

**Evidence of High School Students'
Development of Contemporary Learning Abilities
in a Game Design Program in Rural West Virginia**

Globaloria Student Case Study Series, Pilot Year 2

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

Michael Scialdone, Ph.D. Candidate
Syracuse University
School of Information Studies

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

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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 posed two research questions at the outset:

- In what ways is the Globaloria program engaging for the participating students at RTC?
- In what ways did students develop new skills and learning abilities through their participation in Globaloria in Pilot Year 2 (2008/2009)?

These questions are addressed through qualitative case study findings for RTC three students. The case studies were developed using several data sources including wiki activity, student project artifacts, videotaped presentations, and qualitative responses to the pre-, mid-, and post-program surveys.

One West Virginia case study student, Jonathan, is a 16-year old junior in high school, and participated in the first semester of the program only (Game Design I). The other two students, Cathy and Jason, were both seniors and participated for the full year. After participating with a full class in the fall semester, these two students elected to take Game Design II as an independent study during the spring semester, along with three other students. It was Jonathan and Cathy's first year of participation. Jason was a second-year participant who had participated in Pilot Year One of the study at RTC, and who in Pilot Year Two, took on two roles in the program, as student, and as an intern of the World Wide Workshop Foundation.

Executive Summary of Results

Cathy, Jonathan and Jason reflect three very different case study students who exist in a single class context, sharing the same educator and the same level of access to a common set of curriculum materials and resources. The findings for these students vary widely, and also share some common threads. The case studies provide significant insights into both research questions posed.

Cathy

Cathy presented as a student with mid-range prior school achievement, for whom Globaloria brought out qualities of perseverance and problem-solving in her quest to learn programming to complete her team game in the fall semester when other students backed out of their intended roles. After struggling in the first semester to become the lead programmer in her team, she decides to continue on in Game Design II in the spring, and along with a teammate, develops one of the highest-scoring games in Pilot Year 2, across the entire WV network of schools. Cathy develops a valuable set of project management and computational skills across the CLA categories that we expect are likely to transfer into future learning experiences. Her team's "Learn the Bones" game reflects what the field of educational technology calls a "virtual manipulative," in which the students intuitively include several useful instructional strategies, along with an embedded assessment to test the learner's knowledge.

Across the yearlong timeframe, Cathy shows evidence of developing CLA 1 (invention, progression, and completion of an original digital idea), in that she gained knowledge of origination of a game idea through two iterations of paper prototyping and design proposals, and then went on to develop and complete two game design projects. Cathy's spring semester game is very original, is well explicated on the paper prototype, and it appears that she has succeeded in overcoming some of her difficulties with Actionscript programming experienced and detailed in Semester One.

She also demonstrates that she has excelled in CLA 2 (project-based learning through online project management in a wiki-based network environment), largely by using the experience in Semester One with the unfinished work to more effectively plan, manage and create a complete and functioning game in Semester Two, operating within the constraints of the game idea, the technological functionality, and the given timeframe.

There is also evidence to suggest that Cathy is proficient in CLA 3 (publishing and distribution of self-created digital media artifacts). The wiki metrics indicate that she is one of the most active students in the class during some months in her wiki edits and uploads. There was ample data online supporting the case study findings for Cathy, including paper prototype videos, assignment files, presentation videos, project files and final game files.

Cathy also assumed a leadership role in younger students' project management as a mentor in the second semester. Her mentorship of younger students provides evidence of CLA 2 as well as CLA 4 (social-based learning, participation, and exchange in a networked environment). Also supporting CLA 4 are her self-progress notes as a reflective exercise at times, to share her thoughts with other participants. Additionally, while not frequent, her blogs show a high level of reflective thinking.

The opportunity in Semester Two to choose a new game subject domain and make adjustments to the game design process attempted in Semester One appeared to be quite beneficial to Cathy's learning outcomes.

Jonathan

Jonathan on the other hand presented as a previously high-achieving student who struggled in Globaloria because the program required students to become problem-solvers who are motivated to find solutions to their own design hurdles. Jonathan became frustrated by this and according to his teacher, "gave up." It does not appear that he developed in CLA category 1, which denotes invention, progression, and

completion of an original digital project idea, one of the main goals of the course. He does offer evidence however that he has become more self-aware as a result of his experience.

Jonathan makes an interesting case study student for the contrast he poses to Cathy and Jason, which follows. Clearly, the program did introduce him to one thing he was passionate about, and that was creating digital music. Further, as indicated in his achievement of the highest number of wiki edits and uploads, he has gained skills in CLA 3 (publishing and distribution of self-created digital media artifacts using wikis, blogs, and websites).

