WaterLife: Serious Science Games

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Ask a student what they do after school and it is likely that they spend a significant amount of time playing games. Games are easy to find online, on consoles, laptops, portable gaming devices and mobile phones. Modern video and computer games offer challenge and adventure to a growing number of Americans, but the power of gaming is particularly relevant to today's K-12 students - the digital natives- who have grown up with interactive digital technologies. These students are not just technologically literate, they approach their lives differently as they integrate computers, Internet, texting, and mobile computing seamlessly into their lives.[1] Time spent using digital media by children aged 13-17 has now surpassed the time they spend watching television.[2]

The Pew Research Center reports that that ninety-seven percent of teens ages 12-17 play games. This includes 99% of the boys and 94% of the girls.[3] A Kaiser Family Foundation study found that 8-18 year-olds are spending between 0:33 and 1:33 each day on games, with 8-10 year-olds being the biggest game players. Students spend on average 50 minutes a day on homework, about the same amount that they spend on games.[4] Adults are players too with more than half of American adults age 18 and older play video games with the 18-29 year-old group playing at the highest rate, 81%.[5]

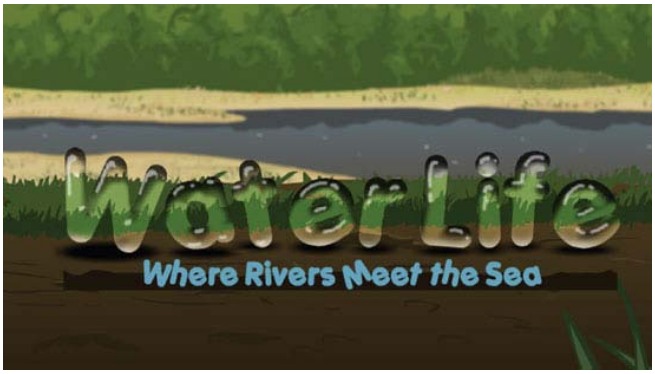
Numerous studies of American competitiveness in recent years have emphasized that America's position in the world depends on a skilled workforce and on leadership in technology. Skills such as strategic thinking, interpretive analysis, problem solving, collaboration, critical thinking, and adapting to rapid change are skills that U.S. employers increasingly seek in new workforce entrants. Educational games can be used to develop these critical skills[6] helping to address a pressing need in the United States, strengthening the education system and preparing young people for 21st century jobs. [1]

Instruction, rather than entertainment, is the purpose of educational games. They target learning outcomes and the achievement of learning goals.[1] Game designers use the principles of learning to impart knowledge that is used for successful game play and to keep the players coming back for new experiences. Some games are highly interactive and allow students to enter an environment that cannot be created in the classroom or at home.

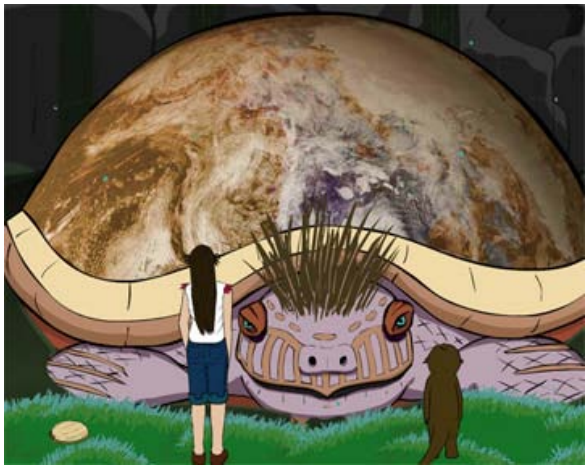
Media and gaming can play a role in providing engaging challenges to keep student interest in science. Ken Perlin, professor of computer science at New York University's Courant Institute of

Mathematical Sciences, reports that online games may be a tool to keep underserved groups interested in science. Underserved groups and girls are very engaged in science through the fifth grade but in middle school, things start to go wrong. He is looking in particular at at-risk ages of 10-13, especially at minorities and girls to repair the pipeline of science interest.[7] Tai and others published a report in *Science* that indicates we should not overlook life experiences before eighth grade and in elementary school. These may have an important impact on future career plans. The results suggest that to attract students in science and engineering, we should pay close attention to children's early exposure to science.[8] Educational games may be a way to provide a continuum of experiences in science and environmental issues.

