Pre- to Post-Program Change in High School Students’ Six Contemporary Learning Abilities (6-CLAs) through Project-based Design of Web-Games and Social Media Use in Globaloria-West Virginia (Pilot Year Two)

Rebecca Reynolds, Ph.D.
Post-Doctoral Research Fellow
American Institutes for Research
Washington, DC

Idit Harel Caperton, Ph.D.
President
World Wide Workshop Foundation
New York, NY
Executive Summary

In Pilot Year Two of the Globaloria initiative, during July 2008 – June 2009, Globaloria was implemented in thirteen locations throughout the state of West Virginia with 291 students. As students engage together in situated learning in the Globaloria program, we suggest that they cultivate 6 contemporary learning abilities that are becoming more and more necessary for successful participation in today’s technology-infused work and professional cultures. These abilities are the main learning objectives for the initiative, and are briefly summarized as follows:

1. Invention, progression, and completion of an original digital project idea (e.g., an educational game or simulation in the Globaloria context)
2. Project-based learning and project management in wiki-based, networked environment
3. Posting, publishing and distributing digital media (e.g., creating and uploading digital graphics, interactive designs, videos, notes, prototypes, and games)
4. Social-based learning, participation, and exchange (e.g., forming and sharing ideas, process notes, programming code)
5. Information-based learning, research, purposeful search, and exploration (e.g., researching the subject domain of a game; exploring design resources)
6. Surfing websites and web applications (e.g., game examples, wikis, blogs, web apps)

This study investigates the hypothesis that students develop six key contemporary learning abilities (CLAs) through their participation in Globaloria.

The current report provides the findings for one location, Randolph Technical Center (RTC) in Elkins.¹ We chose the exemplary high school RTC from among several participating high schools in Pilot Year 2 (PY-2), in part because we had written a case study of RTC in Pilot Year 1 (PY-1), and we expect that this group will be integral for longitudinal analysis across the 5-year pilot, exploring how the program becomes instantiated across time. RTC students were led by a highly engaged educator in both PY-1 and PY-2, Mrs. S., who delivered the program in a consistent, organized way for 23 students in PY-2.

Here we address development of contemporary learning abilities among the 20 RTC students for whom we had complete pre and post cases. The research study we conducted explores the development of students’ contemporary learning abilities by measuring a group of high school student attitudes towards the activities in which they participate, through their responses to a self-report survey of frequency, motivation, and self-reported knowledge. If we find increases in student frequency of engaging in,

¹ We decided to present survey results at the individual school level because the full group of 291 West Virginia students across the state who participated in Pilot Year 2 (PY-2) varies in how the program was implemented at the thirteen different pilot locations in several ways, including grade level, experience of the educator, duration of the project, and level of autonomy afforded to students in carrying out their projects. Therefore, because the schools do not implement the program in an “apples to apples” way, we chose not to aggregate the dataset for all locations in PY-2, deciding it would be more valid at this early stage to focus on the impact of the program upon high school students at single locations, in this case RTC.
motivation toward, and self-reported knowledge of Globaloria activities (which were designed to cultivate the CLAs), this indicates likelihood that students’ actual CLAs increased.

The quantitative analysis offered in this report aligns with qualitative case study findings of students provided in a complementary report, Reynolds, Scialdone & Harel (2010). The complementary report presents three student case studies, as well as analysis of student game design projects. Both reports taken together reflect a mixed methods approach that sheds light on the ways in which these high school students at the 9th-12th grade level come to acquire new contemporary learning abilities as they engage in the learning process in Globaloria across the Fall semester of 2008.

Out of the quantitative analysis, we present several key findings for high school students:

**Finding 1:** Results for Frequency suggest that at RTC, high school students have evidenced apparent (non-statistically significant) increases in frequency of engagement in activities representative of all CLA categories, except for CLA 6. While the results were not statistically significant, the frequency findings provide initial support for our overall hypothesis regarding CLA development because the grouped means appear to trend upwards.

**Finding 2:** The results indicate statistically significant increases in high school students’ enjoyment of CLAs 1-3 and 6 and apparent increases in CLAs 4 and 5. These findings indicate that student participation in Globaloria is a positive experience for them, and results in increased affect towards the activities.

**Finding 3:** Results indicated statistically-significant increases in high school students’ self-reported knowledge of CLAs 2a (creating with digital media) and CLA 3 (publishing/distributing digital media). Further, all other categories of CLAs indicated apparent (non-statistically significant) increases.

**Finding 4:** The results for motivation and self-reported knowledge suggest that the program has been especially successful in introducing constructionist game design activities (in CLA categories 1-3) to student participants.

**Finding 5:** The statistically significant increases in students’ enjoyment and self-reported understanding of the more constructionist activities in these CLA categories taken together provide support for the study’s main hypothesis that students who participate in Globaloria are developing important new abilities that are becoming more and more necessary for successful participation in today’s technology-infused work and professional cultures.
**Finding 6:** The findings for frequency indicate that students in Globaloria were provided greater access to technology in the school setting, than that which they had experienced previously. This finding indicates that **Globaloria helps stem level one of the digital divide (i.e., access)** by providing a group of disadvantaged West Virginia high school students with technology activities in schools.

**Finding 7:** Increases in high school students’ enjoyment and knowledge of CLAs 1-3 points to an increase in their sophistication of technology use for a set of complex technology activities. This finding indicates that **Globaloria helps to stem level two of the digital divide – the growing gap in digital skills and knowledge among the socio-economically disadvantaged.** This is significant because past research has shown that digital skills generate a range of cultural and social capital (e.g., Tichenor, Donohue, & Olien 1970; Bonfadelli, 2002; Livingstone, Van Couvering, & Thumim, 2005; Hargittai & Hinnant, 2008) that can lead to beneficial life and livelihood gains.

Overall, research evidence provided in this study indicates that students’ attitudes towards the activities in which they engage in Globaloria and their self-reported knowledge are shifted in a positive direction as a result of participating, especially for the more Constructionist, effortful and learning-rich activities. This supports the study’s hypothesis that students are developing contemporary learning abilities. Further, the results indicate that the continued scaling of this project in West Virginia could have mitigating effects towards stemming both levels of the digital divide, by affording greater access and technology skills to high school-aged learners.
Introduction

In 2006, the World Wide Workshop Foundation in NYC established the Globaloria network. Globaloria empowers young people in economically disadvantaged and technologically underserved communities to experience a valuable new way of learning through the creation of intricate web content, including interactive web-games. Broadly speaking, the Globaloria program’s mission is to help close the digital-literacy and participation gaps that exist in the United States (and worldwide) by empowering young people to engage in workshop-based game design projects facilitated through the use of a Web 2.0 social learning network and virtual collaboration and support.

In 2007, the World Wide Workshop Foundation partnered with the West Virginia Governor’s Office of Technology to establish the Globaloria-West Virginia pilot, as a model for a state-wide network and curriculum to transform public education, especially in its poorest rural locations. The organization has developed a technology platform and a curricular program that provides opportunities for young learners to engage in social and collaborative game design and construction using a network of Web 2.0 tools and resources including Flash software, a programmable wiki network, a resource website, and community blogging. Figure 1 depicts the Globaloria learning formula, in which teachers and students learn together, using online tutorials and resources for game design and Flash programming, along with live, synchronous virtual and in-person technology trainings and “virtual office hours” provided by leading figures in game design and development.

Globaloria is suitable for engaging middle school, high school, and college-level students. Funding and support is provided by the current office of the WV Governor Joe Manchin, the WV Department of Education, Benedum Foundation, Verizon, the Knight Foundation, and the Caperton Fund. The goal is to increase the number of students in WV to 10,000 in the next few years, and then start replicating the program in other states.

Figure 1 The Globaloria learning formula: Project-based, Student Centered, Social Learning
Rationale for West Virginia implementation

A large program of research is underway in education and the social sciences, exploring the extent and nature of 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. 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 (2002). The second level digital divide is defined by digital literacy or digital skills (2002).

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; Hargittai & Hinnant, 2008).