Jonathan seems to portray his experience in mixed terms, offering sometimes positive self-reports regarding his experience, and other times indicating that he is having difficulty and is frustrated. He presents as being concerned about his grades, often noting quantitative attributes of his work, such as the length of a music clip or length of his final presentation. While he began the course as an avid game player and expected to excel in game design, by December when asked what is most difficult about the course in the mid-survey, Jonathan expresses openly that he has trouble coding games. He states that “the most difficult thing about this class is the coding. It is hard to find the right coding and get that code to work. Coding is time consuming.”

In the post-survey, he states that “I like that we got to work in groups to make a game. I like that we were allowed to research on any site to find coding help.” Here it appears that for Jonathan, the autonomy was enjoyable, however these comments contradict his mid-survey comments reflecting that he felt he needed greater support from the educator in learning programming. It appears that Jonathan has mixed feelings about the way he is learning in Globaloria, and lost motivation when he became frustrated along the way.

Mrs. S offers some comments with the observation that students who are willing to tinker and experiment ultimately find solutions to design problems, whereas some of the high-GPA students who usually excel actually find problem-solving quite difficult and lack patience to figure things out. It appears that Jonathan was not particularly patient and was quick to become angry in the face of design hurdles. He self-reports that maybe Globaloria made him become more patient. This finding warrants further exploration. However, self-led learning appeared to deter Jonathan who didn’t ultimately gain these skills.

Jason

As a second-year participant, Jason excels in this mentorship role, supporting other students in their game design efforts, developing tutorials, and documenting the class in two mini-documentary videos. In his role as a student, his final game, “SIM (Sigma Iota Mu) University,” is attractively designed, imaginative, and receives an above-average game evaluation numeric value. Taking into consideration that he worked alone, it appears that this value reflects a relatively high score indicative entirely of his own skills (in contrast to games reflecting team work whose scores reflect knowledge distributed throughout a group). However, Jason’s educator was somewhat disappointed that he did not make greater efforts to finish his game at the end of Semester Two.

Jason imaginatively plays with his identity as a college student in the content domain of the game, possibly to prepare himself for this new endeavor. As a second year student, Jason advances in his programming skills, and shows strong evidence across the most constructionist CLA categories for his knowledge gained.

In considering the 6 different CLAs that Globaloria promotes, Jason’s case study shows the least evidence of CLA 6 (surfing websites and experimenting with web applications and tools) as there is not much data to show that he engaged in activity relevant to this CLA. There is also minimal evidence to support practice

with activities of CLA 5 (information-based learning, purposeful search, and exploration) as he does not conduct research to support his game idea.

Jason expresses proficiency in CLA 4 (social-based learning, participation and exchange in a networked environment); he has demonstrated that he can collaborate using Web 2.0 tools as he maintains a blog, posts regularly to his wiki, and makes himself available to other students via instant messaging. He has also commented on the wiki pages of other students, exchanged feedback with them, and presented his prototype and iterations of his game. He also demonstrates strength in CLA 2 (project-based learning through online project management in a wiki-based networked environment) through his thoughtful planning and prioritization of game elements. And, he presents some of evidence of CLA 1 (invention, progression, and completion of an original digital project idea) in the overall conceptualization of SIM University, and at minimum its intended and planned functionality.

Jason also states in his final presentation that his participation in Globaloria has inspired him to choose English Education as an intended college major, which will likely lead him to a teaching job one day. He credits his participation in Globaloria with helping him discover this interest in teaching. His participation in creating tutorials and his interactions with younger students indicates he has a high proficiency in and enjoyment of teaching and presenting educational materials to an audience. His creation of tutorials offers initial evidence that when knowledge is developed and learning processes are shared by students in the form of self-made tutorials, archived versions of tutorials as learning process artifacts might be successfully used by future cohorts of Globaloria participants, and recapitulated in later students' own learning processes.

Summary of Recommendations and Conclusion

A further thread that has been woven as a theme throughout all the cases is the extent to which students are expected to engage in self-led learning. All students mention the difficulty of this, and all students discuss and provide evidence of struggling with coding. At the same time, the students also offer evidence of enjoyment in the autonomy afforded by self-learning.

While, pure and simple, *game design requires hard work*, it appears that improvements could be made to the Globaloria program in the following two areas:

1. Improving scaffolding support to students: It appears students participating in Globaloria could use more direct expert guidance and scaffolding when they are beginning to shape the plans for their projects, and, when they need help in the moment, in their design, programming and game development.
2. Enhancing the structure of the curriculum: It appears that especially for single-semester students, the Globaloria curriculum and resource materials could be reviewed and optimized to enable students to create a complete and final project in the given timeframe.

In addition, it appears that the wiki is a platform of student sharing, expression and exchange that may be going under-utilized by students due to the lack of ease with which it facilitates dialogue. Students have become accustomed to using slick synchronous and asynchronous communication interfaces including Facebook, chat and phone texting. Facebook comment features allow for discussion of student posts in a rapid, easy to use interface. Thus, it may be that for today's students, the wiki's organization is not quite optimal in sparking exchange and team collaboration, as it existed in Pilot Year-2. As the World Wide

Workshop continues to develop the wiki platform, we expect to expand its social media features to become more seamless, to encourage more fluent communication among students about their work, in the context of their file postings.