One of the biggest obstacles for educational games is high development costs and an uncertain market for educational innovations. Developing and launching a new video or computer game can cost $10 million with future forecasts of $15-25 million.[1]



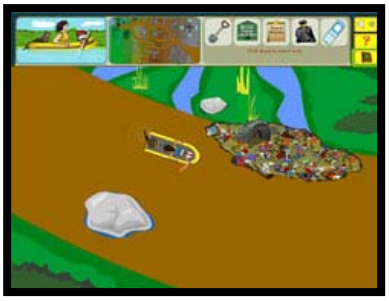
In order to overcome these barriers, NOAA's National Ocean Service partnered with the Computer and Simulation Program at Montgomery Community College. This collaboration has been working since fall of 2007 to develop the first in a series of educational games focused on improving environmental literacy. The students at the college are young, gaming talent that worked with content experts within NOAA to develop the storyline, virtual environments, and simulations for *WaterLife: Where Rivers Meet the Sea.* (http://games.noaa.gov/oscar/) The students were guided by Deborah Solomon, Program Coordinator of the Computer Gaming & Simulation Program, Marina Kraus, Peg Steffen and Atziri Ibanez from NOAA, along with science experts from the National Estuarine Research Reserve System. They received credit in class and pay for some of their time from NOAA and the Montgomery College Foundation.

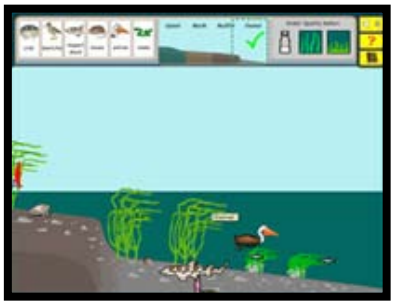


The new game leads students through a series of scenarios and experiences to understand basic estuarine ecology, threats to estuaries, and actions that students can take to become environmental stewards. Using endearing characters and animations, middle school students are drawn into an imaginary world where Valerie (human), Oscar (sea otter) and the Claminator (geoduck clam) work to save their estuary from many threats. They are helped with the wisdom of the Oracle (turtle) and a field guide which contains information necessary to accomplish four tasks.

The game takes place in Elkhorn Slough, a California estuary that is part of the National Estuarine Research Reserve System. Students are challenged to clean up trash in the estuary in the first task, demonstrating knowledge of basic recycling etiquette putting trash in the correct bins.

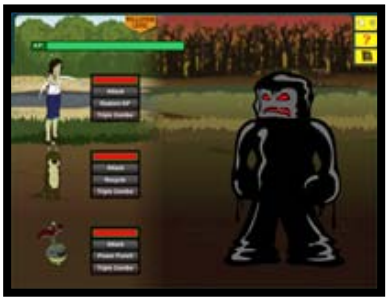
Task 2 requires nimble fingers as students drive through the waters of the estuary to clear waterways of storm debris and trash in order to allow the waters to flow in and out of the estuary. They also have the opportunity to free animals caught in marine debris and to call the authorities to remove toxic pollution.



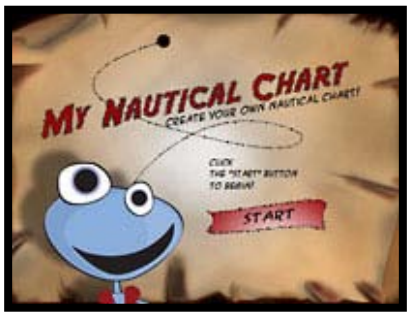


Task 3 requires knowledge about estuary tidal zones as students use their field guide to find out about the plants and animals that live in different areas of the estuary. A healthy food web with the correct plants and animals in the right places allows the student to move to task 4.

Sludge from old septic tanks, oil from motor boats, and run-off from agriculture, lawns, city streets, and parking lots congealed into the pollution monster which must be defeated in task 4 through a typical gaming technique. Knowledge power can be gained by answering questions and students can use the field guide for supporting information.



