The Emergence of Six Contemporary Learning Abilities (6-CLAs) in Middle School, High School and Community College Students as they Design Web-Games and Use Project-based Social Media in Globaloria

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ABSTRACT

Understanding digital communication tools and putting them to work effectively— achieving digital literacy— is essential for success in the 21st Century. Globaloria is an innovative new program of learning (www.globaloria.org) that invites students and educators to master the tools of social media technology as they learn how to create original interactive web games with a social and educational purpose. The Globaloria network and programs use open source social media and Web2.0 technology and resources for learning to empower youth, educators, and education professionals to create, collaborate, contribute, learn and lead in today's digital and globalized world that is driven by the knowledge-based economy. This paper shares findings on middle school, high school and community college students' development of 21st century learning competencies during the pilot year of Globaloria implemented with 89 students in selected West Virginia public schools in 2007/2008. A framework we're calling "6 Contemporary Learning Abilities" (CLAs) emerged from inductive analysis of Globaloria's pilot year results, which appear to effectively support development of a new Constructionist type of digital literacy.

INTRODUCTION

Interactive digital communication increasingly defines the way our world works. It determines the way businesses operate, the way we access services, the way we are entertained, and the way we participate as citizens locally, nationally, and globally. Understanding digital communication tools and putting them to work effectively—achieving digital literacy— is essential for success in the 21st century. We must teach young learners to read and to construct their own interactive digital media systems: textual and graphical media, photography and video media, animation and game media, and more. Blogs, wikis, and social network platforms, utilized in a new educational paradigm, can encourage young people to imagine, create, process, and share ideas and expertise, as they create artifacts and tell stories.

Globaloria is an innovative new program of learning (www.globaloria.org) that invites students and educators to master the tools of social media technology as they learn how to create original interactive web games with a social and educational purpose. The Globaloria network and programs use open source social media and Web2.0 technology and resources for learning to empower youth, educators, and education professionals to create, collaborate, contribute, learn and lead in today's digital and globalized world that is driven by the knowledge-based economy.

Globaloria is a pathway for development of 21st century learning abilities and digital literacy. Globaloria participants learn how to build a web game by actually doing it. Further, they share their ideas, questions and progress online using the latest Web 2.0 tools. They work individually and in collaboration with others within an activity-driven, networked learning community. Globaloria is run by the World Wide Workshop Foundation, which established the program to help close the digital literacy gaps that exist in the United States and worldwide.

The first large-scale pilot initiative implemented was the Globaloria-West Virginia project in year one, launched in partnership with the West Virginia Office of the Governor and the Benedum Foundation in the summer of 2007.[1] The overarching goal for Globaloria-WV in the first pilot year (2007/2008) was to continue advancing an effective and successful educational model for development of a statewide network for 21st century learning – MyGLife.org.

This paper shares findings on students' development of 21st century learning competencies during the pilot year of Globaloria. A framework we're calling "6 Contemporary Learning Abilities" (CLAs) emerged from research in Globaloria's first pilot year in selected West Virginia public schools, as outcomes of the activities students engaged in. We believe the research framework shared here sheds light on key program design innovations and activities that can support learners' development of 21st century skills -- what we are calling "CLAs." The CLAs framework is grounded in an established history of previous research, and in the current program of research underway in the Globaloria-West Virginia project. We believe that the CLAs framework will be useful as both a model to guide curriculum development, as well as to provide a categorization of technology learning variables that may guide a continued agenda of design-based research into 21st century learning with Web 2.0 innovations.

[1] The Claude Worthington Benedum Foundation is a regional philanthropy serving West Virginia and southern Pennsylvania.

LITERATURE REVIEW

The Globaloria program applies Constructionist principles to bring about learning and digital literacy development, through participants' construction, interaction, and play using Web 2.0 tools. Previous Constructionist learning interventions have been found to advance learning and meta-cognition across several dimensions. Such interventions have involved student engagement in project-based design work, using technology tools to develop a creative artifact that represents a given knowledge domain (the subject or theme represented in the project). The medium and content of the project artifacts created by students in this lineage of research have been as complex as digital games about math designed for instance with the Logo programming language (e.g., Harel, 1988, 1990, 1991; Kafai, 1996) and as basic as an artwork reflecting tied knots (e.g., Strohecker, 1991).

Globaloria is a Constructionist game-making network that employs updated Web 2.0 creative media for learning. The program provides a virtual design studio with a curriculum that directs students to learn by doing. Learners collaborate with others to build original web-games and simulations; in order to work, they must master social-media technologies. So they do.

As they do, students are gaining the abilities to play with and originate digital content. They learn how to write and read digitally, to express themselves systematically and creatively in a networked community, and to innovate and collaborate using social networks and social-media technology. In this way, digital skills are learned in context through purposive work towards a real, sharable, playable finished product. These are sophisticated and complex skills, required for students to be productive, successful, 21st-century citizens. The program's development is grounded in a rich history of previous research.

Constructionist origins of Globaloria work.

Constructionism is a philosophy and framework for learning and educative action developed by Seymour Papert and colleagues at the MIT Media Lab in the 1970's and 1980's – in the early days of personal computers. In the Constructionist "framework for [educative] action" (diSessa and Cobb, 2004), it has been proven over decades of research that learners' conscious construction of a computational artifact, as a technologically-mediated public entity, builds knowledge and meaning for the learner and his or her peers (e.g., Harel & Papert, 1990; Harel & Papert 1991; Harel, 1991; Kafai, 1995; Bruckman & Resnick, 1995; Kafai & Resnick, 1996; Urrea, 2001; Ackermann, 2002, 2004; Cavallo, 2004; Kafai, Y. B. & Ching, C. C., 2004; Kafai, 2006; Kafai, Peppler & Chin, 2007; Klopfer, 2008; Reynolds, 2008).

Papert worked with Jean Piaget in Geneva in the 1960's and he builds upon Piaget's ideas about constructivism, which views young learners as mini-scientists and inventors whose active creative work in theory building and testing develops their own knowledge structures and epistemologies of the way the world works. Papert's Constructionism further emphasizes the role of social interaction and role-taking that occurs in project-based learning with technology, incorporating elements of the social cognitive theory of Vygotsky, who emphasized the role of the social environment and social and cultural interaction in knowledge construction and learning. Within Constructionism, educators and especially peers guide each other, helping and "scaffolding" learning as work on projects occurs both individually collaboratively in a workshop-oriented learning environment. Many of Papert's original ideas are outlined in his key paper *Thinking* (1978) and his well-known book *Mindstorms* (1980).

Importance of Game Design

Idit Harel Caperton was instrumental in empirically researching and developing the theory inherent to Constructionism with Papert and other colleagues during her time as a research scientist at the MIT Media Lab. In Harel's (1991) early research she implemented a large-scale, integrated program of learning with elementary school children in Boston, in which children used computers for several hours every day for a year, and learned to program computer games about fractions using the programming language Logo -- when video games were still a burgeoning industry (1991). Students used Logo programming language to represent fractions into complex visual multimedia symbols, by coding the design and interactivity in Logo.

The meta-cognitive process of representation in game design requires the designer to engage in creative ideation and representation of ideas in symbolic form through design and programming (moving beyond play of an existing game, into game creation). Harel (1991) found that engaging students in game design for the purpose of teaching younger students about school subject material (mathematics) fostered deep epistemological thinking, providing students with the opportunity for "learning how to learn" as Papert suggests in *The Children's Machine* (1993).

Some of the resultant outcomes of Constructionist learning in Harel's (1991) research included:

1. Increased meta-cognitive capacities,

2. Increased complexity in learners' construction of narratives,

3. Affective (emotional) psychological development,

4. Ability to appropriate and sustain engagement in a project across time,

5. Enhanced focus and attention,

6. Enhanced levels of interest in and motivation toward technology and toward the given subject area of the project (knowledge domain),

7. Learning, recall, and extension (outside application) of domain-specific knowledge such as the traditional school subject of mathematics (observed qualitatively, and measured cognitively in standardized knowledge tests), as well as affective outcomes and abilities.

Harel (1991) identified the following context factors of the Constructionist learning environment as integral to the positive learning outcomes she documented:

1) Design and programming of a representational game

2) The open-ended, creative nature of the work that enabled students to adopt the most natural approach to problem-solving in game design for each student uniquely,

3) The collaborative group setting in which work was readily shared with others,

4) The purposive nature of the activity – namely that fourth-graders constructed Logo games about fractions that would be used by third-graders to teach *them* about fractions, requiring fourth-

graders to go through a cognitive process of "learning about learning" to implement their games,

5) The significant amount of free time with and accessibility of the desktop PCs to students which provided a sense of ownership and responsibility,

6) The ample opportunities for verbalized discussion and expression by students on the subject of their projects, in written and spoken form,

7) Ample time as well for quiet individual self-reflection,

8) Computer programming as the primary constructive work, requiring children to manifest their ideas about teaching fractions for others using the computational design tool of Logo in game design.

9) The domain-specific mathematical subject of teaching fractions as representing a purpose for the design activity.

Constructionist attributes 1 – 7 above have been replicated in studies using a number of different technology innovations in place of Logo, including Microworlds software, Scratch software, the MaMaMedia web environment, as well as standard technologies readily available on most PCs in homes and schools such as MS Office software, browsers and internet connections (e.g., Kafai, 1995; Bruckman & Resnick, 1995; Kafai & Resnick, 1996; Urrea, 2001, 2002; Ackermann, 2002, 2004; Cavallo, 2004; Kafai, Y. B. & Ching, C. C., 2004; Kafai, 2006; Peppler, Kafai & Chin, 2007; Klopfer, 2008; Reynolds, 2008). Such research has involved participants' project-based design work focused on a specific knowledge domain (e.g., traditional mathematics curriculum), as well as design work focused on an informal self-chosen interest subject based on students' own curiosity. As technology advances further, researchers are also now exploring multi-user virtual worlds that enable user game "modding," or player customization and alteration of artifacts in the expert-designed game environment (e.g., Squire, 2006).

Overall, this body of work has yielded an extensive range of scholarly support for the hypothesis that learning environments implementing Constructionist principles such as those briefly outlined above have a significant beneficial impact on outcomes in participants. Findings continually support the conclusion that learners' project-based conscious creation of a computational public entity results in powerful metacognitive learning gains.

John Seeley Brown's Vision of 21st Century Learning

John Seeley Brown advocates many of the same general learning principles as proponents of Constructionism in his scholarship on communities of practice and 21st Century Learning that occurs in the context of high-density computer cultures, resembling the ways MIT mathematicians, artists, musicians, and engineers collaborate on complex design problems. Seeley Brown speaks often about the crucial value of learning through tinkering, preferably in a studio-like environment, and in a "learning-to-be" model of role-taking that emerges from joining and becoming a full participant in a learning community. Seeley Brown (2005) presents examples of teamwork and workshop learning settings, long an integral component of Constructionist learning. He states that "since nearly all of the significant problems of tomorrow are likely to be systemic problems – problems that can't be addressed by any one specialty -- our

students will need to feel comfortable working in cross disciplinary teams that encompass multiple ways of knowing" (p. 2).

Seeley Brown states further, "we need to find ways to tap the naturally occurring curiosities of our students so that we can turn them loose to do more learning on their own" (2005, p. 2). Empirical research supports the value of engaging students in interest-driven curriculum, allowing students to explore and develop their own individual and situational interests, and using technology to build self-determination and motivate learning (Edelson & Joseph, 2004; Reynolds, 2008). In his theorizing about 21st Century learning, Seeley Brown (2005) emphasizes the importance of "learning to be" in contrast to "learning about." As students engage in their curiosity through teamwork and construction, they learn about roles, and then move on to a greater extent of *role-taking*.