Overall, the case study findings provide ample evidence that the project founders and staff, and participating school administrations and teachers are making ample strides in implementing and continuing to refine the Globaloria program, and that the present participating West Virginia students are engaging in positive experiences that are affording them the opportunity to develop contemporary learning abilities, in preparation for successful futures in today's knowledge-driven professional work environments and cultures.

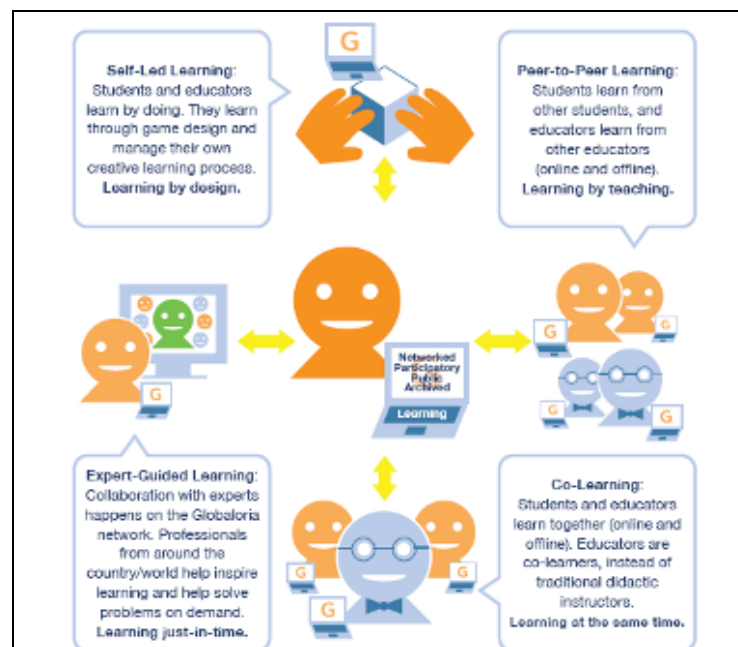
Introduction

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



Purpose of this Study

This paper reports findings from Pilot Year Two (PY2) of this model implementation in the state of West Virginia. In this report, we focus on results for a single pilot location, Randolph Technical Center which is a vocational technical high school in Elkins, WV. The report addresses two main Research Questions:

- In what ways is the Globaloria program engaging for the participating students at RTC?
- In what ways did students develop new skills and learning abilities through their participation in Globaloria in Pilot Year 2 (2008/2009)?

These questions are addressed through qualitative case study findings for RTC three students. One West Virginia case study student, Jonathan, is a 16-year old junior in high school, and participated in the first semester of the program only (Game Design I). The other two students, Cathy and Jason, were both seniors and participated for the full year. After participating with a full class in the fall semester, these two students elected to take Game Design II as an independent study during the spring semester, along with three other students. It was Jonathan and Cathy's first year of participation. Jason was a second-year participant who participated in Pilot Year One of the study at RTC, and who in Pilot Year Two, took on two roles in the program, as student, and as an intern of the World Wide Workshop Foundation.

6 Contemporary Learning Abilities

As students engage together in Globaloria, 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 1 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 1. Contemporary Learning Abilities (CLAs)

Contemporary Learning Ability:	Examples of Globaloria activities that cultivate CLA:
1. Invention, progression, and completion of an original digital project idea (<i>e.g., an educational game or simulation in the Globaloria context</i>)	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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 (<i>e.g., creating and uploading digital graphics, interactive designs, videos, notes, prototypes, and games</i>)	<ul style="list-style-type: none">• 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.

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. 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).

Very few, if any, of these objectives are being met in traditional education, and students are entering college and the workforce unprepared with digital skills. Thus, 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 is continuing to be refined and developed iteratively. As we document student advances in their CLAs longitudinally across time, we expect to find evidence that participating students are integrating these abilities into their professional skill set earlier, and more effectively, than their peers who have not participated, leading to expanded life and livelihood opportunities.

RTC, One of Twenty-Four WV County-Level Regional Technical Centers

Among the thirteen Pilot Year 2 participating schools was Randolph Technical Center (RTC), a regional vocational high school offering programs to students from Elkins, Harman and Tygarts Valley. Students specialize in one of several programs, such as Automotive Technology, Mill and Cabinet, Business Education, Masonry and Power Equipment Systems and must take at least four classes in their specialization. Some RTC classes are also offered at the high school and all students in the Globaloria-RTC program were enrolled there. Students at Elkins High have their time divided into 4 blocks of classes each day and can schedule a class at RTC during any of these blocks. Approximately 90% of Elkins High students take at least one class at RTC during their high school career.

