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Toward a Theory of Game-Media Literacy:
Playing and Building as Reading and Writing

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[1] This is a summary of a paper I presented on a panel with **Prof. James Paul Gee** (James.Gee@asu.edu) at the 2009 Annual Meeting of the American Education Research Association (AERA) in San Diego, Interactive Symposium of the SIG Applied Research in Virtual Environments for Learning. Jim Gee is professor at Arizona State University and a member of the National Academy of Education. His book *Sociolinguistics and Literacies* was one of the founding documents in the formation of New Literacy Studies, a field devoted to studying language, learning, and literacy. Professor Gee's most recent work deals with videogames, language, and learning; he shows how they can help us think about "good learning" and the reform of schools.

Dr. Idit Harel Caperton (idit@worldwideworkshop.org) is a Founder and President of World Wide Workshop Foundation in NYC. A learning scientist, an educational technology innovator, and a social entrepreneur, Idit won numerous awards for her work, including the AERA 1992 Outstanding Book Award for *Children Designers*, the Computerworld-Smithsonian Award (1999), the Internet industry coveted Global Information Infrastructure Award (1999), and the 21st-Century Achievement Award on the MaMaMedia Peace Project from the Computerworld Honors Program (2002). Idit serves on the Advisory Boards of PBSKids, CUNY, ATLAS at CU Boulder, TIG, MEET, and Saybot LLC, as well as on Overseeing Visiting Committees at Harvard and MIT. She is known for her visionary work at the MIT Media Lab in the 80s and for founding MaMaMedia.com in the 90s, a pioneering kids Internet brand using technology for creative learning, innovation, and globalization through constructionist learning. (Address: The World Wide Workshop Foundation, 110 Greene St. Suite 602, New York, NY 10012.)

Abstract

This paper compares and contrasts the varied ideas on game and learning and digital literacy for 21st -century education as theorized and practiced by James Paul Gee and Idit Harel Caperton and their colleagues. It summarizes the insights acquired in their session at the 2009 American Educational Research Association. With attention to the importance of games as means for learning, Harel Caperton expands upon Gee's theories by linking them more firmly to the learning sciences tradition (particularly those of the MIT Constructionists) and extending game media literacy to encompass "writing" (producing) as well as "reading" (playing) games. Harel Caperton claims that if game-playing is like reading and game-making is like writing, then we must introduce learners to both from a young age. Gee and Harel Caperton reveal a shared aim to encourage researchers and theorists, as well as funders and policy makers, to investigate the importance of gaming with regard to cognition. Their AERA panel was intended to be a field-building session and a step toward a larger conversation about the meaning and value of various game practices and literacies within the education system and beyond.

Game Literacy

In order to understand and define game literacy, we must first ask a few big questions: What is the significance of gaming practices for cognitive development and learning? How can games be leveraged as an important component of digital literacy development?

My colleague James Paul Gee and I collaborated at this year's annual meeting of the American Educational Research Association, offering two gaming-based theoretical frameworks for learning and digital literacy. Although we are known to approach these topics ("gaming and learning" and "game literacy") from different perspectives, we attempted to integrate our views regarding 21st-century learners and their preferred learning environments in an effort to arrive at the same focal point.

During the session, we discussed a variety of ideas with examples from our most recent work. We hoped to inspire researchers, practitioners, policy makers and funders to deepen their understanding of various game practices, involving 1) commercially-available videogames; 2) games that involve modding and design; 3) game-making systems like GameStar Mechanics, Game Maker, Scratch; and 4) widely-used professional software programming tools like Java or Flash ActionScript.

This AERA session was intended to be a field-building session—a step toward a much larger conversation about the meaning and value of various kinds of game practices and literacies. We sought to shed light on why today's students should become game-literate, and to demonstrate a variety of possible routes that lead to game literacy. We also discussed the role of utilizing games and creating game-media in the learning and cognitive development of today's generation of students and educators.

Multiple Traditions for Initiating and Interpreting Gaming Practices for Learning

Game literacy is a multidimensional combination of practices. Different gaming practices form a whole that has roots in both traditional literacy theories and Constructionist digital literacy. Though seemingly disparate, both traditions attempt to develop methods for describing how players/learners learn and how they construct knowledge in gaming contexts. Both traditions focus on the processes of learning rather than the product (winning the game or the actual game created by a learner/designer). Both traditions struggle with the difficulties of capturing the process of learning (an intersection of individual, context and activity over time

within a situated perspective) as a unit of analysis. Despite the challenges that persist in such a dynamic and distributed object of study, educators and researchers continue to explore and refine innovative methodological approaches that capture and track learning as it flourishes within the rich environments of various gaming practices so as to inform instructional practice and design (also known as design-based research).