Related to the digital divide is the knowledge gap hypothesis. (Tichenor, Donohue, & Olien 1970). The knowledge gap hypothesis 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, Van Couvering, & Thumim, 2005). Hargittai & Hinnant (2008) find that those with higher levels of 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. Thus, 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).

Most younger individuals gain access to and use technology in two contexts: their home and at school. Socio-economic status clearly impacts young learners’ affordance of technology at home. But what level of technology access exists for young people at school, where those who don’t have reliable computer access at home might be able to compensate for this gap? 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 (2008) and reports that school technology integration and use in pedagogy is minimal.

A primary reason we chose an initial pilot implementation in West Virginia was to test our learning innovation with a population experiencing the effects of the digital divide. The U.S. state of West Virginia has a lower median household, a lower per capita income, and higher poverty level as a percent of the population in comparison to figures for the nation as a whole. As a rural and mountainous state with a higher poverty level than most of the country, West Virginia’s residential broadband diffusion has been challenging, due to geography, 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. The population is at greater risk of the effects of the digital divide.
Demographics of RTC, the pilot community from Year Two addressed in this study, are provided in Table 1.

**Table 1. Year-One (2007) Demographics of Pilot Community, Randolph Technical Center in Elkins, WV**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadband Available at Home:</td>
<td>Yes</td>
</tr>
<tr>
<td>% Students in Low Income Families:</td>
<td>36.1%</td>
</tr>
<tr>
<td>Median Household Income (2007):</td>
<td>$32,130</td>
</tr>
<tr>
<td>WV Median household Income:</td>
<td>$37,057</td>
</tr>
<tr>
<td>National Median Household Income:</td>
<td>$50,740</td>
</tr>
</tbody>
</table>

**SOURCE:** Demographic data provided on the U.S. Census Community Factfinder website, [http://quickfacts.census.gov/qfd/states/54000.html](http://quickfacts.census.gov/qfd/states/54000.html). Demographic data for % low income students was provided on the West Virginia Education Information System website, [http://wveis.k12.wv.us/nclb/pub/](http://wveis.k12.wv.us/nclb/pub/)

The 2007 median income level for the RTC pilot location is below the state and national median income. Overall, 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 (access, and sophistication of use), thereby limiting technology knowledge development by young learners in the home context due to cost and access.

Below, we present a framework of contemporary learning abilities that serve as learning objectives for the Globaloria program, and that represent a new form of Constructionist (digital media creation-based) digital literacy. This definition aligns with Jenkins (2006) who conceives of digital literacy as having the awareness, proficiency and knowledge to be a part of participatory online culture -- the ability to create as well as consume digital content. We propose that the Globaloria program will help schools and communities bridge the divides in technology access and the level of sophistication, educating students (and educators) in a full range of life skills competencies. We anticipate that developing these life skills will help to enhance the prospects of individuals participating in this program, and in turn, West Virginia’s competitive posture in the global economy.

**Globaloria Program Components**

Globaloria-West Virginia engages students and educators throughout this state in virtual and in-school design studios where they learn game design using Web 2.0 creative media and resources offered on the organization’s web platform, MyGLife.org. West Virginia middle school, high school, and community college students, as well as educators, learn to program interactive web games using Flash Actionscript, following a curriculum provided to all school partners via an online collaborative wiki-learning environment. From Pilot Year 1 (PY1) to Pilot Year 2 (PY2), the number of project participants doubled, to involve 24 educators and 291 students in 11 counties throughout West Virginia. Thirteen PY2 partner locations have implemented the curriculum as an in-school game design course elective offered to students for credit and a grade during the regular school day.

Considering today’s technology advances, Globaloria leverages several Web 2.0 capabilities. The term Web 2.0 refers to a variety of relatively new internet-reliant applications which permit users to actively modify, manipulate, and share content (O'Reilly, 2005). Users can easily contribute to Web 2.0 content by using tools for creating, adding, remixing, reorganizing, tagging, and evaluating (Rollett, Lux,
Web 2.0 environments allow for “collaboration, contribution and community” (Anderson, 2007, p. 4). Some examples of Web 2.0 tools include wikis, social networking sites (such as Facebook or MySpace), blogs (web logs), multimedia sharing facilitated through content-hosting services (such as YouTube and Flickr), and folksonomies (websites or networked applications which allow users to tag content).

Globaloria actively employs wikis and blogs in the classroom experience, and also facilitates students’ use of free and open source online Flash programming tutorial resources. On the wiki, students engage in online collaboration and sharing of programming code and assets, document their in-progress work, and then publish their in-progress and final artifacts. Any visitor to the game galleries at MyGLife.org can play students’ final games.

Additionally, in many of the schools where the program is implemented, educators encourage students’ choice of a game project topic based on their own particular interests, further enhancing the possibility of meaning-making, project appropriation, and 21st Century skills development (e.g., Joseph & Edelson, 2002). Further, the program encourages students to create games with a social mission – in line with the trend in “Social Issues Gaming” being fostered by organizations such as Games for Change and the Serious Games Initiative. To-date, students in our program have chosen to create games that reflect topics in the following genres: a) traditional educational games (e.g., a game about math), b) games that provide a social message (e.g., bearing themes related to health, nutrition or global warming– often educational, too), or c) games that could be classified as purely entertainment (for example, a fantasy game about ninja pandas).

The full set of syllabus topics for Globaloria-West Virginia is provided in Table 2. Students proceeded through the Game Design topics in the first semester, and Game Development topics in the second semester. Some first semester students jumped ahead and explored some of the Development topics in Semester Two, but these were not required.

Table 2. Syllabus for Globaloria

<table>
<thead>
<tr>
<th>I. Getting Started</th>
<th>III. Game Development Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Overview</td>
<td>Development Plan</td>
</tr>
<tr>
<td>Create Your Profile</td>
<td>Intro to ActionScript</td>
</tr>
<tr>
<td>Create Your Blog</td>
<td>Programming Practices</td>
</tr>
<tr>
<td>Participation Guidelines</td>
<td>Learning from Others</td>
</tr>
<tr>
<td></td>
<td>Finding Solutions</td>
</tr>
<tr>
<td>II. Game Design Topics</td>
<td>Moving on a Path</td>
</tr>
<tr>
<td>Playing to Learn</td>
<td>Special Effects</td>
</tr>
<tr>
<td>Choosing a Topic</td>
<td>Scrolling Background</td>
</tr>
<tr>
<td>Mini Game Project</td>
<td>Score Keeping</td>
</tr>
<tr>
<td>Imagining Your Game</td>
<td>Collision Detection</td>
</tr>
<tr>
<td>Paper Prototyping</td>
<td>Sound Effects</td>
</tr>
<tr>
<td>Planning Your Game</td>
<td>Timer</td>
</tr>
<tr>
<td>Drawing in Flash</td>
<td>Character Effects</td>
</tr>
<tr>
<td>Adding Navigation</td>
<td>Drag and Drop</td>
</tr>
<tr>
<td>Adding Animation</td>
<td>Platforms</td>
</tr>
</tbody>
</table>
Adding Sound
Adding Interaction
Assembling the Game
Presenting Your Game
Running, Jumping, etc.
Coding "Enemies"
Testing and Debugging
Participation Guidelines
Publishing Your Game

Each separate topic offers relevant online learning resources, activities and assignments. They can be explored in depth online at the following link:  http://myglife.org/usa/wv/rtcwiki/

**Purpose of the Study:**

The Globaloria program’s design has a basis in Constructionism and social learning theory. The program and learning environment (in class and online on the MyGLife.org wiki) provide the opportunity for students, educators and schools to actively participate in a “social learning system” (Wenger 2003) centered on a workshop model that is quite different from the traditional school format.

We are interested in exploring the learning outcomes that result from student engagement in this innovative program. We have outlined a framework of “6 Contemporary Learning Abilities” (CLAs) as the main learning objectives for Globaloria. Our paper addresses the extent to which students' 6 CLAs develop in the program.