Most counties in West Virginia offer technical education via regional centers, high schools, colleges and specialized facilities.¹ Career and Technical Education programs utilize over 300 schools and are available to students in every county. The program operates 34 high schools, 24 county centers with five or more occupational areas, 7 multi-county centers, 16 colleges/universities offering career/technical education and 3 specialized facilities. The US Perkins Grant program subsidizes some of the state initiatives.

RTC has a computer lab, with about 25 recent-model desktop Mac computers.



Figure 2. Randolph Technical Center (RTC), Elkins, WV

Randolph Technical Center, <http://ravic.org/>

[RTC] opened its doors during the 1976-77 school year. During the past two and a half decades, literally thousands of students have received training, developed leadership skills, and grown into productive citizens via the Center. Virtually every area of employment in Randolph County can boast a graduate of the Randolph Technical Center. Graduates have become employed in professional, non-professional, technical and skilled careers. Approximately 56% of our graduates continue their education; another 42% become employed within the first three years following graduation.

¹ See WV Department of Education website, <http://careertech.k12.wv.us/>.

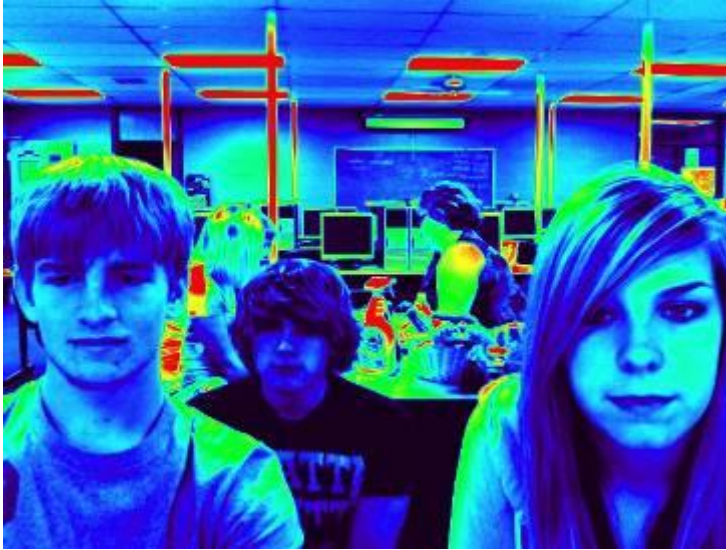


Figure 3. Composite of the Mac Computer Lab at RTC, and some Year 2 students

Globaloria integration into RTC Course Schedule

RTC was a returning pilot location in 2008/2009 that also participated in the 2007/2008 school year. Prior to Globaloria, no high school classes about game design, Web 2.0 activities or social networking had previously been offered at RTC. Globaloria was implemented as an elective course called *Game Design I*, offered for credit during school hours to students in grades 9 through 12 and integrated with the Business Education curriculum for the 2008/2009 school year. Twenty-three students participated in Pilot Year 2 in the fall semester, taking a Game Design I course. Then in the spring semester, Game Design II was offered as an independent study course in which five students enrolled and participated (three of whom were participants from Pilot Year 1 in 2007/2008, and two of whom continued on from the Pilot Year 2 fall semester).

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

I. Getting Started

Course Overview
Create Your Profile
Create Your Blog
Participation Guidelines

II. Game Design Topics

Playing to Learn
Choosing a Topic
Mini Game Project
Imagining Your Game
Paper Prototyping
Planning Your Game
Drawing in Flash
Adding Navigation
Adding Animation
Adding Sound
Adding Interaction
Assembling the Game
Presenting Your Game

III. Game Development Topics

Development Plan
Intro to ActionScript
Programming Practices
Learning from Others
Finding Solutions
Moving on a Path
Special Effects
Scrolling Background
Score Keeping
Collision Detection
Sound Effects
Timer
Character Effects
Drag and Drop
Platforms
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/>

Student learning is supported by their educators, through online resources and tutorials, through periodic virtual training offered by the World Wide Workshop Foundation, and through sharing and collaboration with their peers.

Method

In this paper, we use case study method to explore the performance of three students. We also draw from results of a content analysis conducted upon all Pilot Year 2 games, providing the numeric value (or “score”) that was calculated for the games presented in the case studies, when the game was coded using an inter-coder-reliable content analysis coding scheme. The approaches utilized in the case studies and content analysis are described as follows.

Case Studies

In the 3 case studies, for each student we present findings as they emerged in chronological sequence in the data across Semesters One and Two. The data sources for each case study are as follows:

- 4 Educator Progress Reports submitted quarterly to the World Wide Workshop Foundation, presenting a brief synopsis of each student's performance;
- Students' pre-program survey responses to 5 open-ended questions (late August);
- Students' mid-program survey responses to 13 open-ended questions (early January);
- Students' post-program survey responses to 9 open-ended questions (conducted in January for Jonathan, and in May for Cathy and Jason)
- Wiki posts (including text, video, game design files, graphics files, Flash project files, code);
- Blog posts
- Post hoc interview with the educator to clarify and confirm some findings

Case study student Jonathan participated in Semester One only, and students Cathy and Jason participated for a full year. In each semester, the students met daily (Monday through Friday) for 90 minutes, totaling about 7.5 hours per week of in-class time.