Research into Playing Videogames

The fascination with and research on the cognitive and learning processes that occurs during videogame play is becoming increasingly prominent -- so much so, that a national conference dedicated entirely to this topic was launched by Dr. James Paul Gee in 2004 as a venue for scholarly discourse (Games, Learning and Society, GLS, www.glsconference.org). In this growing field of gaming research, scholars are addressing the nature of cognitive and emotional development, literacy practices, and thinking and learning during gameplay in a range of gaming environments and genres.[2] This line of research focuses on assessing different kinds of learning while playing games released commercially for entertainment (e.g., World of Warcraft, Grand Theft Auto, Zelda, Quake, Dance Dance Revolution, Guitar Hero, Rock Band), or edutainment games (e.g., Civilization, Quest Atlantis) in various contexts (mostly out of school, in homes, clubs and afterschool programs).

These scholars claim that videogame players *are* learning—they do not just click the mouse mindlessly or move around randomly. Indeed, players are found to engage in unlocking rich storylines, employing complex problem-solving strategies and mastering the underlying systems of any given game or level. Scholars are also documenting the richness of players' collaborative inquiry, the complexity of play patterns for exploring information and identities and the emergence of complex forms of learning and participation during gameplay. They assert that through playing videogames and participating in videogame worlds, players can develop understandings and dispositions that are difficult to achieve otherwise. It is critical to note that these researchers' key objective is to document and demonstrate that gaming can provide learning experiences, which are rich and difficult (perhaps impossible) to replicate in other circumstances or learning contexts--especially in school.

[2] Examples for scholarly work in this tradition: James Paul Gee, Kurt Squire, Sasha Barab, David Shaffer, and Constance Steinkuehler, among others. See references section of this paper.

Research into Modifying and Making Games

Simultaneously, a growing number of scholars in the learning sciences, digital media literacy and education fields have researched and/or developed innovative learning programs engaging students in various aspects of game modding and design.[3] They share the view that modding and designing game systems is *itself* essential to digital literacy, as well as to the formation of knowledge and brain development overall.

Some scholars in this group report results about learning environments and tools that utilize game-design platforms (e.g., GameStar Mechanics, Scratch, Game-Maker, or 3D-engines, Alice, and Maya); others focus on the learning value of modding that can be done within commercial games, by using toolkits that companies make for game players (such as those provided in Civilization or The Sims).

Research into Learning Game Making

The research about the learning value of game modding and design connects to Constructionism, a learning theory historically associated with Seymour Papert and his colleagues at the MIT Media Lab. Since the early 1980s, Constructionist learning theorists and practitioners have emphasized the epistemological value of "MIT-style" computational environments as tools for thinking and learning. These programmable environments have been designed to facilitate learning and self expression while tinkering with digital media, programming software, and building dynamic models, simulations, computer games, as well as other complex digital artifacts involving robotics. Researchers focused on figuring out how these tools were used as vehicles for driving all kinds of powerful learning and cognition.

My colleague John Seely Brown provides a closely related theory that also advocates the general learning principles of Constructionism. For the past 20 years, Brown has been focusing on the value of learning in communities of high-density computer cultures that resemble the ways MIT mathematicians, artists, musicians and engineers collaborate on complex design

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[3] Many examples of scholars in this group can be found in the 2009 AERA and GLS 5.0 programs: Kurt Squire, Elisabeth Hayes, Yasmin Kafai, Ivan Alex Games, Robert Torres, Sean Duncan, Kim Sheridan, Kevin Clark, Eric Zimmerman, Katie Salen, and Mary Flanagan, among others.

problems. In his speeches and essays, Brown frequently highlights the importance of learning through tinkering in a studio-like environment, and a "learning-to-be" approach (in contrast to "learning about") to role-taking that emerges from becoming a full participant in a learning community. Moreover, much like the MIT Constructionists (including Seymour Papert and myself), Brown is known for his examples of workshop-style settings, which reinforce the belief that significant global problems are likely to be systemic and can't be addressed by any one specialty. Therefore, students need to feel comfortable working in cross disciplinary teams that encompass multiple ways of knowing and learning.