In order to evaluate student advancement, in this study we use pre- and post-program surveys of students’ frequency, motivation and self-reported knowledge. Because the full group of 291 West Virginia students who participated in Pilot Year 2 (PY-2) varies widely across thirteen different pilot locations, we chose not to aggregate the dataset for all locations in PY-2. For instance, each location reflected variation in project duration, age and grade level of students, prior technology experience, demographics, and educator prior experience and motivation. We decided that due to this variation, it would be more valid at this early stage to focus on the impact of the program upon high school students at one single location, RTC, and explore student learning both quantitatively and qualitatively.

We chose this exemplary high school from among several participating high schools in Pilot Year 2, in part because we had written a case study of RTC in PY-1, and we expect that this group will be integral for longitudinal analysis across the 5-year pilot, exploring how the program becomes instantiated across time. RTC students were led by a highly engaged educator in both PY-1 and PY-2, S.D., who delivered the program in a consistent, organized way for 23 students in PY-2 (20 of whom completed both the pre- and the post-program surveys before and after their Fall semester of participation).

Here we address development of contemporary learning abilities among the 20 RTC students for whom we had complete pre and post cases. The quantitative analysis offered in this report aligns with qualitative case study findings of students provided in a complementary report, Reynolds & Harel (2010). The complementary report presents three student case studies, as well as analysis of student game design projects. Both reports taken together reflect a mixed methods approach that sheds light on the ways in which these high school students at the 9th-12th grade level come to acquire the new contemporary learning abilities as they engage in the learning process in Globaloria across the Fall semester of 2008.
**Literature Review**

**Principles Applied in Globaloria Program Development**

The Globaloria program was conceived and produced in the past three years by a small team at the World Wide Workshop Foundation, a NYC-based educational non-profit founded by Dr. Idit Harel Caperton, who in the 1980’s and 90’s collaborated with MIT Professor Seymour Papert to establish the technology-driven learning “framework for action” Constructionism. Constructionist learning is inspired by the constructivist theory that individual learners construct mental models to understand the world around them. However, constructionism holds that learning can happen most effectively when people are also active in making tangible objects in the real world. In this sense, constructionism is connected with experiential learning and builds on some of the ideas of Jean Piaget. Constructionist principles were applied in projects occurring in selected schools in Boston, Costa Rica, Australia, and other cities and nations, and also in one of the first Internet companies (MaMaMedia, Inc.) with web services for children, founded by Harel Caperton – MaMaMedia.com and ConnectedFamily.com.

Globaloria is unique in that it applies constructionist principles for learning in a curriculum of game design offered via a Web 2.0 technology environment called MyGLife.org. Some of the traditional Constructionist principles applied in Globaloria include the following (e.g., Papert, 1980; Harel & Papert, 1991):

- Workshop-based learning in an informal classroom setting where students can talk openly, share their learning, collaborate, and work in teams with their peers, creating a community of practice;
- Students’ use of programming languages and computational design tools to create complex representational digital artifacts such as games with a goal to help younger learners understand a concept in a given subject domain (the game’s topic);
- Affording students with significant time daily, across many months, to pursue the completion of a final design artifact;
- Frequent student reflection upon and social expression about their work in progress;
- Sharing and presentation of final work in the team and group context.

Research has found that programs applying Constructionist principles provide opportunities for students to develop a sense of meaning and purpose in creative work on a digital artifact (e.g., Harel & Papert, 1991; Harel, 1988, 1989, 1991, 2002; Kafai, 1995, 2006; Lawler, 1984, 1985; Wilensky, 2003; Klopfer, 2008; Seely Brown 2005, 2006; Collins & Halverson, 2009; Dede, Ketelhut, Clarke, Nelson, and Bowman, 2009; Reynolds & Harel, 2009a & b). Globaloria gives students hands-on experience in becoming active users and creators of new technologies, in ways that we expect will be integrated in their future professional lives. This sense of personal meaning results in a greater “appropriation of the project” (Harel, 1991), and gives learners a feeling of ownership over the work they create and share.

Supporting this goal is John Seely Brown’s research (2005) in which he discusses the importance of digital literacy and collaboration in networked, evolving, technological environments. Seely Brown notes 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). As such, he emphasizes the importance of “learning to be” active users of technology, in contrast to “learning about” technology. He further states (p. 6),
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.

Situated learning is learning that occurs in the same context in which is applied. This has also been called “epistemic learning” or learning by role-taking experimentation by scholars such as Shaffer & Gee (2007).

The Globaloria program provides a model for situated, epistemic learning in which both students and educators engage in game design activity in a workshop setting in school, in which students take on the role of a real game designer. Globaloria can be considered a social learning system, in which Wenger (2003) suggests that competence is socially defined, and knowing is a matter of displaying competences defined in social communities. Wenger (2003) diagramed four areas of social constructivist learning that is achieved in communities of practice (which make up social learning systems). These areas are shown in Figure 1 (derived from Couros, 2006, p. 8; Wenger, 1998b, p. 5; Sobrero, 2008).

Figure 2. Social Learning in Communities of Practice, from Wenger (2003)

Student engagement and meaning-making are constructs integral to social learning systems (Wenger, 2003). Wenger (2003) defines engagement as “doing things together, talking, producing artifacts” (p. 78). In engaging together, members “identify gaps in their knowledge and work together to address them” (p. 82). In addition to engagement, two important facets of a social learning system are realistic imaginative activity, as well as alignment (the extent to which activity can be effective beyond the local engagement). Wenger (2003) suggests that every social learning system involves all three to some degree or another.

In Globaloria, students share language, tools, artifacts and methods. Globaloria also builds in realistic imaginative activity in that students practice professional roles. Further, students create games that are published online and playable by others – which reflects Wenger’s third attribute of alignment (effectiveness beyond the local engagement). Wenger (1998a) suggests that meaning-making activities bring about learning and change.

6 Contemporary Learning Abilities

As students engage together in situated learning in the Globaloria program, we suggest that they cultivate 6 contemporary learning abilities that are becoming more and more necessary for successful participation in today’s technology-infused work and professional cultures. These abilities are the main learning objectives for the initiative. Table 3 provides the 6-CLAs and some examples of activities in Globaloria that are designed to cultivate these abilities. The full set of Globaloria activities that cultivate
the CLAs can be found in Appendix A. Their development and conceptualization is addressed in greater detail in papers by Reynolds and Harel Caperton (2009a & 2009b) resulting from Globaloria--West Virginia’s PY1 implementation.

Table 3. Contemporary Learning Abilities (CLAs)

<table>
<thead>
<tr>
<th>Contemporary Learning Ability:</th>
<th>Examples of Globaloria activities that cultivate CLA:</th>
</tr>
</thead>
</table>
| 1. Invention, progression, and completion of an original digital project idea (e.g., an educational game or simulation in the Globaloria context) | • Choosing and researching a subject for a game design project  
• Writing an original game narrative and a proposal to explain the game’s purpose and main subject  
• Programming and completing a final game |
| 2. Project-based learning and project management in wiki-based, networked environment | • Coordinating and managing the process of building the game (design document, user flow, budget, schedule, introduction, overview, treatment, competitive analysis, teamwork, planning, managing implementation process)  
• Managing the team work (defining and assigning team roles, coordinating tasks, and executing one’s role within the team) |
| 3. Posting, publishing and distributing digital media (e.g., creating and uploading digital graphics, interactive designs, videos, notes, prototypes, and games) | • 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 game design iterations and assets to wiki |
| 4. Social-based learning, participation, and exchange (e.g., forming and sharing ideas, process notes, programming code) | • Collaborating by using Web2.0 tools, such as posting to wikis, blogs, open source help forums, instant messaging  
• Exchanging & sharing feedback & resources with others by posting information, links, source code questions and answers  
• Reading and commenting on blogs and wiki pages of others |
| 5. Information-based learning, research, purposeful search, and exploration (e.g., researching the subject domain of a game; exploring design resources) | • 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 |
| 6. Surfing websites and web applications (e.g., game examples, wikis, blogs, web apps) | • 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 CLAs are a working framework that we are continuing to refine through our research and development in the Globaloria-West Virginia pilot project. They serve as outcome objectives and are key
drivers for the continued program design and curriculum decisions made in developing the program. Through participation in Globaloria, we expect that students’ 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.