Facilitating role-taking outcomes in students requires an immediacy of action and experiential opportunities to be built into educational interventions. Seeley Brown states, "Today's students want to create and learn at the same time. They want to pull content into use immediately. They want it situated and actionable - all aspects of learning-to-be, which is also an identity-forming activity. This path bridges the gap between knowledge and knowing" (p. 6). He provides the following epistemic frame to represent this new value for education in Web 2.0 cultures of learning (p. 6):

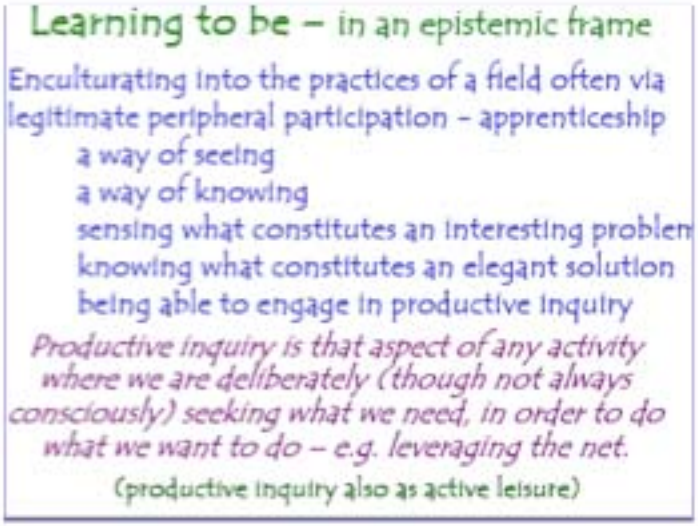

Figure 1. Seeley Brown's Conception of Learning to Be (2005)

Today's Web 2.0 tools enable contact, creation, collaboration, open construction and sharing. We are at a pivotal moment in the advancement of web technologies, at which many of the original goals always inherent to the Constructionist "framework for action" are now becoming more fully realizable with the availability of networked tools for creation- and design-based learning, and the growing ubiquity and affordability of computer technologies. We anticipate that with the right learning innovation supports, Web 2.0 tools will allow learners' "conscious construction of a computational public entity" to extend beyond face-to-face interactions around desktop computers within a given bounded physical learning setting, into the realm of global networks of collaboration, sharing, and *exponential learning*, online.

World Wide Workshop Foundation initiatives set out to develop and demonstrate Web 2.0 networks of creation and participation online that will enable Constructionist learning to flourish. We describe the learning innovation of Globaloria in the following section. In this discovery-based phase of research and development, we are exploring the learning processes that result from student interactions with Globaloria in greater depth, in order to refine the development of the learning innovation, and importantly, to share our findings with the educational research and practitioner community.

GLOBALORIA INTERVENTION

In 2006, the World Wide Workshop Foundation established the Globaloria network and program to help close the digital literacy gaps that exist in the United States and worldwide. Globaloria empowers young people in economically-disadvantaged and technologically-underserved communities to learn and create complex web content – specifically, games focused on social change. Globaloria's unique educational approach embodies the following characteristics:

- Newest technologies
- An innovative learning formula
- Participatory learning
- Open and transparent learning
- Hands-on experiences and opportunities to develop knowledge and to learn by doing
- Hands-on experiences and opportunities to learn by collaborating on a network
- Social networking for learning and social responsibility

We believe that participation in Globaloria leads to proficiency in the "new writing"—the new form of narrative expression promoted by digital content creation.

The World Wide Workshop Foundation is the first organization to create a platform and a program that provides opportunities for young learners to engage in social and collaborative game design and construction using a network of open-source Web2.0 tools and resources. By enabling the acquisition of skills required by 21st-century jobs, Globaloria prepares youth for the new knowledge economy. The Globaloria program is uniquely positioned to serve as a model contemporary Constructionist education project, demonstrating the power of 21st Century Learning.

Globaloria program implementation

Globaloria is both a network and platform. On the Globaloria platform are multiple social network sites for learning, across which students learn to build games in collaborative virtual communities. For example, MyGlobalLife (at MyGlife.org) is an online social network site where games are created about global social issues; MyScienceLife (at MySLife.org) is an online social network site, where games are created for science learning. An individual middle school, high school, community college class, or after-school group, can form its own small community within a network, and can connect with other communities in that network. In the school version of Globaloria, we are carefully selecting and launching communities one by one.

In the Globaloria program, the following four components are customized within the relevant network, for the specific needs and learning objectives of each participating school:

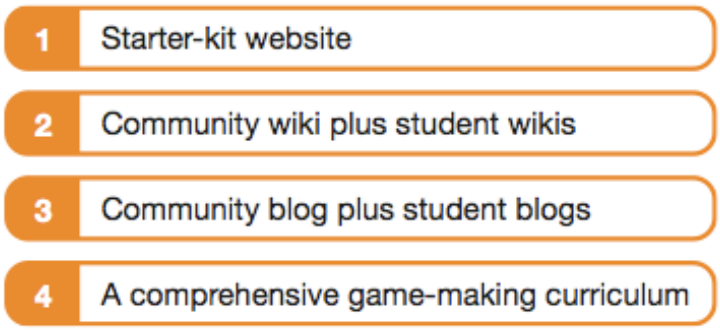

Figure 2. The four Globaloria program components

Specifically, each local community receives:

1. A starter-kit website (produced and developed by World Wide Workshop staff) with four learning channels. The channels include learning resources, such as sample games with downloadable code and custom tutorials. These resources are growing and changing over time with contributions from the community of users.

Figure 3. Globaloria Starter Kit website screenshots

2. A community wiki (implemented using open source MediaWiki tools on World Wide Workshop server space) that serves as a virtual classroom, clubhouse, or design studio. The wiki is a project and design space in which participants create and share their own work—they doodle, sketch, post graphics and photos, and post notes on their Flash applets—and view the work of the design community. It is where the community leader or teacher guides, coaches, and provides schedules, assignments, or support materials.

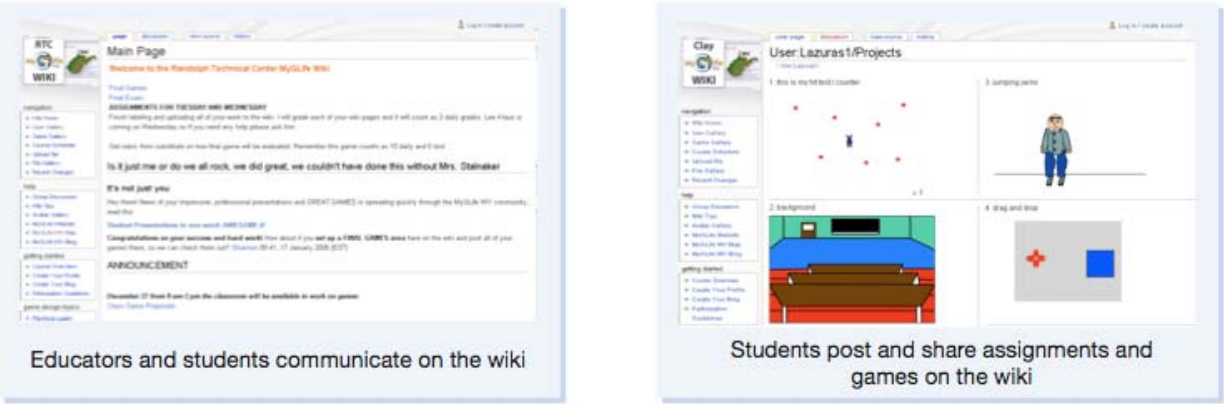

Figure 4. Globaloria community wiki screenshots

3. A community blog (using the free online Blogger tools), which is similar to a journal an artist uses for reflection. Each community creates a blog for sharing their game-making experience, personal insights and accomplishments.

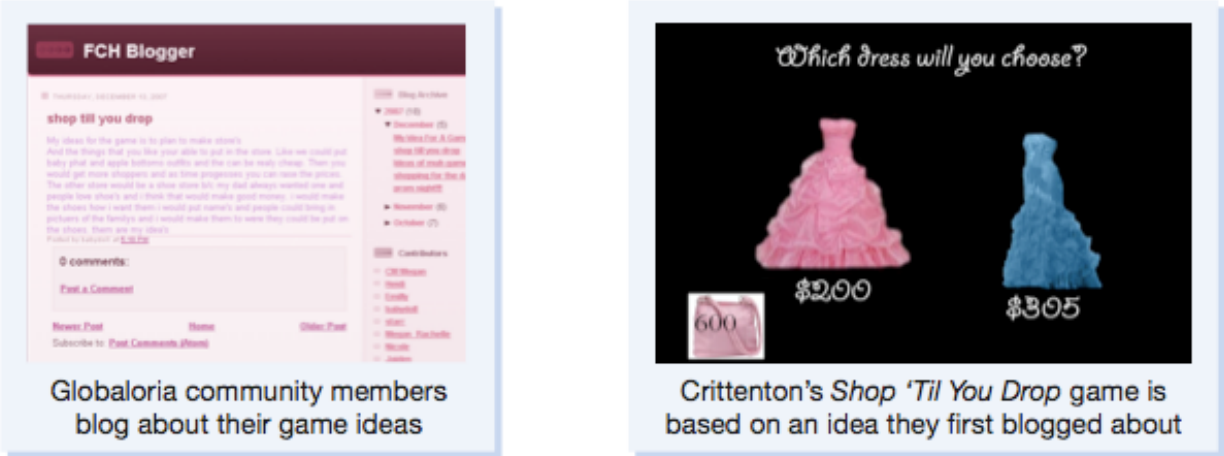

Figure 5. Globaloria community blog screenshots

4. A year-long game design and development curriculum (developed by World Wide Workshop staff) consisting of three units:

- "Getting Started"
- "Game Prototyping"
- "Bringing Your Game to Life"

The self-paced curriculum is designed for everyday execution throughout the academic year, providing 150-250 learning hours. The curriculum is open-ended, dynamic, engaging and meant to be repeated from semester to semester and year to year ("practicum" strategy). It is also customizable and can be improved over time by the community of users.

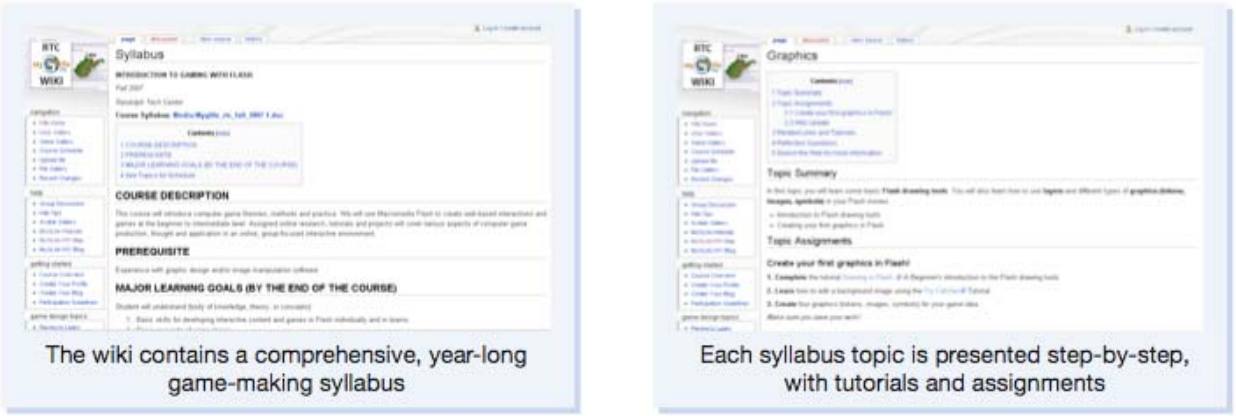

Figure 6. Globaloria game design curriculum screenshots

Flash Game Design

Participants design their games using Flash software. Schools are provided with Flash software for every computer in the local learning environment, if they do not already have it. This provision of software is funded through grant budgets. We chose Flash as the design software for students' game development, in part because Flash technology and artifacts mesh well in the architecture of web-based learning occurring with wikis, blogs, digital video, and other online social networking tools. Students in our program post and share Flash game project files, assets and artifacts online in their wiki communities, and publish their final games in the Starter Kit website game galleries. We believe this learning and sharing in a Web 2.0 context fosters strong synergistic effects, enhancing development of participants' contemporary learning abilities.