In 2006, my team at the World Wide Workshop Foundation revitalized this Constructionist tradition through a social-entrepreneurship initiative called Globaloria**,** an innovative social network and a comprehensive learning program for learning how to create educational web-games and simulations.[4] With a focus on serving (and researching) those who are technologically-underserved and/or economically-underprivileged, the Globaloria networks engage both students and educators to simultaneously master social media technology and learn how to create original web-games with a socially-conscious and/or educational purpose. Breaking away from the MIT computational tradition (e.g., Logo, Mictroworlds, StarLogo, NetLogo, Scratch), the Globaloria network participants learn to program in popular, globally-employed languages such as Flash ActionScript and MediaWiki (in conjunction with other Google tools and Web2.0 applications) by using an open, yet structured and comprehensive curriculum.

Programming games on Globaloria.org (see Figure 1) also engages students in an interest-driven curriculum, allowing them to play games, but also to explore and develop their own games following their individual and situational interests. Students use computational programming tools and Web2.0 technology to generate a self-determined motivation for learning. As students engage their curiosity and imagination through teamwork on game construction, they also "learn-to-be," by taking full participation in a networked, software design-based learning community.

A complementary research agenda[5] has been under development for the past two years to study and assess the effectiveness of this MIT-inspired learning formula. We are beginning to

[4] See: www.WorldWideWorkshop.org and www.Globaloria.org.
[5] See: www.WorldWideWorkshop.org/Reports

observe results indicating the educational value of game making and its contribution to digital literacy and social, emotional and cognitive development especially among low-income students and educators (in both rural and urban communities). Globaloria is the largest effort to date to introduce game-media learning and literacy into public schools and public universities (see Figures 2, 3, 4 and 5).

Literacy and "Good Videogames"

James Paul Gee's ideas about the cognitive and learning processes that occur during videogame play are growing in prominence. In 2007, Gee published two books on this topic (*What Video Games Have to Teach Us About Learning and Literacy,* and *Good Video Games and Good Learning*). In both books, the central theme is that good videogames reflect good principles of learning in their design. Gee focuses on the learning and literacies that develop among players of popular videogames based on learning principles reflected in the game structure itself.

Gee emphasizes an important idea that all literacies must be addressed in relation to specific semiotic domains. He deals with videogames as one such semiotic domain, and explores the processes involved in becoming digitally literate therein. Gee refers to people who play the games as "affinity groups," who, in attaining literacy, are able to situate decoded language, images and other forms of representation within the domains in which they are put to use. Once literacy is established in this contextualized manner, the player is operating in a semiotic domain.[6] Furthermore, Gee formulates a number of key learning principles[7] that are intrinsic to the semiotic domain of videogames. I have selected five to highlight here:

- Principle 1: *Active, Critical Learning:* all aspects of the learning environment are set up to encourage active and critical, not passive, learning.
- Principle 2: *Design Principle:* Learning about and coming to appreciate design and design principles is core to the learning experience.

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[6] Semiotics is defined as the study of signs and symbols and how people construct meanings from those signs and symbols. There is the **signifier** (what the word/text/artifact is called, an arbitrary designation – book, film, game) and the **signified** (what it is interpreted to mean). The key is that once the signifier is made public (in a published videogame for instance), the writer/developer no longer has control over how it is received or understood by those who read/play/watch it.

[7] See Appendix of Gee's book *What Video Games Have to Teach Us About Learning and Literacy, 2007.*

- Principle 3: *Semiotic Principle:* Learning about and coming to appreciate inter-correlations within and across multiple sign systems as complex systems is core to the learning experience.
- Principle 4: *Semiotic Domains Principle:* Learning involves mastering (at some level) semiotic domains and being able to participate (at some level) in the affinity group or groups connected to them.
- Principle 5: *Metalevel Thinking about Semiotic Domains Principle:* Learning involves active and critical thinking about the relationships between the semiotic domain being learned and other semiotic domains.

These principles address important learning processes that have been built into games by their designers. The above principles (and 25 others listed in his book) suggest that there is an in-depth learning-processes at work while playing games. Indeed, game designers learn a great deal as they design game systems and in "good games" some of their learning and system-thinking is transferred to those who play their games.

In his writings, Gee emphasizes how, through good game design, people can leverage deeper learning as a form of pleasure in their everyday lives, without any explicit schooling. He argues that one way to deliver good learning in schools and workplaces would be via games or game-like technologies and calls for making students into full and productive partners in how we design any enterprise in which we use games for learning.

Gee also explores the value of playing games for learning about systems and understanding complex concepts and the way things work in the world. Furthermore, he investigates the potential value of using game engines for knowledge and skill assessment of students learning.