This framework is a new learning innovation, and represents a departure from many traditional digital literacy initiatives in place today. Their conceptualization adds to “digital literacy” scholarship in several fields (e.g., Turkle, 1997; Barron, 2004; DiMaggio et al., 2004; Eshet-Alkalai, 2004; Eshet & Aviram 2006).

Above all, the Globaloria program offers a new and unique model of Constructionist learning towards meeting the objective of better preparing today’s learners for 21st Century work. Very few, if any, of these objectives are being met in traditional education, and students are entering college and the workforce unprepared, so we believe that any student achievements in their CLAs are significant. The World Wide Workshop Foundation and their pioneering school partners are applying this model in today’s public schools now, by training and working with both educators and students simultaneously. The program is a 5-year pilot, and thus is continuing to be refined and developed iteratively. As we document student advances in their CLAs longitudinally across time, we expect to find evidence which suggests that these students are better integrating these abilities into their professional skill set than their peers who have not participated.

**Hypothesis**

We hypothesize that as students engage in the range of Globaloria activities offered in our curriculum and syllabus, they will develop in all of the contemporary learning abilities categories described above.

To address this hypothesis, our research focuses on behavioral, affective, and cognitive development in participants. Specifically, to measure change from pre- to post-program in each abilities category, we focused in our surveys on three self-reported dimensions of the abilities – **frequency (behavioral)**, **motivation (affective)**, and **knowledge (cognitive)**. We explore all three of these dimensions for each of the six CLAs.

**Frequency.** Frequency is a standard variable within new media research that indicates media adoption and diffusion within and across populations. It is a variable common to almost all media research. Increases in frequency of engaging in activities representing the CLA categories provide support for development in the behavioral dimension of the CLAs.

**Motivation.** In the self-determination theory of E.L. Deci and R.M. Ryan, motivation is directed towards various activities, and having motivation towards something indicates a tendency toward repeat engagement with it over time (Deci & Ryan, 2000; Ryan & Deci, 2000a and 2000b). The construct *intrinsic motivation* is composed of the individual’s perceptions of 1) competence (confidence), 2) autonomy (freedom of choice) and 3) social relatedness (feelings of connectedness and sharing with others). These qualities are inherent in the individual, but can also be supported by the environment. Constructionist learning environments cultivate intrinsic motivation and support self-determination by providing opportunities to increase competence, exercise autonomy and share with others (Reynolds, 2008).

Increases in students’ intrinsic motivation toward activities representing the CLA categories provide support for the affective (emotional) dimension of CLA development, and indicate likelihood that they will continue engaging in activities inherent or related to Globaloria after the program has ended.
Knowledge. Knowledge is typically defined as information, understanding, facts and ideas acquired by study, investigation, observation, or experience. Our project focuses on building participants’ knowledge across a range of activities as outlined in the 6 contemporary learning abilities framework. We hypothesize that building students’ immediate knowledge of Globaloria activities, in our unique workshop and experiential context, strengthens students’ overall abilities and knowledge in the categories reflected above. We hypothesize that down the line, these abilities will be transferable and students will be able to apply them in new contexts to further their learning. Immediate-term increases in students’ self-reported knowledge of the activities engaged in provide support for the cognitive dimension of CLA development.

It is important to note that increases in self-reported knowledge may reflect affect (e.g., confidence towards a given activity) to a greater extent than actual cognitive development. Currently, no validated knowledge test exists reflecting the full range of CLA categories. Self-reported knowledge gains signal actual knowledge gains; such a result needs further validation. Therefore, we also address actual game design and level of wiki activity to represent actual cognitive knowledge gains because these artifacts are the direct products of actual student knowledge gained. These results are reported in our RTC case study report.

Methods

Randolph Technical Center Location and Educator.

The Globaloria program at Randolph Technical Center (RTC) was offered as an elective “Game Design” course in the first semester of the 2008/2009 school year. RTC has a computer lab with about 25 recent-model desktop Mac computers where the course was conducted.

The class met daily, with five meetings per week and 90 minutes per meeting. Twenty-three students in the Fall semester of 2008 worked in teams to create their game projects (twenty of whom answered both the pre- and post-program survey). Students were distributed across grades 9 through 12. The class was integrated with the Business Education curriculum for the 2008/2009 school year. Game Design was offered in the fall to a full class, and offered as an independent study course in the spring to six students, two of whom had not participated in Semester One (but had participated in the prior year). This study focuses on pre- and post-program survey results for the Fall semester cohort only. This was the second year of the Globaloria implementation at RTC.

Students represented the full range of school performance levels. The class included three students with learning disabilities, several students who were taking honors/college courses and all abilities in between. All students were white. All of the RTC students have roots in the local rural community and have attended public school in Elkins for their entire school career.

S.D. was the female educator at RTC, age 46, who teaches business education to students in grades 9 – 12. Pilot Year-2 is her second year of participation. Prior to Globaloria’s first year of implementation Pilot Year 1 (2007/2008), S.D. indicated knowledge of software, hardware, blogs and graphic design and had some understanding of Flash and ActionScript but had not ever used a wiki, engaged in game design or worked in a design team online. She had little prior understanding of social network sites or online gaming. Most of her training was “Learn it while you teach it.” She had attended conferences and workshops and had previously taken an online basic Adobe training course. She helped write the state content standards for digital imaging and Web design classes. RTC was the first school in West Virginia to add these courses to the business curriculum.
S.D. was highly active in her participation, and across the first two years of the pilot implementation, she grew to serve as a valuable resource and leader among all of the pilot community educators. S.D. was a model Globaloria learner. In PY2, she continued her motivated, active involvement. In her pre-program survey prior to Year 2, she states that she plans to do the following things differently in Year 2:

1. Encourage more research and not let them do games that they already know the content.
2. I want to learn more Flash coding to help them problem solve.
3. Improve my classroom management so more can be accomplished.

Further, she indicates strong confidence in her abilities in supporting students’ development in activities across all CLA categories, a change from her previous year’s pre-survey, in which she indicated far less confidence in her technology skills prior to participating.

**Game Design and Creation**

Eleven games were created in PY2 at RTC across the school year. Games were categorized as being educational, entertainment, or for a social issue. Table 4 presents these games.

<table>
<thead>
<tr>
<th>Game Title</th>
<th>Students’ Description of Game Objective</th>
<th>Genre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asteroid Avoid</td>
<td>Answer Math questions to avoid asteroids.</td>
<td>Educational</td>
</tr>
<tr>
<td>Chemistry Capture</td>
<td>Answer the chemistry questions to escape and win.</td>
<td>Educational</td>
</tr>
<tr>
<td>Dr. Pill</td>
<td>Kill the viruses inside the human body to save the patient before you run out of time</td>
<td>Educational</td>
</tr>
<tr>
<td>Emergency Surgeon</td>
<td>Save the patient with emergency surgery.</td>
<td>Educational</td>
</tr>
<tr>
<td>Food Fall</td>
<td>Healthy food and unhealthy food fall and you have to catch the healthy food and avoid the unhealthy food at the same time.</td>
<td>Social Issues</td>
</tr>
<tr>
<td>Hidden Door</td>
<td>You play an average high school student who discovers a door in your school that leads to a hidden world...</td>
<td>Entertainment</td>
</tr>
<tr>
<td>Landfill Destroyer</td>
<td>Stack the recyclables to earn points.</td>
<td>Social Issues</td>
</tr>
<tr>
<td>When Zombies Attack</td>
<td>You are a HS student who wakes up and realizes that the world is in mayhem. The cause is a zombie disease outbreak. Find a way out of the school and get to a hospital to cure the deadly viruses. Along the way jump over zombies, solve puzzles, and answer math problems.</td>
<td>Educational</td>
</tr>
<tr>
<td>Zombie Panda Attack</td>
<td>Players progress through a hidden underground lab solving problems and riddles to gain the key to unlocking the cure to a zombie plague. Maze like rooms and brain busting queries await the player.</td>
<td>Entertainment</td>
</tr>
</tbody>
</table>
Learn the Bones
(Semester Two) Learn the bones of the human body. Educational

Sigma Iota Mu
(SIM) University
(Semester Two) This is a real-life simulator that can make you feel like you’re living an alternate life. Mixing that with my personal worries of college, I have made a simulator of college life. Educational

In-depth analysis of three of these games is provided in our Year 2 RTC case study report (Reynolds & Harel 2010).