Further, Flash is an open design platform that requires the designer to anticipate and plan the game purpose, the game environment, the role of designed game characters, player behaviors and actions, game responses, and overall, the creation of an interactive experience for the game player as it unfolds across time. Flash plays a dual function as a design and programming tool. Students with different learning styles and strengths (e.g., storytellers, creative designers, programmers, math experts) can find a creative voice through Flash, and can gain exposure to skills that they did not realize they had before.

Actionscript programming can be easy enough for novice users to learn relatively quickly, in order to achieve gratifying design results that can be built upon and deepened further across time. Through Actionscript programming, students may gain an understanding of mathematical concepts such as algebra. We are currently exploring the learning processes that occur during Flash programming. These experiences may also spark new interests in computer science specializations and technology among students.

Finally, Flash designers worldwide participate and learn Flash design within an open source culture online, which we believe is a valuable new ethic and style of work towards which our program raises students' awareness. For instance, global developer communities have posted a myriad of free Flash tutorials in text and graphic form, and as demo videos on Youtube and in other online venues. Finding, using and contributing to these free online resources and tutorials enable our participants to engage in extensive self-learning. We believe this self-driven

exploration, learning and ultimate sharing is empowering, and is a key ability that our program cultivates. These potential outcomes must be investigated further in research.

Overview of student activities in Globaloria.

Across an immersive semester- or year-long timeframe, student participants in Globaloria originate digital content, write and read digitally, express themselves in a networked community, and innovate and collaborate using social networks and social-media technology.

Globaloria students:

- Participate in open-source communities on a wiki where they read/write information, and pull/push, surf/post, receive/contribute ideas
- Participate in constructive knowledge-sharing networks online
- Design and produce educational, socially-conscious, interactive games and simulations
- Engage in positive virtual communications within diverse communities (age, level, interest)
- Acquire cross-cultural understanding, self determination, and self reliance
- Practice such 21st-century skills as digital creativity and innovation, virtual collaboration and teamwork, media literacy, and computer fluency
- Experience leadership with technology, and receive training in the values of democracy and globalization through the application of social-media technology
- Develop presentation and communication skills
- Take what they already love to do and are doing—using social media technologies and playing web-games—and turn it into an opportunity for 21st-century teaching and learning
- Build and raise awareness about issues of importance to their local, national, and global communities through choice of game themes and narratives and by using digital media to express those choices

Overview of educator activities in Globaloria.

In Globaloria, we also engage educators in experimenting in Constructionist project leadership, using contemporary activities of game design and Web2.0 engagement. The professional development of educators involved a number of components:

- Training workshops (in-person and virtual), to enhance the capacity of teachers to implement Globaloria effectively and independently
- Collaboration and community building, with educators acting as informal mentors
- An educators' blog and private wiki for sharing resources and learning together
- Activities focused on using web-games, social-media technology, and social networks for their own learning and development
- Self-learning and independent development (doing what they ask their students to do)
- Self-reporting to reflect on learning and teaching progress

The following figure represents the flow of learning that occurs in Globaloria.

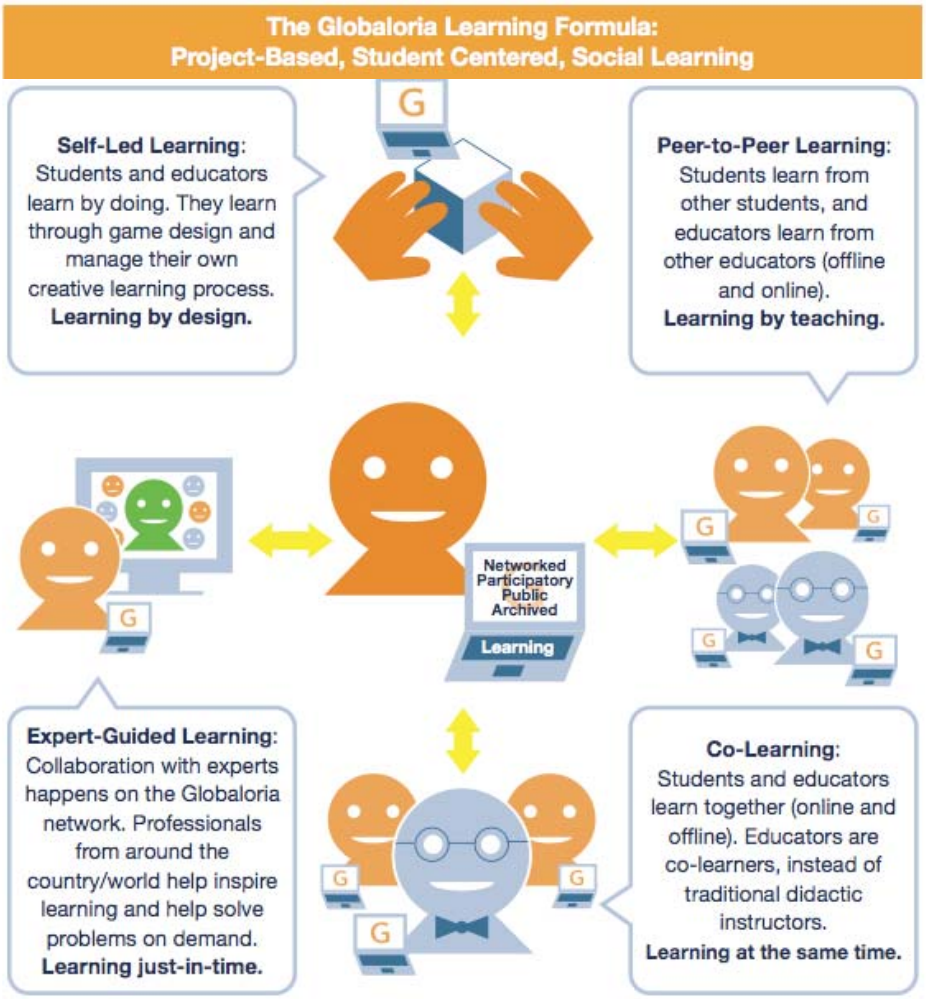

Figure 7. Globaloria Learning Formula schematic

In this model, students and educators learn together. Students learn on their own through exploration of resources, and, students learn from each other through online and face-to-face interactions. Finally, students and educators learn from experts to whom they are put in contact through the World Wide Workshop Foundation – in real-time virtual Webex and face-to-face training sessions.

The Globaloria-West Virginia pilot initiative, where we are currently applying this overall Globaloria learning innovation, is described in detail in the Methods section below.

Research questions

From the early planning stages of Globaloria's development[2], as we were conceptualizing and developing the Globaloria network with a goal to bring Constructionist learning into a contemporary, Web 2.0 context, a key overarching research question guiding our work was:

[2] During several pre-pilot initiatives in which we implemented Globaloria on a small scale (including one in Israel with thirty Jewish, Arab and Russian Israeli high school students, and

What types of new abilities do students develop as they participate and engage in the Globaloria project?

Another research question was:

What specific activities inherent to the Globaloria program elicit the emergent abilities?

We have undertaken a program of design-based research in the Globaloria project, to begin to answer these initial questions in our research, and many others. One result of the research thus far, reported in this paper, is a categorized framework of abilities we see emerging in our student participants, and their alignment with the activities that appear to be facilitating these abilities. This framework is still in development, and is continuing to be refined in the context of our pilot efforts.

METHOD

Research literature in the field of the learning sciences has provided support for the validity of the design-based research methodological paradigm, which calls for investigation into the relationships present among the variables extant to individuals, groups, learning environments and technology innovations, towards advancing learning theory and instructional design (e.g., Barab & Squire, 2004; Wang & Hannafin, 2005). Our project employs design-based research as a method, which we briefly summarize as follows.

Design-based research approach

The "design-based research" method (e.g., Barab & Squire, 2004; Wang & Hannafin, 2005) is highly relevant to the investigation of Constructionist-inspired programs of learning. Proponents who advocate for design-based research see it as a useful method for effectively exploring phenomena in learning settings that apply technology innovations, such as those often used in "Constructionist" projects. Design-based research reflects recent methodological advances in the learning sciences, and builds upon the research innovations initially advanced by earlier Constructionist researchers.

Design-based research endeavors to more fully distinguish curricular context and technology factors as explicit variables and units of analysis – part of the overall "learning innovation". Here the "learning innovation" is a unit of analysis in itself, and the method validates the iterative change and development occurring in such innovations throughout a given design study. Design-based research scholars have stated that Constructionism is more accurately viewed as a prescriptive "framework for action" rather than a theory (diSessa and Cobb, 2004) because it promotes a given teaching philosophy, perspective, and approach to be adopted by education practitioners.

Proponents of the design based research method advocate for identifying learning context factors in the environment and exploring their relationship to specific outcomes in individual and grouped participants. The method also seeks to chart a given innovation's evolution, because this has implications for the best practices of instructional design practitioners. Such research often

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several game design courses taught in Washington D.C. with eight to ten undergraduate and graduate students at American University)

employs systems-based models to identify and define learning variables, and to represent webs of complex relationships in the learning process. It also employs more traditional social science techniques such as pre- and post-tests, surveys, interviews, longitudinal developmental methods, and ethnographic-style participant observation, employed pragmatically within the overarching design-based research methodological framework.

In this initiative overall, we are following design-based research principles, implementing a learning innovation across time, defining and iteratively developing the innovation in situ based on observations and findings, and reporting on the changes to the innovation and the learning outcomes and impact on students, educators, and groups. In this particular study, we have relied on participant observational methods to develop and categorize the 6 contemporary learning abilities framework – based in the researchers' direct experiences conceptualizing, implementing, guiding, observing, and iteratively developing the program.

Data Collection in the Globaloria-WV Pilot.

Globaloria researchers are collecting a broad range of data throughout the implementation of a 5-year pilot project in the state of West Virginia, and conducting evaluation on the network, curriculum, and tools in an effort to improve the program in real-time from year to year. Everything—from the curriculum to the assessment itself—is considered experimental and open to evaluation. First we present some details about the WV pilot implementation, and then discuss data sources.

Globaloria-WV is a 5-year pilot program (2007-2010) commissioned by the West Virginia Office of the Governor. See Appendix A for an overview of the digital divide in West Virginia, which provides rationale for our choice of this state as our initial pilot location for a state-wide implementation.

In our outreach, pilot schools apply to participate (in Year 1, the Office of the Governor selected the schools), and more schools—and more classes within each school—are added each year to expand the reach of the project, and to collect more data. The vision was to start by modeling an educational innovation from the bottom-up, seeded by the Governor and a few foundations, and then to create demand by principals and educators to demonstrate Globaloria's scalability potential. The ultimate goal is for the WV Department of Education to adopt the program and scale it statewide. The plan is to begin in mid-Year 2, brainstorming with the WV Department of Education about how they could become the central administrator of the program and scale it across the state. Globaloria is designed to fit with WV's 21st Learning Strategy, "Route 21."