The Importance of Learning to Program Games to Game-Media Literacy Development

Despite Gee's important contributions (as well as those from the movement he has inspired), a deeper focus on the potential role of game building, designing and programming in cognition, learning and digital literacy development has been missing from the body of research on "good learning" while playing "good videogames."

The question I am posing to "gameplay researchers" (including Gee) is this: How can players' system-understanding and literacy in the semiotic domain of videogame playing

practices be complete without providing them with the opportunity to learn how videogames are *made* through engagement in the game production process?

At our AERA session I strongly suggested to Gee that game-playing is like "reading" and game-making is like "writing" in that they must be introduced to learners hand-in-hand from a young age. One learns to read better and more critically by learning creative writing and, conversely learns to write better and more creatively by reading and analyzing the symbolism in books and genres. It does a disservice to the aim of any literacy education (game literacy included) to overlook the mutually constitutive relationship between reading and writing.

Linking Game-Making Practices to Constructionism

In the 1980s and early 1990s, when videogames were still a burgeoning industry, my research focused on children's creation of instructional software games about mathematical concepts related to rational numbers and fractions. I found that the meta-cognitive process of representation while designing software games requires the designer to go beyond a mechanical interaction with an existing mathematical game and to develop ideas and knowledge in a symbolic form through programming. In my early research in this area, young students used a programming language to represent and teach fractions in a complex set of visual multimedia symbols by coding the design and interactivity in Logo. With my then graduate student, Yasmin Kafai, we found that engaging students in making instructional games to teach younger students about the subject material (vs. creating non-instructional games) cultivated deep epistemological thinking, providing them with opportunities for *learning how to learn*. It has been theorized (and subsequently proven) over decades of research that learners' conscious construction of representational and/or instructional computational artifacts, or a computational model as a technologically-mediated public entity, is highly effective in building knowledge and meaning for the learner and his/her peers. This has led to a wide-spread conclusion that the act of programming (even at a beginner level) is an essential element toward becoming digitally literate.[8]

[8] In the past three decades, Constructionist scholars (myself included) were often challenged regarding whether or not Cconstructionist learning must always include programming to qualify. Is video production considered Constructionist? Is building in Second Life without any programming knowledge, by simply combining prims and dropping in a pre-programmed scripts purchased from somewhere else considered Constructionist? Is using templated environments for building digital media artifacts considered Constructionist? My personal response is: Why not? I am not as pure as many of my colleagues. I believe in the power and value of representing knowledge through programming (as expressed in Globaloria) but I also believe in the value of media making for learning (as expressed in MaMaMedia). Constructionist learning comes in many forms – from Tinker toys, to Logo, to

In the mid 1990s, I took my vision to the Internet and launched MaMaMedia.com, an award-winning website for children. MaMaMedia Inc. was founded during Web1.0 or "old Internet era" and was a pioneer of the many participatory media-making-and-sharing principles we see now in the "new Internet era." In three years it reached over 50 million children, parents and teachers from 36 countries. At the end of the 20th century, in response to the need for all children to develop new learning skills and digital literacies for the coming millennium, I firmly linked the "3 Rs" of traditional education, Reading, wRiting, and aRithmetic, with the "3Xs": eXploring, eXpressing and eXchanging ideas of new digital media. I brought computational creativity and self-expression together with media technology via browsers to millions of children worldwide, driven by the belief that becoming digitally literate was about actively designing and realizing digital media and not just passively consuming it.

As the first decade of 21st century comes to a close, we stand at a pivotal moment in the advancement of videogames, web-games, and web technologies. The computational, social and collaborative principles inherent in the Constructionist framework can now be applied in the context of collaborative game–making projects online. Web2.0 tools allow for learners' conscious construction of a computational public entity to extend beyond face-to-face interactions and pre-internet desktop computers into the realm of global networks founded in collaboration and peer-production online.

Much like MaMaMedia, with the invention of Globaloria, Constructionism has influenced the design of program components that engage participants in experiential, project-based design, programming and collaborative experiences within high-density computer environments in the design-studio style. I hypothesize that the Globaloria activities of game design and programming, wiki-based teamwork and Web2.0 communication, collaboration, and project management are particularly powerful in cultivating *transferable* contemporary learning abilities and encouraging game-media digital literacies in participants.

The Six Contemporary Learning Abilities: A Theory-in-the-Making

The theoretical framework utilized by the World Wide Workshop Foundation to guide the Globaloria program's research is called the "Six Contemporary Learning Abilities with

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Mindstroms robotics, to Game Maker, to Flash. One thing is sure: all these tools and environments exist on the "writing side" of the literacy equation.