Wiki Edits, Uploads, and Blog Posts

The table below presents Pilot Year 2 students’ wiki editing and uploading and blog posting activity, in totals and at the per-student and by month levels. To aggregate this data a research assistant searched the automated MediaWiki metrics tools by participant username, and added up the results at the individual student level for each pilot location, separating out and counting wiki edits and uploads by month, and hand-counting blog posts.

<table>
<thead>
<tr>
<th>Table 5. Wiki Edit, Upload and Blog Post frequencies for Pilot Location RTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total N of students</td>
</tr>
<tr>
<td>Average # months a given student participated in 2008/2009</td>
</tr>
<tr>
<td>Total Wiki file uploads</td>
</tr>
<tr>
<td>MEAN (adjusted) file uploads per student across school-year</td>
</tr>
<tr>
<td>MEAN File Uploads per student, in any given month, Sept - June</td>
</tr>
<tr>
<td>Total site edits</td>
</tr>
<tr>
<td>MEAN (adjusted) Site edits per any given student across school-year</td>
</tr>
<tr>
<td>MEAN site edits per student in any given month, Sept - June</td>
</tr>
<tr>
<td>Total Blog Posts</td>
</tr>
<tr>
<td>MEAN (adjusted) Blog Posts per any given student across school-year</td>
</tr>
<tr>
<td>MEAN Blog Posts per student in any given month, Sept - June</td>
</tr>
</tbody>
</table>

The table indicates that students’ blog wiki edits outnumbered their file uploads to the wiki, and both activities were engaged in more frequently than blog posting. At RTC, blog posting was not highly emphasized or required by the educator in Pilot Year 2. Students received a grade for their participation at the end of the semester, based on their completion of assignments throughout the course, their class and group work participation, and the educators’ qualitative determination of a) the students’ contribution of effort towards the final group game project, and b) amount of Flash expertise gained.
Measurement of Contemporary Learning Abilities outcomes

To measure change in students’ contemporary learning abilities, from pre- to post-program in each category, in our surveys we focused on behavioral, affective and cognitive self-report dimensions for each contemporary learning ability – frequency, motivation, and knowledge.

**Frequency** is a behavioral measure. Frequency is a standard variable within new media research that indicates media adoption and diffusion within and across populations. It is a variable common to almost all media research. To measure frequency we used criteria employed by the Pew Internet and American Life Project in their national surveys of media and technology use. Our surveys measured frequency of technology use across the 6-CLAs. Increases in technology use at school due to Globaloria participation are to be expected. Increases in technology use at home on students’ own time would indicate that the Globaloria program was having an impact on the way that students are spending their free time, and whether they are becoming more productive computer users in their home technology use (to the extent that they have access to technology at home). At this time, our frequency measures reflect both at-home and at-school technology activity, all together. Increases indicate composite, overall impact on students’ technology use frequency. We measured frequency of technology use for a range of activities representing each CLA category, before and after Globaloria by asking students to indicate on a 6-point scale how often they participated in these activities. In our data analysis we additively combined several activities into a single frequency variable for each CLA category. Increases in frequency across the CLA categories may indicate adoption of the skills learned in Globaloria.

Figure 3. Survey question on students’ frequency of engagement in Six CLAs (screenshot)

![Survey Question](image)

**Motivation** is an affective (emotionally-oriented) disposition, operationalized in past surveys as interest/enjoyment in certain activities (e.g., Ryan, Mims, Koestner, 1983). We operationalize student motivation as enjoyment of a range of CLA-related activities. Enjoyment was measured using a 5-point scale as shown in Figure 4 (“Don’t Know” answers were combined with “not at all true”). We asked students to assess their enjoyment in specific CLA-related activities. In our data analysis we report findings for enjoyment in each CLA category.
To measure student knowledge we used an adaptation of a proxy survey measure validated by Hargittai (2005) as 32% predictive of actual knowledge in adults. The question for self-reported knowledge on the pre-program survey presented a list of 21 technology terms that were chosen to reflect a broad range of CLA activities, as indicated in Figure 5. We distributed these terms into their relevant CLA category.

Developing the Frequency, Motivation and Knowledge Survey Constructs Representing the 6-CLAs.

We included survey items for activities reflecting all appropriate CLA categories in our instruments. Prior to measuring pre- and post-survey changes in students’ contemporary learning abilities, we needed to validate our theoretical categorization of the 6-CLAs, so we could measure pre- and post-survey change for each singular construct. For instance, in the survey we asked students about their frequency of engagement in several Globaloria activities meant to cultivate CLA 3 (publishing/distributing digital media) -- such as posting text to a wiki, and posting digital files to the internet. Thus, we needed to confirm that these particular publishing activity-oriented survey items “hang together” as a single construct representing CLA 3 as a dimension of digital literacy. The same was true for all the activities we asked students about in the surveys.

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2 Hargittai (2005) operationalizes her “perceived knowledge” proxy survey instrument as follows: “How familiar are you with the following Internet-related items? Please choose a number between 1 and 5 where 1 represents having ‘no understanding’ and 5 represents having ‘a full understanding’ of the item. (none, little, some, good, full).” Among a random sample of U.S. adults Hargittai’s composite optimal index of internet-related items achieved a Cronbach’s alpha of .89, and was found to have a predictive power (adjusted R²) of .321 for actual internet competence, as measured by a knowledge test of digital task completion. This proxy item holds the highest predictive power among all self-report indices of digital literacy.
Thus, in data analysis, we applied factor analysis to the pre-program survey items in each CLA category. We ran the factor analysis for each CLA, using the full West Virginia dataset pre-program surveys (N=178). See Appendix B for a list of the specific items included in each CLA.

Exploratory factor analysis results for the items included in Appendix B confirmed there to be 7 factors, instead of 6. The factor analysis confirmed CLAs 1, 3, 4, 5 and 6, plus 2 factors for CLA 2 (*creating with digital media* and *collaborating with team members online*). Table 6 provides the Eigenvalues for each factor.\(^3\)

### Table 6. Frequency Factors and Eigenvalues For 6-CLAs

<table>
<thead>
<tr>
<th>CLA</th>
<th>Frequency</th>
<th>Motivation</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eigenvalue</td>
<td>Eigenvalue</td>
<td>Eigenvalue</td>
</tr>
<tr>
<td>CLA 1:</td>
<td>2.26</td>
<td>2.46</td>
<td>1.71</td>
</tr>
<tr>
<td>Invention, progression, and completion of an original digital project idea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLA 2:</td>
<td>2.42</td>
<td>3.12</td>
<td>6.77</td>
</tr>
<tr>
<td>Project-based learning and project management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a: Creating Digital Media with software</td>
<td>1.73</td>
<td>1.66</td>
<td>NA</td>
</tr>
<tr>
<td>2b: Collaborating with Team Members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLA 3:</td>
<td>2.57</td>
<td>1.33</td>
<td>1.61</td>
</tr>
<tr>
<td>Publishing/Distributing Digital Media</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLA 4:</td>
<td>2.15</td>
<td>1.65</td>
<td>2.28</td>
</tr>
<tr>
<td>Social-Based Learning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLA 5:</td>
<td>2.00</td>
<td>1.38</td>
<td>1.59</td>
</tr>
<tr>
<td>Information-based learning, research, purposeful search</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLA 6:</td>
<td>NA</td>
<td>1.47</td>
<td>1.94</td>
</tr>
<tr>
<td>Surfing websites and web applications</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All factors achieved eigenvalues over 1, therefore we performed additive combinations of the items in each CLA category identified (five single factors, and two sub-factors). Survey items that did not factor into categories were excluded from the final combinations. After combining the items into CLA constructs for the full dataset, we grouped and analyzed the survey data specific to our technical pilot location of RTC.