Globaloria-WV participant communities. Snapshot of the five-year pilot participating communities is provided as follows:

- Year 1: 2007-2008 school year (7 schools, 8 groups, 89 students)
- Year 2: 2008-2009 school year (14 schools, 24 groups, 332 students)
- Year 3: 2009-2010 school year (20 schools, 60 groups, 1,000 students)
- Year 4 & 5: Continued expansion projections, TBD.

The Globaloria Year 1 pilot ran concurrently with the 2007-2008 academic year. Eight groups in seven schools participated, consisting of 18 educators and 89 students, representing middle school, high school, community college and alternative educational communities.

The six initial participating schools were chosen by contacts in the WV Governor's Office,

targeting a diversity of high-need groups they believed had a strong potential to initially succeed in the program. The seventh was added mid-year to pilot test a middle school context.

Diverse implementation contexts. The implementation contexts at the seven pilot locations were diverse; in some locations, Globaloria was offered as a mix of integrated courses for credit within the regular school day, and at others it was offered as an after-school program. Specific details on each pilot location's implementation strategy, including average weekly time spent with the program, as reported by the educators, are provided in the following table.

	2007-2008				Semester 1 Implementation		Semester 2 Implementation	
Pilot Location	Total # of Educators Trained	Student Grade Level	Total # of Unique Student Participants	School Type	Type of Program Offered	Individual or Team Work	Type of Program Offered	Individual or Team Work
MHS	2	High School	7	Standard Public High School	After School (HSTA) 2 mtgs/wk 2hrs/mtg	Individual projects	After School (HSTA) 2 mtgs/wk 2hrs/mtg	Team projects
CHS Kanawha Co.	2	High School	11	Standard Public High School	After School (HSTA) 2 mtgs/wk 2hrs/mtg	Individual projects	After School (HSTA) 2 mtgs/wk 2hrs/mtg	Team projects
TTCHS	2	High School	20	Technical Vocational Education	For credit (Business Curriculum) 5 mtgs/wk 90 mins/mtg	Individual and Team projects	For credit (Business Curriculum) Virtual class with MCTC 5 mtgs/wk 90 mins/mtg	Team projects
CCS HS & MS	3	Middle School and High School	9	Standard Public Middle School	After School 2 mtgs/wk 2 hrs/mtg	Individual projects	After School 2 mtgs/wk 2 hrs/mtg	Individual projects
	1	High School	11	Standard Public High School	For credit (Business Curriculum)	-	-	Individual projects
CMMC	2	Community College	12	Technical Jr. College Education	For credit (IT Program) 4 mtgs/wk 2 hrs/mtg	Individual projects	For credit (IT Program) 4 mtgs/wk 2 hrs/mtg	Team projects
KMS	4	Middle School	12	Standard Public Middle School	-	-	Integrated into computer skills class, 5 mtgs/wk 40 mins/mtg	Team projects
FCCG	2	Middle School and High School	7	Alternative Education (at-risk girls)	After School (Special Reward) 2 mtgs/wk 2 hrs/mtg	Individual projects	After School (Special Reward) 2 mtgs/wk 2 hrs/mtg	Team projects

Figure 8. Globaloria-WV Participating Groups from Year 1, representing diverse age, gender, level, implementation contexts, and socio-economic status

See Appendix B for further implementation context details, outlining how the program was rolled out at each location.

Common implementation variables. Each group received a starter-kit website, wiki, blog, and year-long curriculum. On the wiki, Foundation program directors posted the curriculum, educators posted assignments, students posted their game projects, and all participants chatted and collaborated with one another. The wiki also provided useful content for participants on how to plan, create, and present their games. See http://www.MyGlobalLife.org/usa/wv to explore the community wikis. Each class created a blog to discuss the course and game design topics. In Pilot Year-1, we note that most of the educators have never participated in developing their own game design projects, using Web2.0 tools with students, or leading students in game design learning. Most had never used a wiki or posted to a blog, and none had ever used social networks or a wiki in pedagogy for project management purposes to carry out a design project with students.

Research data sources. We initially hypothesized and roughly scoped the first draft of the Contemporary Learning Abilities framework while developing our research design for Globaloria-West Virginia, prior to the launch of pilot year one in the Summer of 2007. This draft framework helped inform our survey instrumentation and our overall research design. We are using a variety of data sources to assess the cognitive, behavioral, and affective impact of Globaloria:

- Pre- and post-program surveys (distributed online)
- Mid-program reflections survey
- Real-time statistical and empirical tracking of specific activities and behaviors of learners
- Evaluations of work product, in progress and at the end
- Evaluations of wiki and blog participation, in progress and at the end
- Notes from interviews, conference calls, and email exchanges with educators
- Evaluation of educators' learning and teaching as expressed in their progress reports
- In-person visits and observations
- Videos and transcriptions from visits and student presentations
- Case studies

We have achieved parental, educator and administrative consents for all student participants in the program, and all student participation in the program and the research is entirely voluntary.

Across the entire Year One timeframe, we continued to return to the CLAs framework we initially posed, making revisions to the "abilities" based on our observations during ongoing data collection, and revisions to the "activities" based on our iterative product development. The present version of the contemporary learning abilities framework is provided in the Results section as follows. Throughout Pilot Year One, and ongoing, the framework has served as conceptual model to guide the impact research in the Globaloria project. We present the framework itself as an *inductive* finding and result. Additional articles are underway that report on the impact research results (pre/post-program surveys, case studies, etc.), which provide evidentiary support for the framework and hypotheses presented as follows (Reynolds & Harel Caperton, 2009).

RESULTS

See Appendix C for descriptive statistics of students involved in Globaloria-WV in pilot year-1. See Appendix D for descriptive data on student game creation and wiki activity metrics that resulted from student participants in Globaloria-West Virginia in Pilot Year One.

6 Contemporary Learning Abilities

The Globaloria program is unique in that it is the first to situate and prioritize Constructionist game design within a collaborative, social, wiki-based learning environment, using Flash as the game design platform. Globaloria is also first to introduce it to students and educators as a U.S. state-wide program for building overall digital literacy. Our initial categorization of Globaloria activities, and the abilities they cultivate, is a skill set we call *contemporary learning abilities (CLAs).*

The following table outlines the abilities, and specifies the activities that Globaloria participants presently engage in, to cultivate these abilities. To develop these abilities in Globaloria, participants engage in game design using Web-friendly design tools, while also using the latest Web 2.0 innovations to enhance their *social construction of knowledge*.

Table 1. Globaloria PROMOTES DEVELOPMENT OF SIX CONTEMPORARY LEARNING ABILITIES (6 CLAs)

6 CLAs	Activities representing each CLA, and how they are articulated and integrated in Globaloria
1. Invention, progression, and completion of an original digital project idea (for an educational web-game or interactive simulation)	Brainstorming and developing game and simulation ideas and storylines (using Web2.0 tools such as wikis and blogs) Choosing and researching a subject for a game design project Developing an original approach to teaching the subject in an educational game Writing an original game narrative and a proposal to explain it Generating creative ideas for designs to express the subject of the game and the user experience Planning game design execution using paper prototyping Programming a game demo that illustrates the original game design and functionality Programming and completing a final game Developing knowledge of the game's domain or topic through game invention and creation
2. Project-based learning through online project management in a wiki-based networked environment	Coordinating the design, creation and programming of the game elements and managing the process of building it Managing the project's execution using a wiki (creating wiki pages, organizing and formatting the wiki, sharing project assets, and progress updates) Managing the team work (defining and assigning team roles, coordinating tasks, and executing one's role within the team) Project troubleshooting for self and others Gaining leadership experience through the project management of all game production elements (e.g., design document, user flow, budget, schedule, introduction, overview, treatment, competitive analysis, teamwork, planning, managing implementation process)

3. Publishing and distribution of self-created digital media artifacts (using wikis, blogs, websites)	Creating a wiki profile page and project pages Integrating and publishing text, video, photos, audio, programming code, animations, digital designs on the wiki pages Posting completed assignments for each course topic to wiki Posting game design iterations and assets to wiki Posting notes and reflections about own projects Developing a blog
4. Social-based learning, participation and exchange in a networked environment (cross age, cross expertise)	Collaborating by using Web2.0 tools, such as posting to wikis, blogs, open source help forums, Instant messaging Exchanging and sharing feedback and resources with others by posting information, links, source code questions and answers Reading and commenting on blogs and wiki pages of others Presenting final digital projects for others – virtually in game galleries and in person in live game demonstrations
5. Information-based learning, purposeful search, exploration	Searching the Web (using Google, wikipedia and other sources) for answers and help on specific issues related to programming games Searching and finding resources on MyGLife.org network, website, and wiki Searching the Web for new Flash design, animation and programming resources Searching for information in support of the game's educational subject matter and storyline
6. Surfing websites and experimenting with web applications and tools	Surfing to MyGLife.org starter kit site and other game sites and playing games online Keeping track of and bookmarking surfing results that are relevant to projects Browsing Web2.0 content sites such as Youtube, Flickr, Blogs, Google Tools

The significance of the Globaloria framework

Traditionally, interventions for teaching digital literacy have focused on the importance of imparting specific technology skills as a main objective, and the development of such interventions are often driven by particular standards. The current definitions of "21st Century Learning Standards and Skills" applied in most state-based and school-based programs emphasize the importance of only a few of the abilities we include above -- mostly Types 4, 5 and 6 (e.g., see 21st Century Learning Association - www.21learn.org). Similarly, the few standardized tests that exist today for testing the so-called "21st Century Learning Skills" tend to measure only Types 4, 5 and 6 of the 6-CLAs, focusing on "information literacy."[3] Our framework and program is unique in its emphasis on abilities 1, 2 and 3 above, presented in the context of digital literacy initiatives, with a theoretical linkage to Constructionism.

Globaloria as a model program for 21st Century learning promotes educators' and students' use of digital media *as learning tools* for achieving content-driven curricular individual learning goals. In this model, the skills themselves are learned in construct with the domain knowledge of the game subject -- moving interventions away from those focused on behavioral technical skills-based objectives. The intervention we have developed in our comprehensive and integrated set of Globaloria activities seeks to be a model program for the achievement of the abilities mapped out in the CLAs framework (which largely relate to the latest NETS student standards). We believe that the 6-CLAs develop in parallel, contribute to each other, and are best achieved in an integrated way through constructive, project-based activities that engage learners in a wide spectrum of technology uses with a more meaningful purpose.

The CLAs framework attempts to provide a guideline for integrated Constructionist learning in the Web 2.0 era. The program promotes educators' and students' use of digital media *as learning tools* for achieving content-driven curricular individual learning goals. In this model program, technology skills themselves are learned simultaneously with the domain knowledge of the game subject. We describe achievement of the CLAs as a powerful new type of Constructionist digital literacy.

Application of the CLAs in our ongoing research.

The Globaloria program's 6-Contemporary Learning Abilities framework is a new learning innovation, and our application of it reflects a practice that is a departure from most traditional digital literacy initiatives in place today. In presenting Globaloria as a model for state-level technology learning intervention, we are dedicated to outlining, defining, researching, and better understanding the outcomes of the opportunities afforded to students who engage in this innovation. In our continued research, we are exploring the following dimensions of impact presented in Figure 9.

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[3] For instance, the Educational Testing Service's Information Literacy (iSkills) assessment, which focuses on the activities of: "Web Use (E-mail, Instant Messaging, Bulletin Board Postings, Browser Use, Search Engine); Database Management (Data Searches, File Management); and Software (Word Processing, Spreadsheet, Presentations, Graphics)" (accessed March 13, 2009 from http://www.ets.org/ictliteracy/).