Technology" (6-CLAs). It is centered on connecting today's youth to computational thinking by making and playing games and thus becoming game-media literate. The World Wide Workshop Foundation believes that the six stipulated Constructionist game-media literacies and competencies are necessary for effective learning and working in today's technology-driven landscape and global workplace. The Six Contemporary Learning Abilities (6-CLAs) are:

- CLA-1) Invention, progression and completion of an original project idea (educational game or simulation)
- CLA-2) Project-based learning and project management (managing game production in wiki-based networked environment)
- CLA-3) Posting, publishing and distribution of digital media (game designs, video prototypes, graphics and design notes)
- CLA-4) Social-based learning, participation and exchange (sharing game ideas, process notes and code)
- CLA-5) Information-based learning and research (purposeful search and exploration related to game topics and programming)
- CLA-6) Surfing and analyzing websites and web applications (for game code and tips)

This framework is the first to propose integrating Constructionist literacy elements into the domain of gaming and applied digital literacy typologies. We hypothesize that game-making is key to developing the above core competencies. Moreover, by developing these competencies, students cultivate a variation of Constructionist digital literacy, which provides new opportunities for closing the digital-literacy gap between all types of learners and educators (the "haves:" digital natives, privileged suburban and urban youth, as well as the "have-nots:" low-income inner-city and rural children and adults).[9]

[9] In another AERA paper (with Rebecca Reynolds, 2009) we describe the 6-CLAs as an early-stage conceptual framework and we are currently forming goals to establish a criterion for success. Theories have two central properties: they must be falsifiable and have a sense of process (theories are scientific, and must be tested). The CLAs adhere to these theoretical properties in asserting our goal: *the mastery of the CLAs will lead to closing the digital literacy gap*, including the game literacy gap. Globaloria maintains a sense of process in its implementation, and the World Wide Workshop Foundation and its research affiliates are implementing and testing methods for assessing the success of Globaloria in cultivating Constructionist digital literacy.

Two Traditions and Two Bodies of Work: What's Next?

While Gee's theories on the key learning principles acquired through game-playing are well worth investigating further in different contexts, his privileging of game-playing orients his work toward "reading" and neglects the "writing" side of game media literacy development. In contrast, the Constructionist digital literacy framework, which highlights the importance of, and even *prioritizes*, learning game design and programming (especially within networked, transparent and collaborative wiki-based environments) underscores "writing" as an essential component for the development of a fuller game-media literacy, with attention to the Six Contemporary Learning Abilities (6-CLAs).

Despite relevant differences, Gee and I both stress the importance of the process of learning to learn while gaming (in both playing and designing) and we both encourage researchers to identify better methods for observing and tracking the emergence and evolution of concepts and artifacts that occur across extended time frames of game literacy development. Gee and I believe that a learner's understanding of any issue, concept, or system is facilitated and distributed across the network (Globaloria.org) or community (of a commercial videogame players) and that cognition is situated and distributed in both a gameplay and/or game-making activities. Therefore, capturing learning-in-the-making while playing/reading and/or designing/writing is necessary in order for this combined game media literacy theory to advance.

Similar to the interlaced relationship between learning reading systems and writing systems in print-media literacy, I argue that an integrated set of several game-media activities (including game-playing, game-modding and game-making) should occur in parallel in today's Web2.0 landscape both in and out of school.

There is also an urgent need (in the United States and worldwide) to cultivate the desire in youths to participate in computational and engineering thinking and learning of their own volition. Motivational initiatives are especially needed amongst girls and minorities. Designing and programming games and sims, or even modding games and sims, may very well be a useful gateway.

These broader, integrated conceptualizations by both Gee and myself suggest a new necessity for youths to play games of different genres for the sake of engaged learning and system-thinking. This necessity extends to the design and programming of games in different genres and on different topics in order to yield transferable outcomes and competencies essential

to effectively navigate today's technology-driven world. Collectively, our aim is to encourage researchers and theorists to investigate the importance of gaming with regard to cognition and advance the gaming and learning discourse generally. This goal will be achieved by addressing the key significance of both game-playing and student-centered game-production experiences in learning and in the successful acquisition of comprehensive game-media literacy.

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Appendix

Figure 1: Screen shots from the Globaloria.org Platform. It includes games to play and evaluate, in conjunction with a comprehensive game-making curriculum, tutorials and tools for forming an online design studio and communities of practice of Constructionist digital literacy.

Figure 2: Taking Gaming to School: Demonstrating the network effect of scaling the Globaloria gaming program innovation in West Virginia, over five years.