To make sense of all the extensive data and develop the student case studies, we batched the disparate data from all of the sources by student, and by chronological order, and developed observations about student performance across time based on the content observed and reviewed. As we batched the data together and reviewed student performance, certain trends and findings emerged for each.

Chronologically, Semester One data sources used were as follows.

First Half of Semester One (September/October, 2008):

- First Educator progress report (September, 2008)
- Students' pre-program survey responses to 5 open-ended questions (late August);
- Student Wiki activity and blog posts for this timeframe

Second Half of Semester One (November 2008 - Early January 2009):

- Second Educator progress report (December, 2008)
- Students' mid-program survey responses to 13 open-ended questions (early January);
- Students' post-program survey responses to 9 open-ended questions (conducted in January for Jonathan)
- Student Wiki activity and blog posts for this timeframe
- Post-hoc interviews with the Educator

Then in Semester Two, the data sources were as follows.

First Half of Semester Two (January 2009 – Early March 2009):

- Third Educator progress report (March, 2009)
- Student Wiki activity and blog posts for this timeframe

Second Half of Semester Two (Late-March 2009 – June 2009):

- Fourth Educator progress report (June, 2009)
- Student Wiki activity and blog posts for this timeframe
- Students' post-program survey responses to 9 open-ended questions (conducted in May for Cathy and Jason)
- Post-hoc interviews with the Educator

In the case studies that follow, we present observations, evidence from the data, and summarized findings for each individual student, related to the study's two research questions on student engagement, and contemporary learning abilities gained. The resulting cases present a narrative of student engagement, and in many ways the data presented tells its own story.

We wish to note here that the Wiki served as a valuable data source in that it offers a history of all student actions. Students must login each session in order to contribute anything to the site, so their actions are recorded and searchable in the Wiki history and archives. Further, the wiki provides automated overall metrics for each individual student's activity (number of wiki edits and uploads). It was very useful for case study generation by researchers who were working remotely and using students' produced and posted work as a main data source.²

Content Analysis Method

For each student, we also provide the content analysis coding metrics for the final game artifact they created with their team members. Neuendorf defines content analysis "as the systematic, objective, quantitative analysis of message characteristics" (2002, p.1). A key word in this definition is "message." Neuendorf explains that in order to use content analysis, "there must be communication content as a primary subject of the investigation" (p. 14). She makes references to text as the message, but further notes that, for example, "the text of a film includes its dialog, its visuals, production techniques, music, characterizations, and anything else of meaning presented in the film" (p. 15).

Content analysis suits our research into the form and message of final student games for two reasons. First, a primary individual goal of the program is to facilitate students' construction of a final digital interactive game artifact. Thus, there are functional constructive qualities of the games that can be analyzed and measured. Secondly, as part of the overall mission of Globaloria, students are encouraged by their educators to produce games with social or educational messages to them; that is, games are purposefully constructed with the goal of conveying messages about social or educational topics. That said, some students choose to create an entertainment game in cases where educators give them the option to choose whatever theme they wish. Thus, we have found that we can categorize game subjects into three domains: educational, social issues, or entertainment.

In this way, the medium itself (the game design and functionality) is considered part of the message. Furthermore, our coding scheme touches on the deeper subtexts in the game content as well (seen for instance in the topics that students choose, such as global warming, and the way they express the game narrative).

² In Pilot Year 2 we did not conduct site visits. In Year 2 we sought to evaluate whether the wiki data sources we used were sufficient for capturing the learning process. We wished to consider how much we can infer about a case, and about students' learning, drawing upon the actual work they produced and posted online to the Wiki environment. This is important because we expect that actual student work produced will be a key data source for the research moving forward as the project grows.

Our content analysis procedure was conducted using a coding scheme that was developed to evaluate students' engagement and development of new skills in Globaloria during Pilot Year 2 of the program in West Virginia (the 2008-2009 academic year). Researchers who were working remotely from the actual on-the-ground project in West Virginia developed the coding scheme, through virtual interaction and play with students' final digital project artifacts— those social-issues, educational and entertainment genre games students created and posted online during their Globaloria involvement in Pilot Year 2.

The coding scheme measures features in students' finished game projects and related wiki postings, allowing for inferences about valuable learning that resulted from student game-making. For the purposes of game content analysis, and given the wide variation in quantity and complexity of features included in student games, we define "game" as: a file that goes beyond a mere image, to include some level of interactivity, in which, at minimum, the file provides response to the player, based on a player action. We further classify a "game" as a game that reflects a .SWF (Small Web Format) file, with at least a button or character that moves and a response screen based on clicking of buttons/objects.