Assessment of Cognitive, Behavioral, and Affective Impact

	Students	Educators
Cognitive Impact (Knowledge)	▶ Reviewed and evaluated artifacts ▶ Implemented pre- and post-program surveys to assess experience and skill ▶ Observed and archived written and spoken expressions about work across time ▶ Measured knowledge attained through participation in activities	▶ Reviewed and evaluated artifacts ▶ Implemented pre- and post-program surveys to assess experience and skill ▶ Observed and archived written and spoken expressions about work ▶ Measured knowledge attained through participation in activities
Behavioral Impact (Frequency)	▶ Measured traffic on the wikis and the blogs by students who posted and shared digital artifacts (wikis, blogs, and games) ▶ Conducted pre- and post-program surveys on the change in usage of technology ▶ Evaluated their own comments on their own work and the work of other students ▶ Evaluated their use of social networking tools	▶ Measured traffic on the wikis and the blogs by educators who posted and shared digital artifacts (wikis, blogs, and games) ▶ Evaluated how they comment on their own work and the work of other educators ▶ Evaluated how they use social networking tools
Affective Impact (Feelings and Motivation)	▶ Pre-, mid-, and post-program surveys on participant self-perceptions, motivation levels, and degrees of engagement in Globaloria-type activities ▶ Observed emotional expressions regarding activities	▶ Conducted pre- and post-program surveys on participant self-perceptions, motivation levels, and degrees of engagement in Globaloria-type activities ▶ Discussed changes in their self-confidence and engagement

Figure 9. Globaloria research: Dimensions of possible impact on participants

We have used the 6-CLAs framework to guide our survey instrumentation for behavioral and affective impact of the Globaloria initiative. For instance, we are using survey items measuring behavioral *frequencies* of engagement in activities within each CLA category. We are also using items measuring student's affective *interest and motivation* towards activities within each CLA category. We are also in the process of contracting with a 3rd party educational consulting firm, Edvantia, to develop a performance-based evaluation that may test student knowledge.

Our continued research explores the following hypotheses:

- Hypothesis 1. The Globaloria program can enable mastery of complex computational skills that are not currently taught in most standard public schools, especially in economically-disadvantaged communities.
- Hypothesis 2. The Globaloria program and platform can be easily customized to meet the needs of diverse schools.
- Hypothesis 3. The Globaloria program is gender, age, and ability neutral.
- Hypothesis 4. Globaloria activities promote Constructionist Digital Literacy and, more specifically, they cultivate the abilities highlighted in the Six Contemporary Learning Abilities framework (6CLAs).
- Hypothesis 5. The Globaloria program can serve as a transformational intervention, guiding educators and administrators through the reform of classrooms and school

systems.

- Hypothesis 6. Achievement of the 6CLAs will lead to greater opportunities to participate in the global knowledge economy.
- Hypothesis 7. The Globaloria program can lead to enhanced life and livelihood possibilities for participants.

Summary of results from Year One empirical analysis.

In the first pilot year, during the summer of 2008, we wrote a series of Foundation reports based on our empirical analysis across the year long timeframe (some results of which are published in Reynolds & Harel Caperton, 2009). The first Foundation report was an in-depth case study of findings from the TTC high school pilot location, including quantitative survey results, game and wiki evaluation findings, and qualitative individual case study results. The second Foundation report was an in-depth case study of findings from the CMMC community college pilot location, paralleling the data sources for Report 1. The third Foundation report addressed comparative differences between the varying implementation contexts of: a) technical high school, b) technical community college (where Globaloria was implemented as an integrated course for grade and credit), and c) non-technical contexts (where Globaloria was implemented more informally, to middle school and high school students in after-school program contexts). The third report was quantitative, drawing from survey findings and wiki and game design content analysis.

Here, we briefly summarize findings from these three reports.

Report 1: TTC case study results summary

Implementation was successful. Beginning in September 2007 twenty TTC students participated in an experiment in Web 2.0 collaborative learning. They used the Globaloria Wiki Starter Kit, the MyGLife.org learning platform and hands-on help to complete individual and team assignments as they progressed in the game design process. They created profile, project and team pages and commented on each others' work. They used live expert resources provided by the Foundation. Working in teams of two or three students, by the end of the semester, in January 2008, class teams had created eight games, proudly posted on the TTC Wiki. The Globaloria platform and curriculum were well-received by teachers and students. The success of Globaloria caused TTC teachers and administrators to contemplate the introduction of a high school major in digital game design.

TTC infrastructure was functional and compatible with Globaloria. The TTC computer lab and technology equipment were highly reliable and there were few technical interruptions.

Daily integration of the program contributed to its success. TTC students had ninety-minute sessions daily, and received course credit and a grade. With more regularly scheduled class time than students at other pilot locations, where game design was offered just twice a week and as a more informal after-school program, TTC students excelled.

Strong participation and enthusiasm of the lead educator contributed to the program's success. Mrs. SD was a highly active participant, communicating frequently with the Foundation team, and contributing her own creative and innovative solutions, such as an original evaluation

system. She learned Flash, ActionScript and wiki programming along with her students, and participated in all opportunities for professional development.

Through participation in Globaloria, students acquired new skills and gained insight into the collaborative ways of working and learning made possible by Web 2.0 technology. We found statistically significant increases in the frequency of students' engagement in several CLA activities, specifically online team collaboration, creating with digital media and surfing for information as well as increased enjoyment, confidence, motivation and knowledge.

Globaloria appears particularly well-suited to individualistic learning styles associated with this generation of Internet-connected teens, as well as some students identified as learning disabled. Our project highlighted the need for new methods of teaching and support in a program such as ours – especially for students with alternative approaches to schoolwork that have impeded their achievement in the traditional school setting. Several such students performed exceptionally in the context of Globaloria. It is important for the World Wide Workshop team to provide educators with targeted evaluation tools (such as wiki metrics and game evaluations) that will accurately reflect student effort and performance.

Two of our case study students overcame the limitations of dyslexia in the Globaloria creative atmosphere. One took on the role of class computer programming expert and went on to higher education in math. Another assumed the role of project manager, produced the background music for his team's game and became interested in the game design industry.

Game design presents opportunities for students to explore unique talents and interests. Globaloria immerses young people in an environment of original thinking to enhance their entry into the real world of virtual project-based work. For example, case study students developed as project managers, leaders and team members, learned to access resources for self-teaching and information about community and environmental topics, and discovered new career possibilities.

We need to learn more about the relation between grades and motivation. Students who had earned high marks in traditional settings may have been motivated to exert effort when assignments were graded. However, grades may not motivate students who are more independent learners. Evaluation of student performance and effectiveness of graded assignments are areas for additional research.

Year 1 data provides a critical reference point. Semester 1 feedback from students and educators resulted in adjustments by Foundation staff to the Semester 2 curriculum and platform. We implemented several new supports, including live web sessions with expert *Flash* designers, and improved the **MyGLife.org** platform. Efforts were made to enable students to continue Globaloria activities on their own time. These strategies include repeat enrollment in game design courses taken as a "practicum," availability of open computer lab time during and after school, maintenance of the Semester 1 Wiki website and blog for lab and home access, ability to maintain online and in-person collaboration with the continuing students and developing internship possibilities for students to stay connected and mentor new students.

See World Wide Workshop Foundation Report 1 and Reynolds and Harel Caperton (2009) for more details.

Report 2: CMMC community college case study results summary

Implementation at CMMC was successful. The Globaloria platform and curriculum were well-received by educators and students. Beginning in early October 2008, eight CMMC community college students participated in an experiment in Web 2.0 collaborative learning in

Globaloria. Working individually in Semester One, and in one large team in Semester Two, students created a total of eight individual interactive web games, seven of which were the result of individual solo efforts, and one of which was the result of a group team effort. The group game, "Adventure West Virginia," scored the highest among all of the games created in the Globaloria-WV program state-wide in Pilot Year-1 in game evaluation using a coding scheme. The success of Globaloria advanced the planning at CMMC by faculty and administration to develop and offer a specialized major in the IT program in digital game design, starting in year 2.

Implementation of infrastructure was successful at CMMC community college. Computer labs and resident technology equipment provided at CMMC were highly reliable for student work with few interruptions in technical functionality.

Integration of Globaloria at CMMC as an experimental course in the IT department for credit and a grade contributed to the success. Students at CMMC worked up to four days per week in class in the context of an integrated course for credit and a grade -- only one of two pilot locations in Pilot Year One where we experimented with this integrated format. The CMMC program was unique in this regard. With more time on task students were able to accomplish significantly more than other students at pilot locations where game design was offered just twice a week and in a more informal after-school context.

T*he strong participation and enthusiasm of the lead educator also contributed.* Mr. SP was a highly active participant in the program, communicating frequently with the World Wide Workshop Foundation team, and contributing his own creative and innovative curricular solutions such as a new organizational structure for Wiki pages, self-made video tutorials for his students, and a re-sequencing of the course curriculum customized for his student population. He also participated in all opportunities for educator professional development. His active involvement in the community of educators resulted in several improvements to the structure and sequencing of instructional topics in the core Globaloria curriculum and syllabus, used by all WV locations.

Through participation in Globaloria, students acquired new skills and gained insight into the collaborative ways of working and learning made possible by Web 2.0 technology. Students at CMMC engaged in activities representing the entire range of the CLAs. Wiki activity metrics and game design content analysis results evidence increases in several categories of these abilities, to the extent that these artifacts are the actual products of students' skilled activity. For instance, results indicate that the average game evaluation score in Semester One for the CMMC case study students was 20, and in Semester Two, the team game achieves a score of 49, more than double that of Semester One. This finding indicates a significant progression in game development complexity likely attributable to students' continuing development of Flash expertise in Semester Two, and the team design context in Semester Two.

Further, our quantitative results indicate that CMMC students experience important shifts in how they use a wide range of Web 2.0 technologies to problem solve and meet their digital design needs. We observed students' development of the broad range of CLAs, in parallel as they developed games under the self-learning, co-learning, peer-learning, expert-learning model. These results begin to provide support for our claim to the value of the integrated nature of the Globaloria program of project-based learning, in which students engage

in activities that cultivate all of the CLAs simultaneously in a workshop setting, through complex game design and social media use.

At CMMC, all student games created in both Semesters 1 and 2 reflect themes bearing an educational and social mission. Students at CMMC appeared to readily adopt this central goal of Globaloria to promote games for social change, and express interest and enthusiasm towards this mission. In Semester 1, game narrative themes included spelling, travel, astronomy, work etiquette, survival in nature, and making sound life choices. In Semester 2, the Adventure West Virginia game reflects significant connections to the local culture, and leverages the burgeoning economic development opportunities in adventure tourism growing in the state of WV.

Game design creates unique opportunities for students to explore individual talents and interests. Our program immerses young people in an environment of original thinking to enhance their entry into the real world of virtual project-based work. Categories of specialized talents and interests tapped by CMMC students include project management and leadership abilities, presentation and communication skills, resourcefulness and self-learning, teamwork, raised awareness in their preferences for project team roles through the experience of team game design, cultivation of a connection to local cultural issues, adoption of open source norms, and mentorship as a result of mastery.

Globaloria is well-suited to adult learners in the community college context. Our case studies highlighted the relevance of this program for adult learners who have a goal of enhancing their technology expertise in order to advance their life and livelihood skills, particularly in the area of web development. CMMC students in Pilot Year-1 self-report a greater level of confidence in several aspects of self-initiated learning and team work endemic to successful 21st century professional settings.