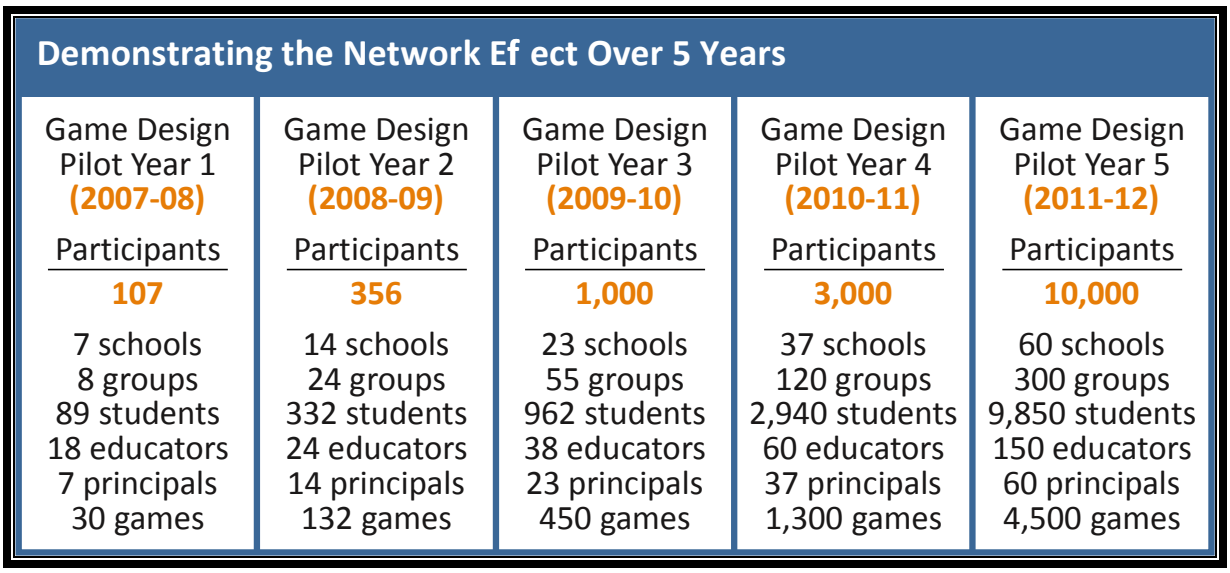
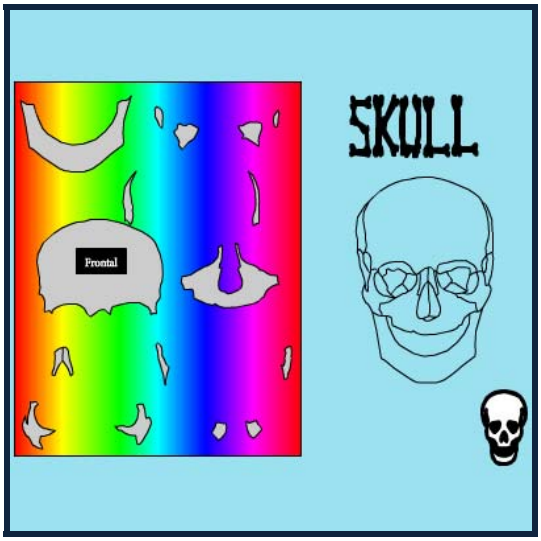
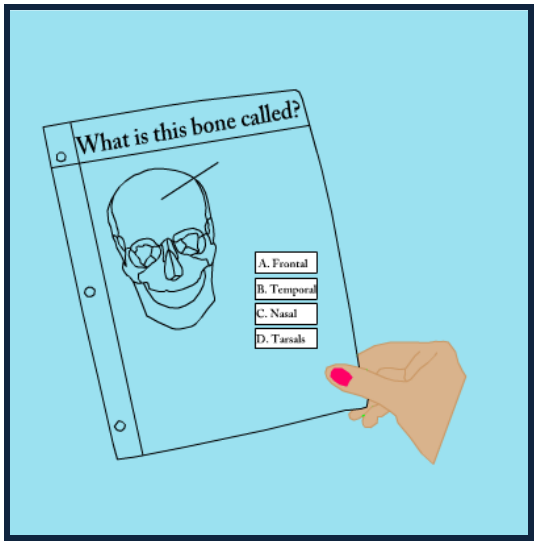


Figure 3: High school students learn science by programming the game "Learn the Bones."

Screen 1. Title screen (when game opens).The Cosmic Energy Team designed two options for the user: Play the game, or learn about the game and how it was made and who made it.