We hypothesized that prior to Globaloria, students would have engaged in the activities represented by CLAs 4, 5 and 6 more frequently than with the activities described by the first 3 CLAs, which require a higher level of digital literacy, and would have been less motivated towards these activities due to lack of experience and knowledge. And, we hypothesized that Globaloria participation would result in increases in frequency of engagement, motivation toward, and knowledge of all activities that are meant to cultivate the CLAs. The findings that follow present the results of our pre- and post-program surveys.

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\(^3\) It is standard practice in factor analysis to only retain factors with eigenvalues greater than 1. Values greater than 1 indicate that the factor explains a significant amount of the variability in the construct.
Results

Twenty students completed both a pre- and post program survey at RTC, however we know from educator record-keeping that there were 23 students enrolled in the first semester, and two new students added in the second semester (both of whom had taken the course in the prior PY-1, but not the fall of PY-2). Table 7 presents some demographics of the students enrolled.

Table 7. Student Participation in RTC

| # Students Who Started Program in Semester 1: | 23 |
| # Students Who Started Program in Semester 2: | 2 |
| # Boys | 14 |
| # Girls | 11 |
| Average Age of Student | 17 |

The pre- to post-program survey findings that follow for frequency, motivation and knowledge reflect results for the 20 students from the first semester who completed both the pre- and the post-survey, and engaged in the program for four months (September through December of 2007).

Frequency.

Table 8 presents the pre- and post-program survey results of the seven CLA frequency factors, as well as the significance level of the two-tailed t-test of the pre- and post-Globaloria survey differences.

Prior to Globaloria, group means for the less-constructionist CLAs 4 – 6 (social-based learning, information-based learning and purposeful research, and surfing the internet) ranged from 3.37 (about once a week) to 5.05 (about once a day) as indicated in Table 8. In contrast, pre-Globaloria group means for the more constructionist CLAs 1 – 3 (invention progression & completion, project-based learning (creating and collaborating), and publishing/distribution digital media) ranged from 11.35 (never) to 2.30 (a few times a month). This result was expected, since CLAs 1 – 3 reflect a more complex, constructionist form of digital literacy, which most students have not acquired prior to entering Globaloria.

In their post-Globaloria survey, students reported higher apparent frequencies on five of the seven CLA factors than in their pre-Globaloria survey. While none of the changes in reported frequencies are significant at the 0.05 level, two frequency gains are notable: collaborating with team members (CLA 2b) and publishing/distributing digital media (CLA 3). The increase in activities associated with publishing/distributing social media are near significant (P = 0.0538).
Table 8. Pre- and Post-Program Means for Frequency Factors

<table>
<thead>
<tr>
<th>CLA #</th>
<th>CLA Name</th>
<th>Pre-Survey Mean</th>
<th>Std Dev.</th>
<th>Post-Survey Mean</th>
<th>Std Dev.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLA 1:</td>
<td>Invention, progression, and completion of an original digital project idea</td>
<td>2.30</td>
<td>1.30</td>
<td>2.53</td>
<td>1.08</td>
<td>0.85</td>
</tr>
<tr>
<td>CLA 2:</td>
<td>Project-based learning and project management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a:</td>
<td>Creating Digital Media with software</td>
<td>1.85</td>
<td>1.19</td>
<td>2.02</td>
<td>0.94</td>
<td>0.71</td>
</tr>
<tr>
<td>2b:</td>
<td>Collaborating with Team Members</td>
<td>1.35</td>
<td>0.99</td>
<td>1.88</td>
<td>1.13</td>
<td>1.68</td>
</tr>
<tr>
<td>CLA 3:</td>
<td>Publishing/Distributing Digital Media</td>
<td>1.66</td>
<td>1.10</td>
<td>2.21</td>
<td>1.04</td>
<td>2.06†</td>
</tr>
<tr>
<td>CLA 4:</td>
<td>Social-Based Learning</td>
<td>4.05</td>
<td>1.63</td>
<td>4.00</td>
<td>1.48</td>
<td>-0.16</td>
</tr>
<tr>
<td>CLA 5:</td>
<td>Information-based learning, research, purposeful search</td>
<td>3.37</td>
<td>1.55</td>
<td>3.78</td>
<td>1.07</td>
<td>1.44</td>
</tr>
<tr>
<td>CLA 6:</td>
<td>Surfing websites and web applications</td>
<td>5.05</td>
<td>1.15</td>
<td>5.00</td>
<td>1.26</td>
<td>-0.16</td>
</tr>
</tbody>
</table>

Source: Globaloria West Virginia Pre-Program Survey, STUDENTS, Pilot Year-2; Globaloria West Virginia Post-Program Survey, STUDENTS, Pilot Year-2

N = 20

P-values are based on t-tests. Two-tailed statistical significance at the p ≤ .05 level is indicated by an asterisk (*).

† P-value = 0.0538, which rounds to 0.05 but is not statistically significant at the 0.05 level.

Survey item scale (How Often Do You ...): 1 = Never , 2 = A few times a month, 3 = About once a week, 4 = A few times a week, 5 = About once a day, and 6 = Several times a day.

Regarding frequency in engaging in Globaloria activities, we would expect their frequency to increase as a result of their daily involvement in the program.

Finding: Frequency results suggest that at RTC, students have evidenced apparent (non-statistically significant) increases in the activities representative of all CLA categories, except for CLA 6.

For CLA 3, Publishing/Distributing Digital Media, the increase was close to being statistically significant. While the increases in frequency at RTC are not dramatic, they do indicate that student involvement in the class has elevated their level of engagement in a range of technology activities.

Motivation.

As shown above in Figure 4, motivation was measured by questions that asked about enjoyment (e.g., “I Enjoy ... Planning a digital design project.”). Therefore, group mean values in Table 9 represent the
levels of enjoyment among survey respondents. Like frequency, we expected students to have higher apparent levels of enjoyment for CLAs 4 – 6 than for CLAs 1 – 3 before entering Globaloria. This result was confirmed, shown clearly in Table 9, where the pre-program survey means for activities in CLA categories 4 – 6 range from 2.95 (sometimes true) to 4.60 (very true), whereas the means for CLA categories 1 – 3 range from 1.43 (not at all true) to 1.93 (not usually true).

Results from the pre- and post-Globaloria surveys indicate that the increase in students’ enjoyment of activities within each of the more complex, constructionist CLAs (CLAs 1 – 3) were statistically significant, as was the increase in enjoyment of searching the internet (CLA 6). Among the statistically-significant increases, the group means for students’ enjoyment of invention, progression and completion activities (CLA 1) increased from 1.93 (not usually true) to 2.63 (sometimes true). The group mean of students’ enjoyment of creating digital media activities (CLA 2a) increased from 1.64 (not usually true) to 2.41 (not usually true). Also, the group mean of students’ enjoyment of collaborating with team members (CLA 2b) increased from 1.43 (not at all true) to 2.28 (not usually true). The group mean for publishing/distributing digital media (CLA 3) increased from 1.53 (not usually true) to 2.68 (sometimes true). Finally, student enjoyment of surfing websites and web applications (CLA 6), increased from 4.25 (usually true) to 4.60 (very true).