The success of Globaloria in Pilot-Year-2 motivated educators and administrators at the CMMC location to initiate a new undergraduate program of study in Game Design at CMMC and the affiliated University, launching in Pilot Year-2. The CMMC educators used their experience with Globaloria in Pilot Year-1 to inform the development of a new Game Design program, which will be implemented as a full two-year degree major and course of study for undergraduate students at both CMMC and the larger University community. The two core courses for this program in Game Design I and II will be initially based on the Globaloria curriculum. Further, in Year 2, advanced high school students who participate in a Globaloria game design course may enroll remotely for college credit from CMMC, and apply these credits towards their undergraduate degree. This finding is highly notable as it indicates strong administrative support in this locality for the Globaloria formula after just one year of implementation.

See World Wide Workshop Foundation Report 2 and Reynolds and Harel Caperton (2009) for more details.

Report 3: Comparative results summary: Technical community college, technical high school and non-technical after school programs as contexts

The MyGLife.org technology platform, tools, resources and game design curriculum were ready to be implemented and tested in several ***diverse*** *pilot locations with students and*

educators – enabling students' development and publishing online of functioning web games in Pilot Year-1. Evidence for this finding resides in our evaluation of students' actual performance in game design, and measurement of their Wiki activity.

Wiki and game design content analysis results indicated that technical college, technical high school, and non-technical high school students demonstrated apparent differences in their productivity and output. Specifically, both the wiki and game activity of the technical high school students was highest, followed by that of technical college students, followed by that of the non-technical pilot locations. Interestingly, the wiki metrics results parallel the game evaluation results. These findings may signal the extent to which the use of the wiki may be a positive contributor to game design, and vice versa – and that these activities are well-suited to being conducted in construct. Quantitative correlational research investigating these relationships is being conducted in Year Two.

As students engaged in the range of Globaloria activities offered in our curriculum and syllabus, they developed in several categories of contemporary learning abilities (CLAs). Prior to Globaloria, the high school groups of students evidenced apparent differences in their experience with activities representative of CLAs 1-3 versus 4-6. Specifically, the two high school groups' descriptive results prior to Globaloria indicate that they participated more frequently in, and were more highly motivated towards, activities representative of CLAs 4-6, than the more Constructionist CLAs 1-3. In contrast, at CMMC, prior to Globaloria, community college IT students were more highly motivated and engaged more frequently in activities representative of CLAs 1-3 than 4-6.

Below is a summary of the pre- and post-program survey results for each of the 6-CLAs, for frequency and motivation, by location. Boxes marked with an X indicate statistically-significant increases from pre- to post-survey. Here we see that for frequency, RTC and the non-technical locations had statistically-significant increases for several of the CLAs, both Constructionist and more traditional. Our hypothesis proposing that participation in Globaloria would increase students' frequency of engagement in activities representing the range of CLAs was partially supported for the high school students. Decreases in non-technical students' CLAs 4 and 6 may have been the result of their replacement by activities representing the more constructionist CLAs.

Table 2. Summary of statistically significant changes in students' frequency of engagement in 6-CLAs, by location

Frequency of engagement in 6-CLAs	**RTC**	**MCTC**	**Non-technical schools**
CLA 1 Invention			X
CLA 2a Project-based learning (Creation)	X		X
CLA 2b Project-based learning (Collaboration)	X		X
CLA 3 Publishing digital media			X
CLA 4 Social-based learning	X		X (decrease)

CLA 5 Information-based learning	X		
CLA 6a Surfing for fun	X		X (decrease)
CLA 6b Gameplaying			

We also measured self-reported knowledge, for RTC only, and results indicated a positive significant change for this variable as well.

The N for the technical college students at CMMC was very small. Results indicated apparent increases in CMMC students' frequency of engagement in playing games (CLA 6b), information-seeking (CLA5), and creation (CLA 2a) did support our hypotheses.

In addition to the results above, at all of the high school locations, it appeared that home technology use increased as a result of Globaloria participation. And, at all of the locations including CMMC, students reported an intention for future engagement in many of the activities they experienced in Globaloria in Pilot Year-1. These results begin to provide support for our claim to the value of the integrated nature of this program of project-based learning, in which students engage in activities that cultivate all of the CLAs simultaneously, and in parallel, through complex game design and social media use.

Overall, it appears that the program had a more dramatic impact on individual attitudes of high school students (both technical and non-technical) than on college students at CMMC. There did not appear to be a marked difference between attitudinal impact towards activities representative of the CLAs for technical versus non-technical high school students. Both sets of high school students evidenced an overall similar pattern of positive changes in motivation towards all the CLAs, and frequency of engagement in the constructionist 6-CLAs. However, the non-technical students reported a possible displacement of their frequency of technology use from CLAs 4-6 (which evidenced decreases) to CLAs 1-3 (evidencing increases) after Globaloria. It may be that for the non-technical students who previously reported much lower time spent with technology overall, their participation ended up shifting their technology use from CLAs 4-6, to more constructionist activities, which may be seen as an overall positive benefit. It appeared that motivation remained largely static for CMMC students from pre- to post-program – a possible result of age differences.

Non-technical high school students also evidenced an increase in their overall technology use from pre- to post-program, apparently bringing them up to the same frequency of usage overall as the technical high school students by the end of their participation. These results highlight the effectiveness of Globaloria in helping to mitigate and equalize the digital divide for the most disadvantaged students.

It appeared that the main implementation context variables that played a role in student outcomes included: a) students' overall time spent with the program, as a result of the location's integration of Globaloria as a course for school credit and a grade, versus as an informal after-school program; b) students' prior experience with technology which may be related to their enrollment in a technical versus a non-technical pilot location; c) student age, to the extent that it appears that the high school students performed highest, followed by college students, followed by middle school students; d) motivation and expertise of the educator (educators at the technical

locations became more highly involved in the program, and had a higher level of technology instructional expertise).

Overall, it appears that the Globaloria program was effective in addressing two facets of the digital divide for our West Virginia participants: technology access (level 1), and sophistication of use (level 2). Through their participation, students were given a new reason to access the technologies already present in their school setting, and to use these technologies in a fuller capacity. They also gained a broad range of technology skills, and experienced new forms of problem-solving in digitally-mediated environments. See World Wide Workshop Foundation Report 3 for more details on comparative results.

DISCUSSION

Contemporary learning abilities are those enabling learners to successfully navigate, contribute to, and benefit from, today's cultures of knowledge creation and sharing in networked environments. Our model of contemporary learning abilities is focused on problem-solving in technology environments, more so than functional "technology skills." We propose that these abilities are more highly transferable and applicable towards constructive work contexts learners will encounter in the future. Continued research must focus on the broader outcomes that result from development of these abilities, especially among populations for whom the digital divide is most pronounced.

More research work will be needed in our projects underway to continue building a basis of evidentiary support for the framework's validity, and to begin to address the many research questions this framework brings about. For instance, further research is needed to empirically confirm the relationship between Globaloria activities and educator and student outcomes (possibly through quasi-experimentation), and, to provide support for our claim that the synergistic effects of the integrated Constructionist learning (occurring through Flash game design, wiki collaboration together) are particularly powerful. We need to explore the effectiveness of our model of self-learning, co-learning, peer-learning and expert-learning, and, to continue developing and improving the learning innovation of the Globaloria web environment and curriculum. Throughout the process of continued research, we expect that the CLA framework will be further refined and elaborated into a more over-arching research model for the program overall.

Additionally, further research is needed to analyze how well the CLAs hold up in other immersive, Constructionist programs and contexts, involving alternative technology and programmatic innovations, and to track student outcomes and achievement longitudinally over time. For this reason, we share the model with the AERA research community, in hopes that it may contribute to others' research and learning innovation development efforts.

CONCLUSION

At the national education policy level, recognition exists for the need to move beyond technical skills-based standards as the objectives for learning with technology. The most recent version of the ISTE NETS standards for students do include more updated constructionist-type learning objectives categories, such as Standard 1, "Creativity and Innovation" which calls for students to be able to "demonstrate creative thinking, construct knowledge, and develop

innovative products and processes using technology" (ISTE NETS Standards for Students, 2007). Further, the ISTE NETS standards for teachers inspire educators to:

1. Facilitate and Inspire Student Learning and Creativity: Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

2. Design and Develop Digital-Age Learning Experiences and Assessments: Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS•S.

3. Model Digital-Age Work and Learning: Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.

4. Promote and Model Digital Citizenship and Responsibility: Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices

5. Engage in Professional Growth and Leadership: Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources. (ISTE NETS Standards for Teachers, 2008)

These standards offer considerable synergy with the Constructionist approaches we have adopted in Globaloria, and achieving these objectives could be seen to *require* Constructionist interventions. Unfortunately, while the updated NETS standards reflect significant advances in national educational policy guidelines addressing technology integration for learning in schools, the reality is that actual interventions and technology integration in schools nation-wide and world-wide has long been faltering. Supporting this is a 2008 report of the National Education Association, which presents findings of a large national survey of US educators on the state of technology integration in U.S. schools (NEA, 2008). The study presents a wealth of data on technology availability in schools as reported by educators, and finds that:

- The number of computers in public school classrooms was not adequate to enable use of computers effectively for classroom instruction, and the classroom was not the main location in school where most students used computers.
- Most educators used technology regularly at school for administrative tasks, but substantially fewer used it for instruction-related tasks
- About half of the educators surveyed required their students to use technology at school for individual research and problem solving, but only a few educators reported that they required their students to use computers regularly.
- However, most educators surveyed were highly optimistic about the impact of technology on their jobs and on their students, and they considered technology essential to teaching and learning. Most believed that technology had improved students' motivation for learning.

The study concludes that although all educators and students in public schools have some access to computers and the Internet, "we have few assurances that they are able to use

technology effectively for teaching and learning." These findings are suggestive that in *all* US states, technology integration in the public school context is still quite limited.

Globaloria is unique in many ways among technology integration initiatives, because it embraces the new social media as constructive tools for learning (instead of restricting their use), to foster much-needed changes in educational practices, at the state level, and from the ground, up --- starting with the students and courageous educators who are willing to take a leap in letting go of the traditional top-down control of their classrooms to foster student learning in a noisy, dynamic, activated workshop environment. We hope that offering the categorized framework of Contemporary Learning Abilities, and their associated activities, may be useful for the educational research and practitioner communities, serving as what Papert (1980) called an "object to think with" -- fostering discussion and dialogue useful to research, curricular development and updated technology integration.

APPENDIX A:
Rationale for West Virginia as the First State for Globaloria Pilot Rollout

The digital divide

The digital divide is a phenomenon that can be defined in simple terms as the gap between those who use computers and the internet, and those who do not. Related to the digital divide is the "knowledge gap hypothesis," (Tichenor, Donohue, & Olien 1970) which suggests that as the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease. Technology and internet media provide a new channel for mass media information, and, for learning. The use of computers and the internet has been found to generate a range of cultural and social capital for those who do so (Livingstone, S., Van Couvering, E. & Thumim, N. (2005). The extent of personal capital a person gains is related to the specific ways in which one uses technology, and the purposes towards which one applies this use. Digital inequality may result in knowledge gaps, educational opportunity barriers and disparities in groups' socio-economic potential, all of which run counter to fulfillment of democratic goals and ideals (Bonfadelli, 2002).

The digital inequality gap is occurring around the world, and has been identified at two levels (Hargittai, 2002). The first-level digital divide toward which our program is oriented is defined by access—or lack of access—to computing technologies and the Internet. The second level digital divide is defined by digital literacy or digital skills. In this study, we define digital literacy as having the awareness, proficiency and knowledge to be a part of participatory online culture (Jenkins, 2006)– the ability to *create* as well as consume digital content. When limited access is a problem within a given context or population, the second level digital divide (lack of digital skills) also is prevalent, because without access one cannot use technology and develop skills. However, even among those with moderate to high levels of technology access, research has indicated that ways of using technologies vary extensively, and more sophisticated forms of content creation, participatory use and digital knowledge have been associated with higher socio-economic status and level of education (Pew Internet and American Life Project, 2007).