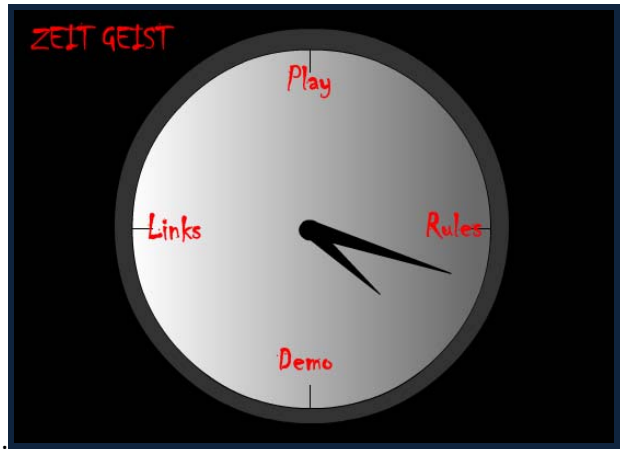
Screen 2. Skull Level. Rolling over the bones with the mouse reveals the scientific name of the bone. Clicking on the bone enables the player to drag it to the picture of the skull. Clicking on the skull graphic in corner enables the player to continue when finished.



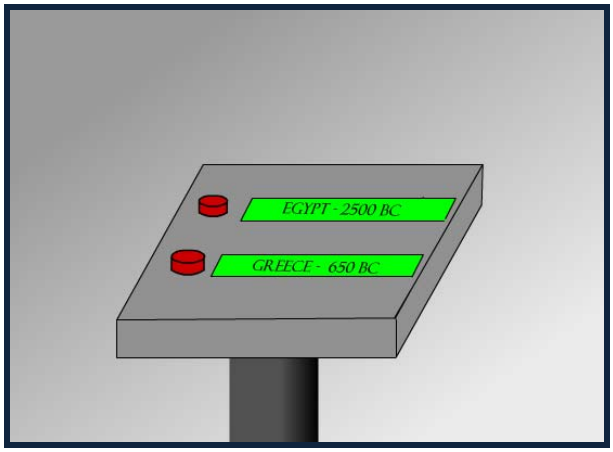
Screen 3. After the player completes correctly the drag-and-drop, they are asked questions related to that level. Right answers score 2 points, and wrong answers lose a point.

Screen 4. Arm-Hand Level: Similar interaction pattern as in Skull Level.

Figure 4: High school students learn history by programming an educational game "Zeit Geist".

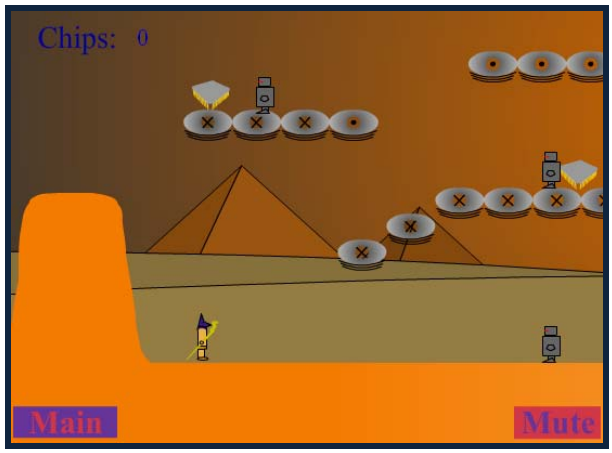


Screen 1. The opening title to the game gives players the options to see a demo, read the rules, look at links (related to the content of the game), or play the game



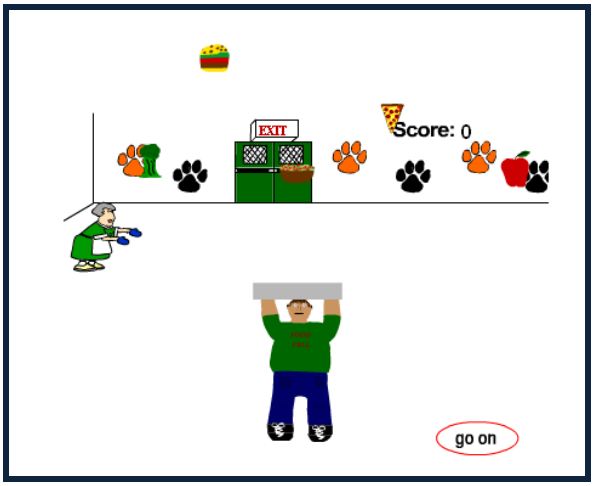
Screen 2. Zeit Geist Game's Menu. Player can choose which country and time period to enter (Egypt or Greece)

