interview/ As the New York Times recently described the philosophy of Quest to Learn and Katie Salen, its founder, "building a game — even the kind of simple game a sixth grader might build — is equivalent to building a mini-world, a dynamic system governed by a set of rules, complete with challenges, obstacles and goals. At its best, game design can be an interdisciplinary exercise involving math, writing, art, computer programming, deductive reasoning and critical thinking skills." http://www.nytimes.com/2010/09/19/magazine/19video-t.html?pagewanted=1

As the generation that grew up with video games enters and assumes leadership positions in the work place, computer and video games are being increasingly used to conduct business. A growing number of major companies, from automobile manufacturers to beverage producers, employ video games to find and train employees and increase sales among their younger tech savvy customers. With the video game industry booming and its products gaining broader acceptance, the use of games in the work place is certain to expand in the years ahead. By the end of 2012, between 100 and 135 of global Fortune 500 companies will have adopted gaming for learning purposes, according to The Apply Group. One entertainment software company, Games2Train, has developed employee training games for American Express, Bank of America, IBM, JP Morgan Chase, Nokia and Pfizer. In addition, Canon uses a video game in which repairmen must drag and drop parts into the right spot on a copier to train technicians. IBM has also produced *Innov8*, a free, interactive game that teaches graduate students business and technology skills.

ESA STEM Initiatives

In collaboration with our partners the MacArthur Foundation, the Joan Ganz Cooney Center at Sesame Workshop, E-Line Ventures, AMD, and our ESA member company partners—Sony Computer Entertainment, Electronic Arts (EA), and Microsoft— ESA helped launch two STEM video game design challenges.

In 2010, ESA launched its first STEM competition, *Game Changer*, with MacArthur, Sony PlayStation, and Electronic Arts. ESA's effort is a component of MacArthur Foundation's $2 million annual Digital Media and Learning Competition, which "advances the most innovative approaches to learning through games, social networks and mobile devices." This competition challenged developers to create STEM-related learning content for two existing video game titles that were popular with children—Sony's PlayStation's *LittleBigPlanet* and EA's *Spore*.

The second STEM competition, the *National STEM Game Challenge*, was undertaken with founding partners Joan Ganz Cooney Center at Sesame Workshop, E-Line Media, the AMD Foundation, and Microsoft, along with outreach partners including the American Library Association, Boys & Girls Clubs of America, The International Game Developers Association, the American Association of School Librarians, and BrainPOP. The Challenge was launched in September 2010 by President Obama as part of the national "Educate to Innovate" campaign.

The President noted that "(o)ur success as a nation depends on strengthening America's role as the world's engine of discovery and innovation." The President added, "I applaud partners in the National STEM Video Game Challenge for lending their resources, expertise, and their enthusiasm to the task of strengthening America's leadership in the 21st century by improving education in science, technology, engineering and math."

The Challenge encourages the design of new video games that engage America's youth in STEM-related learning by targeting the participation of developers across three demographics: middle school youth, college game developers, and professional game designers. Last year, the youth segment of the contest attracted over 500 submissions from children all over the country, the winners of which are featured in the video shown during my live testimony. The second year of the Challenge will launch this Friday, September 16th as part of the Department of Education's Digital Promises initiative, which showcases the positive role that the federal government can play, at no cost to taxpayers, of incentivizing public-private partnerships to develop innovative approaches to vexing policy issues.

Each year during the video game industry's preeminent global computer and video game trade show—the E3 Expo—ESA organizes the annual Games and Learning Summit to promote a dialogue among industry leaders, educators, policy makers, and others on the growing role of video games in education, health, and economic development. This year's summit featured over 60 experts and spawned several public-private partnerships that, while currently in their nascent state, will hopefully prove to be as successful as the *Game Changer* and *STEM Video Game Challenge.*

Earlier this year, ESA funded and organized *The Atlantic's* "Technologies in Education Forum." The forum focused on "the new policies, technologies, and tools available to those working on the front lines to bolster American student learning and achievement, especially in the critically important STEM curricula." The audience of stakeholders learned what public policies are necessary to bring new technologies into classrooms, how educational video games are changing the way students learn, and how new technologies can be used to improve vital intellectual skills and prepare the near future American workforce to compete in an increasingly advanced global economy. The forum featured keynote speakers from Congress and the Administration and three panels covering the future of technology in education, the path to a new curriculum, and the long term benefits of increasing the role of technology in workforce development. The panelists included experts from the Federation of American Scientists, DARPA, the National Math and Science Initiative, among others.