A large program of research is underway in education and the social sciences, exploring the extent and nature of the digital divide phenomenon. One recent study (Hargittai & Hinnant, 2008) of US 18-24 year olds finds that women are more likely to report lower levels of self-reported digital skills, as are those who use the internet infrequently. The study finds that the higher the level of education, the greater the self-reported digital skill. And, the same study finds that those with higher levels of self-reported skill are more likely to visit the types of Web sites that may contribute to improving their life chances and from which their human and financial capital may benefit. This finding highlights the extent to which digital literacy initiatives may impact equality and opportunity more broadly.

Contexts of technology access and use for younger individuals comprise mostly home and school. Socio-economic considerations clearly play a role in home access, due to the cost of hardware and network access. But what technology affordances exist for youth in the school context?

At the national level, a 2008 report of the National Education Association presents findings of a large national survey of US educators on the state of technology integration in U.S. schools

(NEA, 2008). The research cited above highlights the extent to which both digital divides prevail in the United States; one factor is the high cost of technology and internet services in the home context, and another is the failure of U.S. schools to provide substantive opportunities for technology use and learning for all students.

The U.S. state of West Virginia has a lower median household and per capita income and higher poverty level as a percent of the population in comparison to the country as a whole. The following graph illustrates the relative poverty level of the state of West Virginia, compared to the US as a whole, as well as the level in each of the six counties in which our participating schools are located. As a rural and mountainous state with a higher poverty level than most of the country, WV residential broadband diffusion has been challenging, due to both infrastructure and cost. This is evident in the lack of broadband coverage for rural, under-served communities located in poorer, remote pockets of the state.

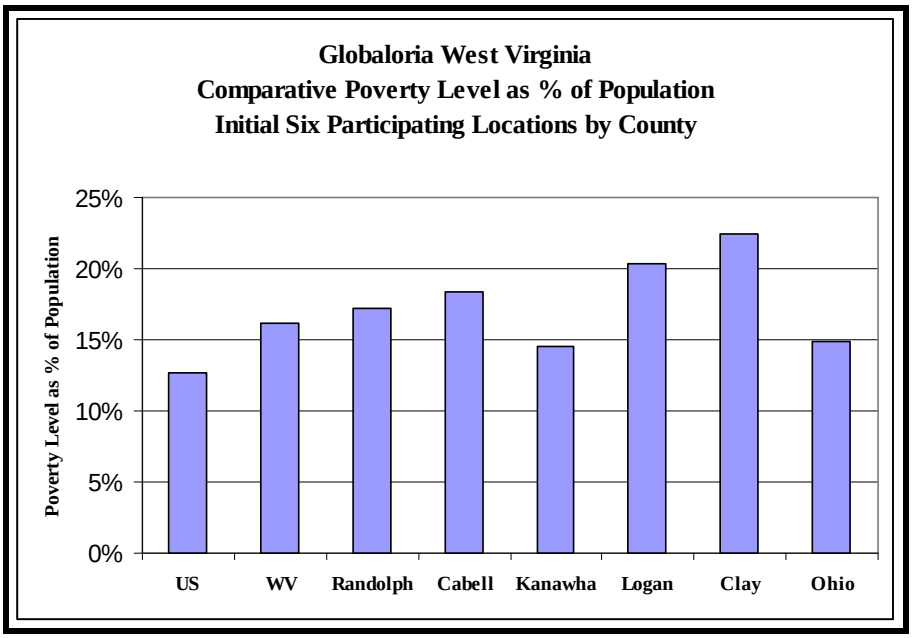

Figure 10 Poverty Level as a Percent of the total population for the US, the state of West Virginia, and the six WV counties in which Globaloria-WV sites are located.

Further demographics of the pilot communities from Pilot Year One are provided in Table 2.

Table 3. 2007 Census data[4]

Pilot Location	Broad-band Available at Home	% Students Considered Low Income	Pop-ulation	Median Income	WV Avg Income	National Avg Income
FCCG	NA – resi-dential	NA	31,419	$27,388	$33,993	$44,334
CCMS & HS	Yes	56.20%	10,330	$22,120		
CHS	Yes	47.46%	53,421	$34,009		
TTC	Yes	36.14%	7,000	$25,710		
CMMC	Yes	NA	51,475	$23,234		
KMS	Yes	51.56%	15,557	$24,729		
MHS	Yes	44.06%	770	$40,179		

The 2007 income levels for all pilot communities except for CHS and MHS, WV all fall below the state and national average income. Further, in CHS and KMS the percent of students considered low income was close to the West Virginia state average of 52%. In CC MS & HS, this statistic is higher than the state average. The 2007 average % of low-income students in the South as a whole is 54%, while the average for the rest of the states in the nation is lower than the south, at 41%. [5] Only at TTC is the % of low-income students lower than the national average. These demographics signal the potential for digital divide issues at home for students at most pilot locations due to issues in cost.

We expect that broadband diffusion and socio-economic barriers in West Virginia increase the likelihood of digital divide effects being present in the state, at both the first and second levels, thereby limiting technology access, use, and skills acquisition by young learners in the home context due to cost and lack of awareness. Further, the NEA study's findings for technology integration nation-wide are suggestive that on the whole, school settings do little presently to mitigate inequalities and gaps present in home access and use (highlighting a serious gap in US schools' present role in enhancing students' sophistication of technology use on any large scale).

We propose that the Globaloria program can help schools and communities bridge both divides, educating students (and educators) in a *full range* of life skills competencies that are critical for building contemporary digital literacy, and enhancing both their own and their state's competitive posture in the world of tomorrow.

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[4] Demographic data for pilot location communities was derived from data provided on the U.S. Census Communtiy Factfinder website, http://factfinder.census.gov/home/saff/main.html?_lang=en. Demographic data for % low income students was provided on the West Virginia Education Information System website, http://wveis.k12.wv.us/nclb/pub/

[5] Suitts, S,. (April 16, 2008). Crisis of the New Majority: Low-Income Students in the South's Public Schools. *Southern Spaces*. http://www.southernspaces.org/contents/2008/suitts/1a.htm.

APPENDIX B

Globaloria-WV Implementation in Diverse Contexts

Integrated Courses in technical settings. Globaloria was implemented at two vocational training schools as an experimental, integrated course for a grade and course credit, and offered daily. At TTC, a public technical high school in WV, the program was offered as "Game Design I" from September 2007 – January, 2008. Here, in the fall semester, 20 students opted to take the class, and worked in teams to create 8 final game projects. Five senior male students continued in the Spring 2008 semester as a single game design team, enrolling in "Game Design II" offered by the TTC educator as an independent study course. For this course, the students worked virtually with the CMMC community college students, participating in the course through online interactions on a course wiki we provided, and through live Web sessions with the CMMC instructor.

At CMMC community college, Globaloria was offered in a higher education context in both the Fall and Spring semesters, as "Game Design I," and "Game Design II," to 8 students in the school's undergraduate IT program. All eight students continued for the entire year, and were joined in Semester 2 by the 5 TTC senior male high school students. See Reynolds & Harel Caperton (2009) for empirical findings for these two locations.

After-school programs, in non-technical settings. In Semester One, at four other locations (CCMS& HS, MHS, CHS, and FCCG), Globaloria was implemented in an after-school context, for varied amounts of time at a given location throughout the week. At the CCMS&MS, MHS, and CHS pilot locations, Globaloria was integrated within a traditional, non-technical public school setting. FCCG is licensed by the West Virginia Department of Health and Human Services as a residential maternity facility and a Level II Behavioral Health Center and child care agency that offers both education and specialized care for at-risk teen girls. We implemented the program at FCCG to test our model with a specialized program for at-risk youth.

Less intensive integrated programs in Semester Two. In Semester Two, due to shifts made by the school principal and a change of educators, CCMS&HS opted to alter their implementation strategy, and offered Globaloria to 5 high school students during the school day, embedded into the curriculum of an existing computer skills class. The CCMS&HS educators shifted from Semester One to Semester Two due to scheduling conflicts, a lack of motivation to participate in the Semester One lead educator, and a re-prioritization of the Globaloria program undertaken by the school principal. CCMS&HS maintained the after-school program context for a small number of their middle school students. KMS began Globaloria in Semester Two in January, and also offered Globaloria in the context of a computer skills course to 12 middle school students. The students involved in the Semester Two implementations at KMS and CCMS&HS were mostly new to the program and had not participated in Semester One. The educators were also new at both locations, so both locations were really starting from the beginning in January 2008.

APPENDIX C

Globaloria-West Virginia student participation data, Pilot Year One

All student participants of Globaloria-WV in Pilot Year-1 had online accounts on the MyGLife.org platform, so data on student participation was aggregated based on user account info from the wiki, and cross-checked with lists of students culled from the pre- and post-program survey responses and from educators. We aggregated the following overall tallies for the full number of unique student participants, presented below. There were fluctuations in student involvement in the program across semesters, in which some students started the program and dropped due to scheduling changes in other after-school activities. Additionally, new students joined later, and in some cases, former students who had dropped participation restarted again later. These fluctuations occurred only at the after-school locations, not in the classes integrated into the school day, which had consistent numbers within Semesters One and Two. In Pilot Year-2, we have further systematized our process for tracking each student's participation status, with help from the Educators and our local program manager who started mid-year in Year-1.

Table 3. Participation Tallies

Student Participants in Pilot Year-1	**Students**
Total unique students who participated, 2007/2008	89
Fall student participants	67*
Spring student participants	48*
*NOTE: In the Spring, 41 students dropped/ended participation (21 as a result of the TTC course ending), and 22 new students were added at the continuing locations.	

Age, grade, and gender. At all pilot locations except for the technical high school (where Globaloria started and ended earlier), pre-program online surveys were conducted in early October 2007 and post-program surveys were conducted in May of 2008. At the technical high school, pre-program surveys were conducted in early October 2007 and post-program surveys were conducted in January 15, 2008 for the full class of Semester One students, whose participation ended at this time. The five Semester Two students who continued on at the technical high school also took the final post-program survey with the other students in May 2008. To distribute the surveys, links were provided to the educators and shared on their course wiki homepages.

A total of 81 students responded to the pre-program survey. Of the 81 responding participants, 53% were boys, and 47% girls, representing a relatively even distribution on gender. Excluding the older group of 8 technical community college students, the mean age of the sample of high school and middle school students was 14.9 (SD=1.8), and the mean for grade in school was 9.4 (SD=1.8). The mean age of CMMC college students was 27.0 (SD=7.0).

Technology access at home. Regarding technology access, the students in Globaloria at the different pilot locations report the following responses in the pre-program survey for their home access to computers, and their home access to the internet.

Table 4. Computer access and use at home by pilot location

Pilot Location	Do you use a computer at home?	How do you access the internet at home?
TTC (technical HS)	90% Yes	13 high speed, 5 telephone, 2 no internet at home
CMMC (technical college)	100% Yes	7 high speed, 1 no internet at home
FCCG	100% Yes	2 high speed, 1 telephone, 1 no internet at home
CCMS&HS	100% Yes	18 high speed, 1 telephone, 1 don't know
CHS	90% Yes	9 high speed, 1 telephone, 1 don't know
KMS	83% Yes	4 telephone, 2 no internet at home, 6 don't know
MHS	100% Yes	4 high speed

Overall, participants report having almost ubiquitous access to computers at home, and most report using a high-speed connection to the internet at home (cable, DSL, or wireless).