The game is accompanied by many resources for students, parents, and teachers and it is hoped that it will be the start of additional investigations. Of particular note is the *Estuaries 101* curriculum. Focusing on estuaries, the curriculum modules feature hands-on learning, experiments, field work and data explorations. The curriculum consists of four modules, Life Science, Earth Science & Physical Science each using estuaries as the context for developing content knowledge and skills relevant to that domain, and a Chesapeake Bay Module which integrates and deepens the focus on estuarine concepts in a local context. (http://estuaries.gov/)



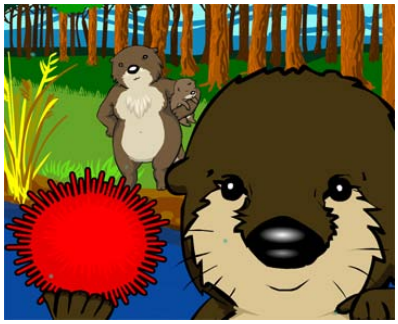
WaterLife will eventually grow to include a series of environmental games for middle school students and resides on the NOAA's new game website, http://games.noaa.gov/. This collection includes several interactive experiences for younger children, *Sea Floor Mapping* and *Nautical Charts*.

A future challenge for the *WaterLife* development team is to find an effective way to measure and assess what students learn from the game. Instead of concrete measures of learning, what is typically available from games is anecdotal evidence - students are excited, they are motivated, they are immersed, and they have new expertise not easily assessed in traditional methods.[1] Formative evaluations were done with students from middle schools to provide feedback on the character and story development along with the game play experience. More formal evaluation efforts will begin with focus groups of students and teachers in summer, 2009.

Partnerships like the one that has been forged between NOAA and Montgomery College can provide expanded educational game opportunities at a low cost and provide important experience to new game developers. The game industry is a high-growth $50 billion global industry that has opportunities for education and a technology-driven workforce. Proven work portfolios are critical to college programs and the game industry does not hire workforce candidates without demonstrable prior art.[9] Students in the NOAA/Montgomery College partnership found working with a federal science agency a valuable experience. NOAA requires rigorous science review and accuracy of content. The review process was new to the students, but provided a view of the restrictions that exist for game developers serving federal customers.

Educational games may have huge potential in reaching the 50 million pre-kindergarten through high school student population. They are fundamentally different from the prevalent instructional paradigm of "tell and test". Learning becomes personal and in context, and allows students to acquire new knowledge, skills, and transfer what they have learned to practical application.[10] Digital natives want learning experiences that parallel the exciting and engaging digital formats in which they routinely participate. Educational games may improve students' attitudes about learning even difficult subjects, including those who are not attracted to studying mathematics and science. Digital games for learning could be powerful tools to learn the skills to succeed in the new global economy[1] and to promote the knowledge and behaviors for future environmental stewards.

Play to Learn!



Resources:

[1]Summit on Educational Games, Federation of American Scientists, Oct. 2006, http://www.fas.org/gamesummit/

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

[3]Teens, Video Games and Civics, Pew Research Center, Sept. 2008 http://pewresearch.org/pubs/953/teens-video-games-and-civics

[4]Generation M: Media in the Lives of 8-18 Year olds, Kaiser Family Foundation, March, 2005. http://www.kff.org/entmedia/entmedia030905pkg.cfm

[5] Video Games: Adults are Players Too, A. Lenhart, S.Jones, A. Macgill, Pew Research Center, Dec. 2008, http://pewresearch.org/pubs/1048/video-games-adults-are-players-too

[6] Games helps students hone 21st-century skills, L.Devaney, eSchool News, June, 2008.

[7]Gaming Education, NSTA Reports, National Science Teachers Association, Dec. 2008

[8]Planning Early for Careers in Science, R. Tai, C.Liu, V. Maltese, X. Fan, Science, May 2006.

[9]Digital Games: A Technology Forecast, J.Brazell, N. Kim, H. Starbuck, Texas State Technical College, Feb. 2004. http://system.tstc.edu/forecasting/reports/dgames.asp

[10]Envisioning the Future of Education, Learning While Mobile, M. Van "T Hooft, *Learning and Leading with Technology*, Mar/Ap, 2008.