Another notable example in the public-private partnership STEM realm, while not an ESA initiative, is the *Girlstart* program in Texas, which stems from the work of ESA STEM partner AMD, as well as Dell (in collaboration with the Texas Alliance for Minorities in Engineering and the Boys and Girls Clubs of America). The *Girlstart* initiative seeks to empower girls in science, technology, math and engineering by establishing after-school programs, camps and workshops where participants can hone skills used to create computer and video games and explore their interests in these and other STEM-related professions.

ESA Foundation's STEM-related Grants

The ESA Foundation (ESAF) is dedicated to supporting positive programs and opportunities that improve the lives of America's youth, and has raised over $11 million for a wide variety of worthy causes. The Foundation awarded a range of grants that further STEM education and exploration through video game technology. An ESAF grant in 2011 to Case Western Reserve University supported the Great Lakes Game Project Challenge through a partnership between Electrical Engineering and Computer Science Department and the Great Lakes Energy Institute at Case. Students will compete to create a video game focused on wind energy and sustainable energy generation.

The 2011 ESAF grant to a group called Edheads will fund the development of an online interactive engineering design experience centering on nanoparticles. Edheads will work with the Ohio State University Nanoscience and Engineering Center to create a video game that will blend engineering, human health and medicine, and critical thinking skills to appeal to girls ages 15-18 who are considering medical careers.

Several years ago, ESAF made a three-year commitment to the Federation of American Scientists (FAS) to support additional teacher training, improve game support materials, increase outreach activities and widen distribution and evaluation. FAS created Immune Attack, an educational video game that introduces basic concepts of human immunology to middle school, high school and entry-level college students. Designed as a supplemental learning tool, Immune Attack aims to familiarize students with molecular biology and cell biology concepts as they pertain to the battle between white blood cells and infectious agents. ESAF first supported distribution and development of materials as well as teacher trainings for the game in 2007.

ESAF awarded a grant to the World Wide Workshop Foundation in 2011 to expand the integration of the *Globaloria Platform* in low-income rural counties in West Virginia. Globaloria is an online social learning network for designing and constructing web-games, which includes programmable wikis and blogs, game programming tutorials, content resources and a self-paced curriculum. *Globaloria* "seeks to transform education by merging technical and computational skills into a rigorous academic curriculum."
http://www.worldwideworkshop.org/programs/globaloria/globaloria-in-wv

ESAF looks forward to announcing new grant winners for similar projects in the next month.

Conclusion

STEM education is critically important to our economic success as a nation. To better engage youth in learning opportunities around STEM skills and processes, we must reach children on their own turf. The entertainment software industry is playing a critical role in helping to address America's STEM skills crisis by leveraging the creativity of our industry to showcase the benefits

of STEM education. Video games offer a unique way to captivate the imagination of students with STEM by tying these subjects to familiar activities which they enjoy. Video games provide a powerful environment for STEM learning by letting players interact with and even design a story, rather than passively consume it. In other words, America needs to build a future workforce of not just consumers, but creators.

As I noted above, visionary educators are increasingly recognizing the positive impact of entertainment software and utilizing games as a teaching device in a growing number of classrooms, especially in the area of STEM. In doing so, they are embracing the cultural and technological shifts of the 21st century and expanding the use of a favorite leisure activity, computer and video games, into a critical and still-emerging educational resource.

As Michael Levine of the Joan Ganz Cooney Center at Sesame Workshop recently noted, "(t)he transition to a technology-rich education system that maps to the modern knowledge-based economy is happening. There is no putting the digital genie back into a bottle. It's our job – from game developers to the White House – to harness the creative power and potential of gaming to help schools engage and excite a new generation of technologically-savvy learners." We at ESA and in the entertainment software industry are honored to play a role in catalyzing this transition.