Technical High School Students' Prior Technology Uses

While they report high access and regular technology use, the results in the Figure below indicate that that prior to Globaloria, students at the technical high school had little experience in ever having engaged with the more Constructionist activities our program focuses on (invention, progression, and completion of an original project idea; project-based learning and project management in a networked environment; and publishing and distribution of digital media). Most students had never used a wiki, designed a graphic, developed an interactive game, put together a design team, used programming software, posted creative files or worked on a digital design team online. At this technical location, around half of students had used a blog and designed graphics, thought up ideas for a game project and posted creative files online. A smaller number of students had prior computer programming experience.

10. Before Globaloria, have you ever:		
	Yes	No
Used a wiki?	31.6% (6)	**68.4% (13)**
Used a blog?	**52.6% (10)**	47.4% (9)
Designed graphics on a computer?	31.6% (6)	**68.4% (13)**
Thought up an original idea for a game project?	**63.2% (12)**	36.8% (7)
Developed an interactive game from beginning to end?	5.3% (1)	**94.7% (18)**
Put together a team to make it happen?	15.8% (3)	**84.2% (16)**
Done any computer programming?	31.6% (6)	**68.4% (13)**
Posted creative files like graphics, animations or games, to the internet?	47.4% (9)	**52.6% (10)**
Worked in a team on a digital design project, online?	10.5% (2)	**89.5% (17)**

Figure 11. Prior Constructionist Computer Activity

The 6 students who report previous use of a wiki was somewhat surprising. It is possible that students interpreted *used a wiki* as having visited wikipedia as a source of information in an online inquiry search. Future survey instrumentation will distinguish between basic informational reading of wikipedia content and project-based contribution of original content in the Globaloria wiki platform environment. Additionally, the students at the TTC location started the program a month earlier than the other locations in Year 1, therefore the survey was implemented about two weeks after they began the project. While we requested for students to respond based on their activity prior to starting the program, some may not have done so. Finally, the question "Have you ever developed an interactive game from beginning to end?" was followed by "Have you ever put together a team to make it happen?" Some students missed the connection, answering "no" to the interactive game experience and "yes" regarding teamwork. This item also will be clarified in future surveys.

Technical Community College Students' Prior Technology Uses.

Prior to Globaloria, most CMMC students had never used a wiki, developed an interactive game, put together a design team, or worked on a digital design team online. Most students at this technical location had experienced blogging, designing graphics on a computer, and programming computers. Students were close to evenly divided in their experiences thinking up game ideas, and posting graphics online.

Figure 12. CMMC Students' Prior Constructionist Computer Activity

2. Before Globaloria, have you ever:		
	Yes	**No**
Used a wiki?	12.5% (1)	**87.5% (7)**
Used a blog?	**75.0% (6)**	25.0% (2)
Designed graphics on a computer?	**87.5% (7)**	12.5% (1)
Thought up an original idea for a game project?	**50.0% (4)**	**50.0% (4)**
Developed an interactive game from beginning to end?	12.5% (1)	**87.5% (7)**
Put together a team to make it happen?	12.5% (1)	**87.5% (7)**
Done any computer programming?	**75.0% (6)**	25.0% (2)
Posted creative files like graphics, animations or games, to the internet?	**50.0% (4)**	**50.0% (4)**
Worked in a team on a digital design project, online?	37.5% (3)	**62.5% (5)**

Non-technical school students' prior technology uses.

Student responses on questions asking about their prior experience with activities representing the more constructionist CLAs indicate that most had never used a wiki, designed graphics, thought up an original game idea, developed an interactive game from beginning to end, put together a team to make it happen, done any computer programming, posted graphics, or worked on a digital design project online. A little over half of the students had experienced using a blog. Overall, most of the activities they engaged in within Globaloria were entirely new to them.

Table 7. Non-Technical School Students' Prior Experience with the More Complex CLAs (1–3)

Before Globaloria, have you ever:	**No**	**Yes**
Used a wiki?	76.2%(16)	19.0%(4)
Used a blog?	42.9% (9)	57.1%(12)
Designed graphics on a computer?	71.4%(15)	28.6%(6)

Thought up an original idea for a game project?	66.7%(14)	33.3%(7)
Developed an interactive game from beginning to end?	95.2%(20)	4.8%(1)
Put together a team to make it happen?	95.2%(20)	4.8%(1)
Done any computer programming?	61.9%(13)	38.1%(8)
Posted creative files like graphics, animations or games, to the internet?	81.0%(17)	19.0%(4)
Worked in a team on a digital design project, online?	90.5%(19)	9.5%(2)

APPENDIX D

Descriptive data on student game creation and wiki activity metrics

Student games. The table that follows provides details on student games created by students in pilot year one of the Globaloria-WV initiative. Screenshot examples of a small sample of student games follow. We further evaluated games using a game coding scheme. Results on game evaluation for the TTC and CMMC locations are presented in Reynolds & Harel Caperton 2009, as well as our 3 Foundation reports.

	YEAR 1 (Sem 1 & 2)
Total Game Projects Initiated	30
Student Games by Focus	
Games on Traditional Education Subjects *(spelling, mathematics, science, financial management)*	13 (43%)
Games on Global Social Issues *(climate change, pollution, poverty, health, complex life choices, community)*	8 (27%)
Casual Games *(puzzles, trivia, humor, action, adventure)*	9 (30%)
Individual vs Team Games	
Total Games made by a Team	17 (57%)
Total Games made by an Individual	13 (43%)

Figure 13. Pilot Year One student games, Globaloria-WV

Opening Screen

Math *Infinity Quest* game: Title screen

First math question

Math *Infinity Quest* game: Teaching elementary level arithmetic

Figure 14 TTC Student team game screenshots: Infinity Quest

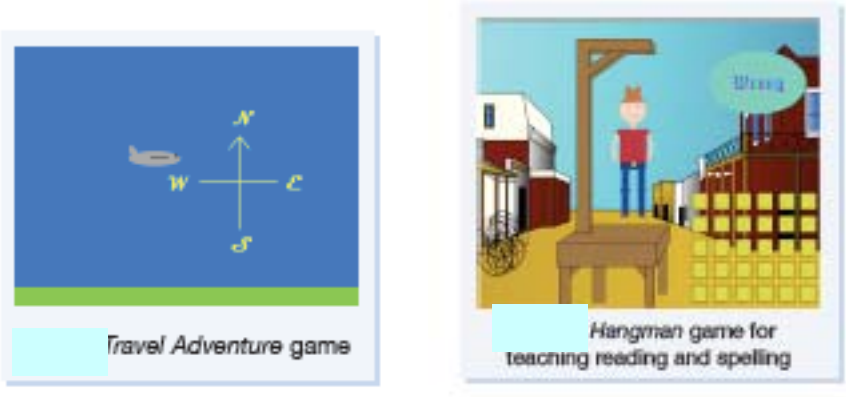

Figure 15. CMMC student individual game screenshot: *Travel Adventure* and Hangman

Figure 16. CMMC team game screenshot: *Adventure West Virginia*

Wiki page views, edits and upload metrics. Wiki use metrics present evidence of specific behavioral actions taken by students as they learned to use our tools and resources. To measure aggregate data on wiki use, we mined each pilot location wiki's user log files and hand-generated tallies on site metrics from the wiki's "User Contributions" page – a feature built into the MediaWiki open source architecture that provides metrics by user. Site metrics include wiki page views, edits and file uploads. These metrics include the following actions taken by students: editing content on a wiki page, saving the page, re-editing the same page and saving a moment later, visiting again much later and editing, uploading files, commenting on others' work, browsing the work of others, etc.

Page Views. Page view data is a basic metric reflecting site usage by all participants and all visitors of the pilot wikis. We suspect relatively few outside visitors have visited our wiki platforms, because we do not actively or directly publicize the course wikis outside of the Globaloria participants. Therefore, we suspect that page views reported reflect mostly the activity of the pilot participants themselves. The total number of wiki page views reported by the site metrics across pilot locations for the year was 107,046.

*Wiki Edits***.** Wiki edits reflect the total number of edits and saves made by all student participants at a given pilot platform, which can include the actions of editing any wiki page on the site and saving, re-editing the same page and saving a moment later, and commenting on others' work. This data is a clear reflection of the actual behavioral wiki work of students, across the yearlong timeframe at each location. The total number of wiki edits reported by the site metrics across pilot locations for all of Pilot Year-1, from September 14, 2007 – June 30, 2008 was 7735.

*Total file uploads***.** Total number of file uploads reflect the total number of game files, documents, Flash project files and other files that have been uploaded by individuals in a given pilot location across the entire year. This metric is corrected to exclude uploads made by the wikitech administrator, interns, and WWWF team members. File uploads is a metric that demonstrates the synergy of game design, construction, *and* Web 2.0 publishing, because students are mostly uploading artifacts created in Flash that they wish to publish online to share with their peers and gain feedback. The total number of file uploads by all WV students across the year-long timeframe was 1799.

For further empirical case study and aggregate findings for the Globaloria-West Virginia project (evaluation of student games, location-by-location wiki site metrics and survey results, and more), please see Reynolds and Harel (2009).

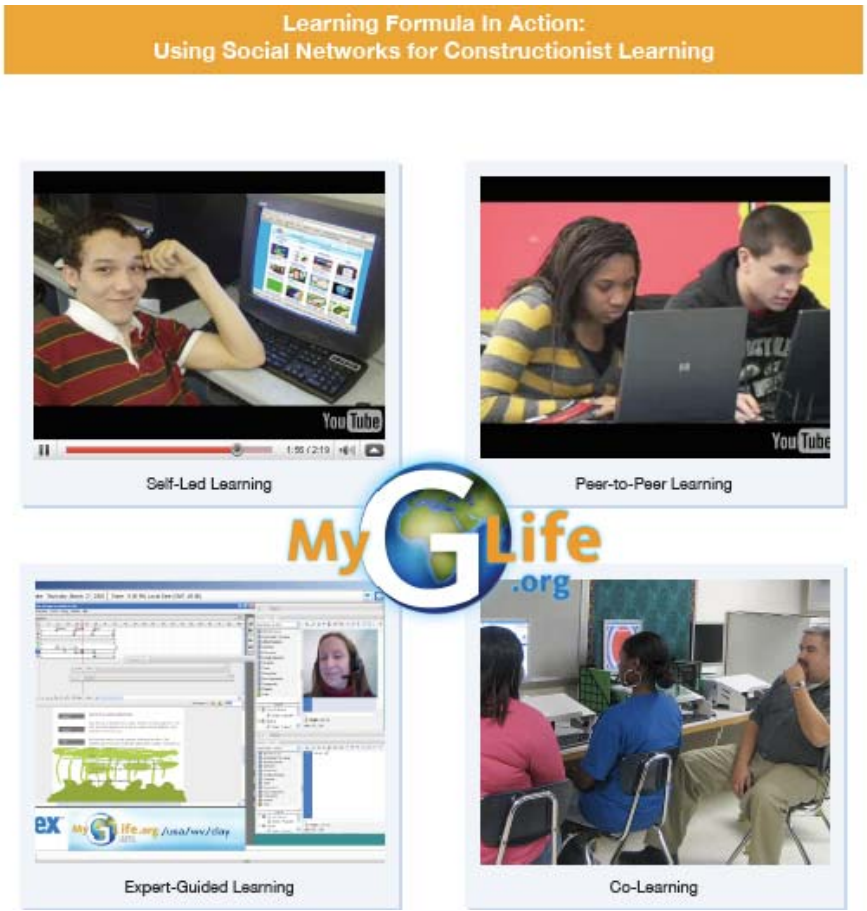

Figure 17. Photos of the Globaloria learning formula in-action

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