Screen 3. *A scene from the Greece level. The main character, the background scenes, as well as the music and sounds effects change depending on the nation and time period.*

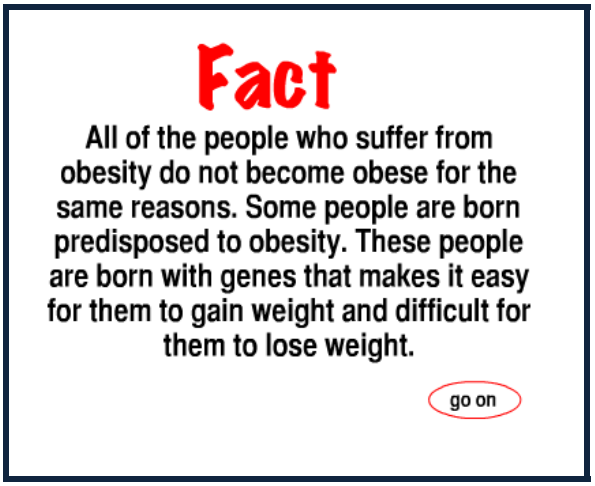


Screen 4. *A scene from the Egypt level. Player can see the Chips score (top left), and always select to go back to the main menu, or to mute the music and sound effects (at bottom left and right of screen).*

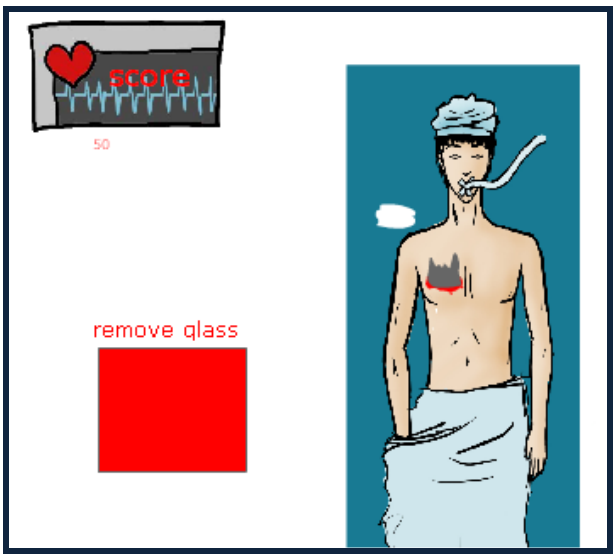
Figure 5: High school students learn about health issues by programming educational games



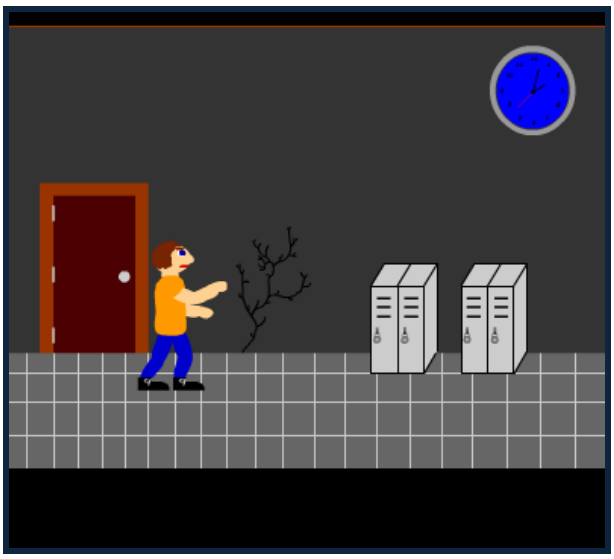
Screen 1. *Food Fall is a health game where players must control a character moving with a tray trying to catch healthy food and avoid the unhealthy food.*



Screen 2. *Between game levels, facts about obesity or healthy eating habits are presented. Research was conducted into the topic of obesity in our nation, and what would be a useful interface and play interaction for fostering healthier diet.*



Screen 3. *Emergency Surgeon is a health game where players select different medical tools and do surgery. This game includes a health bar and drag-and-drop interaction.*



Screen 4. *When Zombies Attack is a math game where players must solve sets of mathematical problems to defeat the zombies that have taken over the school. The game includes a timer and a scoring system.*

Figure 6. **The Globaloria Learning Formula: Game design studio-based learning for cultivating game-media literacy that included both reading and writing games.**