Table 9. Pre- and Post-Program Means for Motivation Factors

<table>
<thead>
<tr>
<th>CLA #</th>
<th>CLA Name</th>
<th>Pre-Survey Mean</th>
<th>Std Dev.</th>
<th>Post-Survey Mean</th>
<th>Std Dev.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLA 1:</td>
<td>Invention, progression, and completion of an original digital project idea</td>
<td>1.93</td>
<td>1.06</td>
<td>2.63</td>
<td>1.33</td>
<td>2.48</td>
</tr>
<tr>
<td>CLA 2:</td>
<td>Project-based learning and project management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a:</td>
<td>Creating Digital Media with software</td>
<td>1.64</td>
<td>0.95</td>
<td>2.41</td>
<td>0.98</td>
<td>2.45</td>
</tr>
<tr>
<td>2b:</td>
<td>Collaborating with Team Members</td>
<td>1.43</td>
<td>0.71</td>
<td>2.28</td>
<td>1.19</td>
<td>2.90</td>
</tr>
<tr>
<td>CLA 3:</td>
<td>Publishing/Distributing Digital Media</td>
<td>1.58</td>
<td>0.82</td>
<td>2.68</td>
<td>1.31</td>
<td>3.63</td>
</tr>
<tr>
<td>CLA 4:</td>
<td>Social-Based Learning</td>
<td>4.05</td>
<td>1.21</td>
<td>4.28</td>
<td>0.88</td>
<td>0.65</td>
</tr>
<tr>
<td>CLA 5:</td>
<td>Information-based learning, research, purposeful search</td>
<td>2.95</td>
<td>0.96</td>
<td>3.28</td>
<td>0.88</td>
<td>1.21</td>
</tr>
<tr>
<td>CLA 6:</td>
<td>Surfing websites and web applications</td>
<td>4.25</td>
<td>0.91</td>
<td>4.60</td>
<td>0.68</td>
<td>2.10</td>
</tr>
</tbody>
</table>

Source: Globaloria West Virginia Pre-Program Survey, STUDENTS, Pilot Year-2; Globaloria West Virginia Post-Program Survey, STUDENTS, Pilot Year-2

N = 20

P-values are based on t-tests. Two-tailed statistical significance at the p ≤ .05 level is indicated by an asterisk (*).

Survey item scale (I enjoy ...): 1 = Not at all true, 2 = Not usually true, 3 = Sometimes true, 4 = Usually true, 5 = Very true.
Regarding student motivation (enjoyment) in the range of Globaloria activities, given that most students had not participated in these activities prior to Globaloria, an increase in their enjoyment will indicate positive affect towards the activities, and increased likelihood of repeat engagement.

**Finding:** The statistically significant increases in student enjoyment of CLAs 1-3 and 6 and the apparent increases in 4 and 5 indicate that student participation in Globaloria is a positive experience for them, and their participation results in increased positive affect towards the activities.

For CLAs 4-6, there might have been a ceiling effect, because pre-program survey means were already quite high. Student enjoyment in Globaloria activities signals a likelihood of repeat engagement in the future, especially in the more constructionist design-oriented, computer programming and collaborative activities that are unique to Globaloria.

**Knowledge.**

The questions used for the knowledge factors asked students to report their level of familiarity with digital media terms (e.g., blog, wiki) and activities (e.g., program on a computer). Similar to the frequency and motivation factors, prior to Globaloria, students report having a greater understanding of the activities representing the CLAs 4 – 6 than the more Constructionist CLAs 1 – 3. Table 10 presents these findings, with means of CLAs 4 – 6 ranged from 3.65 to 4.35 (*a good understanding*), whereas means for CLAs 1 – 3 ranged from 1.85 to 2.35 (*a little understanding*).

Results from the pre- and post-program surveys show apparent increases in self-reported knowledge for all seven factors of the CLAs, though the gains were only statistically significant for students’ reported knowledge of creating with digital media (CLA 2b), and publishing/distributing digital media (CLA 3).

Among the statistically significant increases, the group means for students’ self-reported knowledge of creating with digital media (CLA 2b) increased from 2.20 (*a little understanding*) to 2.93 (*some understanding*). Self-reported knowledge about publishing/distributing digital media (CLA 3) increased from 2.35 (*a little understanding*) to 3.53 (*good understanding*). There were near-statistically significant increases for CLA 1 (*U = 0.0705*), CLA 2b (*p = 0.0743*) and CLA 5(*p = 0.0608*).

<table>
<thead>
<tr>
<th>Table 10. Pre- and Post-Program Means for Knowledge Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLA #</strong></td>
</tr>
<tr>
<td>CLA 1:</td>
</tr>
<tr>
<td>CLA 2:</td>
</tr>
<tr>
<td>2a:</td>
</tr>
<tr>
<td>2b:</td>
</tr>
<tr>
<td>CLA 3:</td>
</tr>
<tr>
<td>CLA 4:</td>
</tr>
</tbody>
</table>

23
CLA 5: Information-based learning, research, purposeful search  
   3.65  0.84  4.05  0.65  1.99
CLA 6: Surfing websites and web applications  
   4.35  0.93  4.50  0.51  0.77

Source: Globaloria West Virginia Pre-Program Survey, STUDENTS, Pilot Year-2; Globaloria West Virginia Post-Program Survey, STUDENTS, Pilot Year-2

N = 20
P-values are based on t-tests. Two-tailed statistical significance at the p ≤ .05 level is indicated by an asterisk (*).
Survey item scale (How familiar are you with the following terms and activities?):
1 = None, 2 = Little, 3 = Some, 4 = Good, 5 = Full.

Our measurement of students’ self-reported knowledge (understanding) of Globaloria activities is the closest this study comes to measuring actual CLA development.

Finding: Results indicated statistically-significant increases in students’ self-reported knowledge of CLAs 2a (Creating with Digital Media) and CLA 3 (Publishing/Distributing Digital Media). Further, all other categories of CLA indicated apparent (non-statistically significant) increases.

Here again, for CLAs 4-6, there might have been a ceiling effect, because pre-program survey means were already quite high. The self-report survey measure of knowledge upon which we adapted ours (Hargittai, 2005) was found to be 32% predictive of actual knowledge in a study with adults. We expect that the measure we used holds validity similar to the aligning measure used in Hargittai’s (2005) study with adults. Thus, increases in self-reported understanding seen here indicate likely increase in actual knowledge.

Discussion

In this study, we hypothesized that as students participate in Globaloria to design and create an interactive game using an online syllabus, tutorial resources and Wiki environment with their peers, they will develop in all of the contemporary learning abilities categories described above.

The research study we conducted explores the development of students’ contemporary learning abilities somewhat indirectly, by measuring a group of middle school student attitudes towards the activities in which they participate, through their responses to a self-report survey of frequency, motivation, and self-reported knowledge. If we find increases in student frequency of engaging in, motivation toward, and self-reported knowledge of Globaloria activities (which were designed to cultivate the CLAs), this indicates likelihood that students’ actual CLAs increased.

The study finds evidence for high school students’ increases in frequency of technology use as a result of participation. It also appears that the nature of students’ technology activity might be shifting, from the less constructionist activities (for which frequency increases appear limited) to the more constructionist (for which frequency increases appear larger). While the results were not statistically significant, the frequency of engagement findings provide apparent support for our overall hypothesis that students’ CLAs are developed in Globaloria, because the grouped means trend upwards.

Further, findings for motivation and self-reported knowledge suggest that the program has been especially successful in introducing constructionist game design activities (representing CLAs 1-3) to
student participants. The statistically significant increases in students’ enjoyment, and self-reported understanding of the more constructionist activities in these CLA categories support the study’s main hypothesis that students’ CLAs are developed through Globaloria participation.

**How Globaloria Mitigates Level One of the Digital Divide: Access**

Further, the findings for frequency indicate that students in Globaloria were offered greater affordance of access to technology in the school setting, than that which they had experienced previously. Thus, this finding indicates that Globaloria helps address level one of the digital divide (access) by providing a group of disadvantaged West Virginia high school students with technology activities in schools.

**How Globaloria Mitigates Level Two of the Digital Divide: Sophistication of Use**

Finally, it is also important to note that the constructionist activities of Globaloria are more effortful than simply surfing and searching the web. Globaloria involves students in learning to use Flash software, computer programming in Actionscript, project management skills on a wiki, and synthesis to piece together various game assets and to create their final game in a collaborative group context. Increases in high school students’ enjoyment and knowledge of CLAs 1-3 points to an increase in their sophistication of technology use for a set of complex technology activities. This finding indicates that Globaloria can help address level two of the digital divide – the growing gap in digital skills and knowledge among the socio-economically disadvantaged.

As mentioned previously, past research has shown that digital skills generate a range of cultural and social capital (e.g., Tichenor, Donohue, & Olien 1970; Bonfadelli, 2002; Livingstone, Van Couvering, & Thumim, 2005; Hargittai & Hinnant, 2008). Globaloria provides students with insights on how to actively use technology and the internet for constructive purposes. We expect that the enhancement of students’ access and sophistication of technology use afforded through Globaloria will help improve their life circumstances and livelihood potential.