The coding scheme draws upon the major objective of the Globaloria program: building students' *Contemporary Learning Abilities* (CLAs) (Reynolds & Harel, 2009). The coding scheme presents a robust set of game attributes to be counted, which map to the CLAs. Students' inclusion of the given attributes in a game indicates that he or she has gained knowledge in the related CLA dimension, because in order to code the game with a given attribute requires learning the given skills.

The content analysis coding scheme measures and assesses students' contemporary learning abilities, by focusing on students' actual game design work conducted in the course of a year-long constructionist program of project-based learning. Three coders reached an average of over 80% reliability when coding 10% of all 95 games created in pilot year 2 across the 13 Globaloria pilot locations. This is an acceptable reliability level for content analysis. The final content analysis coding scheme we used is presented in Appendix A of this study. Analyzing games provides us with direct insights into students' development of CLAs in the following ways. Appendix A provides the specific codes used for each coding scheme category below.

CLA 1: Invention, progression, and completion of an original project idea for an educational game or simulation

- Indicated by the following coding scheme categories (and individual codes within):
 - a. Game Design
 - b. Game Functionality,
 - c. Game Audio Visual, and
 - d. Game Subject/Narrative

CLA 2: Project-based learning and project management in wiki-based, networked environment

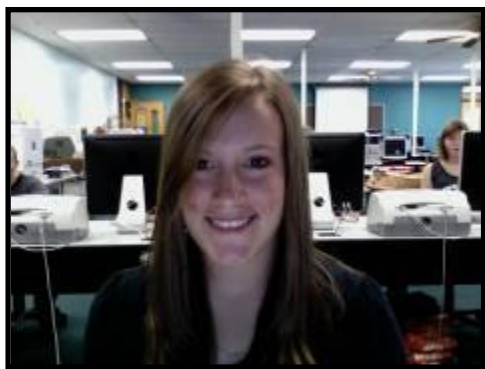
- Indicated in particular by the following coding scheme categories (and individual codes within):
 - a. The Game Plan and Demo (it's inclusion on the wiki, and it's qualitative depth)
 - b. Game Functionality, Game Audio Visual, and Game Subject/Narrative categories (because to achieve these categories, the student needs to have successfully project-managed the game's development).

There coding scheme we used predominantly codes for CLAs 1 and 2, and thus the higher the score, the greater extent of learning has occurred in these two CLA categories, because in order to include the elements coded, the individual must have the requisite knowledge to do so. For these more Constructionist CLAs 1 & 2, the game artifacts themselves (measured and reported upon here) may be the strongest indicators. While it is an imperfect metric of *individual* learning because in two of the three case studies presented, the students worked in teams, the value attributed to the games provides a metric for comparison between and among the games as artifacts, and with the aligning case study data we can gain a sense of what game design and programming roles students played within their given team context.

To some extent the coding scheme also addresses CLA 3 (posting, publishing and distributing digital media designs, videos, graphics, notes, and games) and CLA 4 (social-based learning and exchange), indicated by the coding scheme category of playable game *presentation on the wiki*, which requires students to publish, share and discuss their game artifacts with other students. And, to some extent the coding scheme also addresses CLA 5: Information-based learning, research, purposeful search, and exploration in that we have 1 code about student research that appears to have gone into the game narrative.

This approach to evaluation provides an alternative to administering a standardized knowledge test. Here, students' knowledge gained is evaluated through identifying the extent of their productive output in constructionist work towards a final, completed project, based on a set of learning objectives. A full methodological description of the coding scheme development is presented in the Globaloria report by Reynolds, Scialdone & Harel Caperton (2009) entitled "Developing a Content Analysis Approach to Measuring Student Engagement in Constructionist Game Making Learning Environments."

Cathy



Globaloria-WV case study student Cathy is a senior at RTC in 2008/2009, age 17, and it is her first year participating in the Globaloria program. She participated for the entire year, electing to continue on as an independent study student in Game Design II in the spring semester. Regarding her background, she states, “i was born in Elkins and have lived in Montrose all my life.... I enjoy going to football games and playing volleyball and softball.” Prior to Globaloria, for her career plans, she states, “i plan on going to WVU to be a physical therapist.”

Cathy states in her first blog post that her reason for taking part in this program was that she did not know much about computers. Asked why she chose to participate, and what her goals were, she states in her pre-survey, “I thought that game design would be fun and interesting. To learn how to make and play games.” Regarding her game ideas prior to Globaloria, she states in the pre-survey, “i have no idea. i haven't really thought about any ideas.”

We chose Cathy for case study because she exemplifies a female high school student who has little background in technology prior to starting the course. Cathy also did not have a prior interest in gaming but her curiosity was piqued when she saw a design-oriented class offered at her school, so she decided to try something new. Cathy is a student who thinks knowing more about technology might help her in the future but is not entirely sure yet in what ways.

Through her experience, we observed Cathy grow in confidence, evolving in her first semester team project from her role as graphic designer, into becoming the group’s main programmer. Cathy evidences strong perseverance and self-initiative in solving design problems. Due to her successes in the first semester, she continues on in Semester Two with a new game design collaborator, Emma, to create an educational game called “Learn the Bones” that ends up winning first prize in a local Flash game design festival.

We believe Cathy is typical of many students in this age group who have little prior technology experience, but find a valuable learning experience in the activities afforded in the Globaloria program at her school.

Semester One Wiki edits and uploads, Cathy and her class

Students use the wiki as an online learning environment for sharing, collaborating, and presenting their design artifacts for peer feedback. Wiki engagement for these purposes is a key objective of the Globaloria program, reflected in CLAs 2, 3 and 4. Here we provide some data on students’ Wiki edits and uploads across Semester One, offering initial insights into students’ level of wiki activity across the timeframe. We present Cathy’s individual activity monthly, in relation to the class range.

Table 3 shows Cathy’s wiki edits for Game Design I by month, and compares her posts to the class range. In September, she made 89 posts, which was in the upper range compared to other students. In the later months, she performs from the lower to the mid range in her wiki page editing activity. Her wiki editing activity appears to taper somewhat in later months.

Table 3: Cathy's Wiki Edits from Game Design I, by Month

Month	Cathy's Wiki Edits	Range of Wiki edits, low to high
August	7	3 - 31
September	89	9 - 101
October	38	10 - 94
November	18	4 - 49
December	24	2 - 63

It appears from the wiki activity overall for this location that students at RTC made wiki edits to profile and project pages more frequently when they first began in September, tapering off somewhat while learning game design (November). Then wiki activity begins to pick up again at the end of the course when their game files are more complete and ready to be shared.

Supporting the results for wiki *edits*, Table 4 indicates Cathy's wiki *uploads* from Game Design I, in which she added files such as Flash files or images to the wiki. Her metrics are again mid-range during this time, with a few instances of posting just slightly more than her classmates. Her activity in uploading is highest in October.

Table 4: Cathy's Wiki Uploads from Game Design I, by Month

Month	Cathy's Wiki Uploads	Range of Wiki uploads, low to high
August	3	2 - 5
September	6	3 - 14
October	15	4 - 25
November	7	2 - 14
December	9	0 - 21

Overall, Cathy's wiki activity is about average in most months. Students were in class for 90 minutes each session, and with vacations and weekends, were in class about 18 days per month on average. The wiki activity of the class as a whole at RTC appears on average to be about four edits per student per session, and less than one file upload per student per session. Thus, it appears that networked wiki editing and uploading comprised a small proportion of their class activity, in comparison to time spent creating their games using Flash software resident on their computer's hard drive.

In Pilot Year 2, blog posts were not required by the educator. Blogging as an activity was introduced at the start of the semester to students and it was optional; most students did not engage in blogging at this pilot location. The educator confirmed that in Pilot Year 3, blogging would be required weekly.

Cathy's Participation in Game Design I: First half of Fall Semester, September/ October, 2008

In the first half of the semester, students proceeded through several syllabus Game Design topics and assignments, up to and including the topic, "Adding Interaction." In this timeframe, Cathy completed tasks on her wiki project page that include "Playing to Learn," "Social Issue Games," "Imagining Your Game," "Adding Navigation," "Animation," and "Adding Sound." In her team, she also contributed towards work on

the topics, ““Paper Prototyping,” “Planning your game,” and “Drawing in Flash.” In the first several syllabus topics, students are introduced to games in general, game genres, and a structured approach to thinking about different components of a game (such as the topic, storyline, genre of game, and types of functionality they might want to include). Students then begin to learn game design in a modular sequence that leads them to creation of a final Flash game file that is playable and represents the themes they have chosen to express.

The educator at this location made the instructional strategy decision that students would work in teams to create games in Semester One. Cathy engaged in individual work during this timeframe, and she also joined together with teammates Jonathan in 11th grade, and Andrew in 10th grade starting on September 9, 2008, in a team they call “JAC in the BOX,” with JAC stemming from the initials of their first names.

In work posted to meet the requirements of the “Imagining Your Game” section, in early September, Cathy posts a digital image of the outdoors she created in Flash using the imaging tools to her own wiki profile page, and posts a description of her group’s game that includes a dynamic background image. Screenshots are shown in Figure 4 below. The image at right presents the team’s initial game plan which describes their intention to create a “global issues game” about recycling.

Figure 4: Examples of Cathy’s Early Project Work, September, 2009 --
Animated Design Artwork and Semester One Game Plan for Landfill Destroyers Game



Cathy’s Early Reflections on Her Experience

Cathy’s profile page on her wiki contains a grid table with self-reported progress notes, using a template that was provided by the World Wide Workshop Foundation on every class wiki. Cathy’s blog page also provides some glimpses into her reflections on what occurred during this time. Cathy appears to have kept up with the progress notes diligently, documenting work completed after nearly every class session.