In future research, we expect to measure students’ development of the knowledge and actual abilities students gain more directly. We also must identify the factors that contribute to variations in student development of contemporary learning abilities, such as age and grade level and amount of time spent in the program. Further, in other research underway, we explore the specific program features that are bringing about the given CLA skills, in an effort to continue iteratively improving the curriculum and resources provided. We must also establish a more direct link between student CLA knowledge development, and their ability to transfer this knowledge into more lasting life outcomes across time, such as continued learning and career development.

Overall, research evidence provided in this study indicates that the continued scaling of this project in West Virginia could have mitigating effects towards stemming the effects of the digital divide, by affording greater access and technology skills to high school-aged learners. Randolph Technical High School will remain a pilot location of focus in Pilot Years 3 – 5 of the Globaloria project, to continue to explore the instantiation of the program and its effects on rural West Virginia students and educators in a technical high school location that has been a part of the program since its inception in Pilot Year 1.
### APPENDIX A

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

<table>
<thead>
<tr>
<th>6 CLAs</th>
<th>Activities representing each CLA, and how they are articulated and integrated in Globaloria</th>
</tr>
</thead>
</table>
| 1. Invention, progression, and completion of an original digital project idea (e.g., an educational game or simulation in the Globaloria context) | Brainstorming and developing game and simulation ideas and storylines  
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  
Proposing game design ideas and 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 and project management in wiki-based, networked environment | Coordinating and managing the process of building the game  
Managing the project’s execution using a wiki (creating wiki pages, organizing 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. Documenting, posting, publishing and distributing digital media (e.g., creating and uploading digital graphics, interactive designs, videos, notes, prototypes, and games) | Creating a wiki profile page and project pages  
Posting 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 |
<table>
<thead>
<tr>
<th>6 CLAs</th>
<th>Activities representing each CLA, and how they are articulated and integrated in Globaloria</th>
</tr>
</thead>
</table>
| 4. Social-based learning, participation, and exchange (e.g., forming and sharing ideas, process notes, programming code) | Collaborating by using Web2.0 tools, such as posting to wikis, blogs, open source help forums, Instant messaging  
Exchanging & sharing feedback & 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, research, purposeful search, and exploration (e.g., researching the subject domain of a game; exploring design resources) | 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 M.C.er and storyline |
| 6. Surfing websites and web applications (e.g., game examples, wikis, blogs, web apps) | 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 |
APPENDIX B

Survey Variable Composites: CLAs

To begin to validate our theoretical categorization of the 6-CLAs, prior to combining constructs we applied factor analysis to the pre-program survey items representing each CLA category, within the full West Virginia pre-survey dataset (N=178).

We hypothesized that the groupings of items indicated below would hang together in factor analysis, reflecting a single factor. Therefore, we performed factor analysis for each CLA below using the multiple items indicated (anywhere from 2 to 7 items). Factor analysis confirmed the relatedness of the individual items used to identify each construct, with items below hanging together for CLAs 1, 3, 4, 5 and 6. For CLA 2, the factor analysis results indicated 2 sub-factors (creating with digital media and collaborating with team members online separately). Therefore we defined this as 2 separate categories.

We then performed additive combinations for the set of items in each CLA category identified (five single factors, and one factor separated into two sub-factors). We combined appropriate variables in this way in the pre-survey dataset, and in the aligning post-survey dataset. Survey items that did not factor into categories were excluded from the final combinations.

Pre/post program survey t-tests were then run for Frequency, Enjoyment and Understanding, using the single combined construct in the pre- and post-surveys, in each of the 6 CLA categories.

Table A1. Frequency Factors and Eigenvalues For 6-CLAs

<table>
<thead>
<tr>
<th>CLA</th>
<th>Items: How Often Do You ...</th>
<th>Eigenvalue</th>
</tr>
</thead>
</table>
| CLA 1: Project Development and Completion | Think up an idea for a creative project involving computer technology?  
  Think up an idea for an interactive game?  
  Work on creating a digital design project, from beginning to end? | 2.26       |
| CLA 2: Project-based Learning  
  2a: Creating with Digital Media | Make graphics, animations and/or interactive games?  
  Make digital music or video on a computer?  
  Program on a computer? | 2.42       |
| 2b: Collaborating with Team Members | Work with a team on a digital design project, communicating with team members ONLINE?  
  Work with a team on a digital design project, communicating with team members FACE-TO-FACE? | 1.73       |
| CLA 3: Publishing/Distributing | Post content/messages on a Wiki? | 2.57       |
Digital Media
- Post content/messages on a blog?
- Post digital video to the internet? (Youtube, etc.)
- Post graphics/animations/games you’ve created to the internet? (MyGLife, etc.)

CLA 4: Social-Based Learning
- Exchange messages in email?
- Exchange messages in instant message or chat?
- Use social networking sites like Facebook or Myspace?

CLA 5: Learning Purposeful Research
- Use a search engine to find resources when you think of a question about something?
- Use Wikipedia?
- Use a search engine to find resources for help with a digital design project?

CLA 6: Searching the Internet
- Search around online for fun? (NA)

### Table A2. Motivation Factors and Eigenvalues For 6-CLAs

<table>
<thead>
<tr>
<th>CLA Name</th>
<th>Items: I Enjoy ...</th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLA 1: Project Development and Completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking up ideas for a digital creative project.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking up ideas for an interactive game.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating the storyline for a digital design project.</td>
<td>2.46</td>
<td></td>
</tr>
<tr>
<td>CLA 2: Project-based Learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a: Creating with Digital Media</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning a digital design project.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating a digital design project.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating an interactive game, from beginning to end.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer programming (e.g., ActionScript).</td>
<td>3.12</td>
<td></td>
</tr>
<tr>
<td>2b: Collaborating with Team Members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working with a team on a project, communicating ONLINE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working with a team on a project, communicating FACE-TO-FACE.</td>
<td>1.66</td>
<td></td>
</tr>
<tr>
<td>CLA 3: Publishing/Distributing Digital Media</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing a blog.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posting/publishing files you create to a Wiki.</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td>CLA 4: Social-Based Learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socializing with friends using internet tools like email, instant messanger, Facebook, Myspace.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commenting and giving feedback to others online.</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>CLA 5: Learning Purposeful Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Searching for an using online resources when I think of a question about something.</td>
<td>1.38</td>
<td></td>
</tr>
</tbody>
</table>
Searching for an using tutorials and online resources to help with digital design projects. Surfing online for fun. Finding and playing internet games. 1.47

Table A3. Knowledge Factors and Eigenvalues For 6-CLAs

<table>
<thead>
<tr>
<th>CLA</th>
<th>Items: <em>How familiar are you with the following activities?</em></th>
<th>Eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLA 1: Project Development and Completion</td>
<td>Thinking up ideas for the storyline of a game. Designing an interactive game from beginning to end.</td>
<td>1.71</td>
</tr>
<tr>
<td>CLA 2: Project-based Learning 2a: Creating with Digital Media</td>
<td>Flash software, Actionscript, Graphic Design, Digital design project, Programming, Animation, Software</td>
<td>6.77</td>
</tr>
<tr>
<td>2b: Collaborating with Team Members</td>
<td>Collaboration</td>
<td>NA</td>
</tr>
<tr>
<td>CLA 3: Publishing/Distributing Digital Media</td>
<td>Wiki, Blog</td>
<td>1.61</td>
</tr>
<tr>
<td>CLA 4: Social-Based Learning</td>
<td>MySpace, Email, Instant Messenger</td>
<td>2.28</td>
</tr>
<tr>
<td>CLA 5: Learning Purposeful Research</td>
<td>Wikipedia, Google</td>
<td>1.59</td>
</tr>
<tr>
<td>CLA 6: Searching the Internet</td>
<td>Internet games (Addictinggames.com, etc.), Multiplayer online games (World of Warcraft, etc.)</td>
<td>1.94</td>
</tr>
</tbody>
</table>
References


Deci, EL, Ryan, RM, The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry, 11, 227-268 (2000);