Cathy’s first blog post on September 3, 2008 notes that she was not familiar with computers when she began the course, and that within two weeks she was progressing much more quickly than she had anticipated. She writes that “I have only been in this class for about 2 weeks but I still feel that I have learned more than I thought I would. The game that I hope to make would be fun but at the same time I hope that the people playing it would still learn something from the game.” On a blog post dated September 18, 2008 she states that “Flash is a really interesting way to make and design pictures and objects.” Overall, her blog posts in this early timeframe indicate positive affect and enjoyment toward the program.

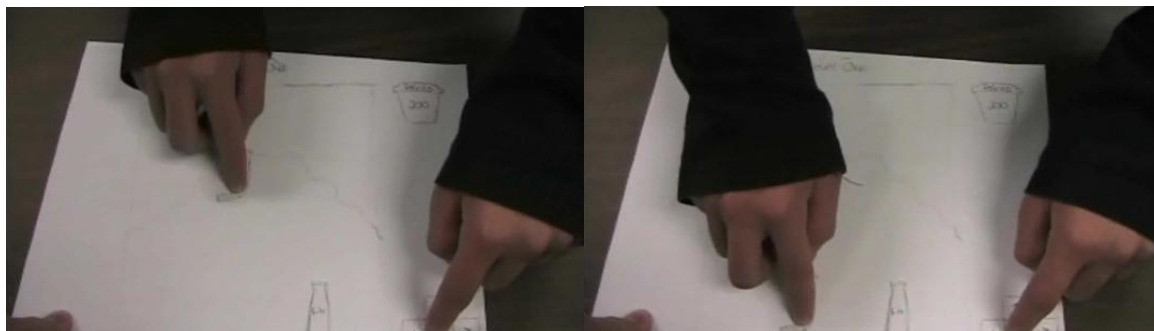
Paper Prototype

As September progresses, Cathy begins to work more with 3 teammates in JAC in the BOX . These students created a team wiki profile page in addition to their individual profile pages. On September 25, 2008, the students post their a video of their paper prototype on the JAC in the BOX team page, which presents the early plans for their team game. The prototype provides some structure for the students' wide-ranging early ideas, and allows them to make some initial design decisions on paper, before delving into design with the software tools.

The team names their game "Landfill Destroyers" and sticks with their initial plan to create a game about the importance of recycling. They use different pages to show different aspects of their game, and paper cut outs to simulate moving objects. The presentation of the paper prototype is narrated by one of the male student team members, and the other male student makes sound effects for specific elements of the game. It appears that Cathy filmed the video presentation, and contributed to the art and design of the paper prototype.

The prototype indicates that game play will consist of navigating objects that fall from the top of the screen down into a landfill, with the objective to get certain objects into a trashcan. They explain that with each level, the objects fall faster, and that the players need to earn increasingly more points, so he or she has to be more adept at navigating objects using arrow buttons. Once a set number of points are earned, a level is cleared and a fact about recycling is presented to the player. The game gets increasingly difficult up to level 5, which they note features objects falling really fast. Figure 5 features screen shots from their presentation.

Figure 5: Screenshot of Paper Prototype Video that Students Uploaded and Embedded to the Wiki: Cathy and Team Demo Their Plan for Level One of "Landfill Destroyers" Game



On the JAC in the BOX team wiki, they post a game pitch that describes their game in more detail. They write:

Audience: The game is for ages 10 and up, We made it that way because both adults and children need to know about recycling.

Game Play: The people that play this game will see a landfill in the background, and as the levels go on the landfill in the back ground decreases in size. They will try to put the recycled items such as bottles, glass, metal, paper, and cans in rows and recycle them, instead of them going to the landfill. You will control the objects by using the arrows on the keyboard. At the end of the 5 levels the game is over, but it's not as easy as it sounds because the higher the level the faster the objects come.

What are the rules? The goal of the game is to make it to level 5 (the end of the game) by recycling. If you make it then you will win.

Fun Factor: The players are challenged because the levels get faster and you need more points as you move up in the levels. It will be fun to play our game, because most people like games that are interesting and not too confusing.

Intelligence Factor: Our game is made to teach people about recycling, and to learn different facts about recycling to should them how important it is

Style Factor: The animation in our game is going to be cartoonish. It is going to be hard to make everything realistic in our game idea, given our experience and that it is simply a bunch of falling recyclables plus education. The sounds in our game will be glass shattering, paper being tore apart or crumpled into ball, plastic popping after being squeezed, metal being crushed, and aluminum cans being opened. The music will go to the speed that the objects are falling.

Originality Factor: What makes our game different is that it combines a fun game with the prospect of learning about the benefits of recycling. It has recycling objects falling that gather into a row so that they can get recycled. Making a game that has to be about recycling is a pretty original idea.

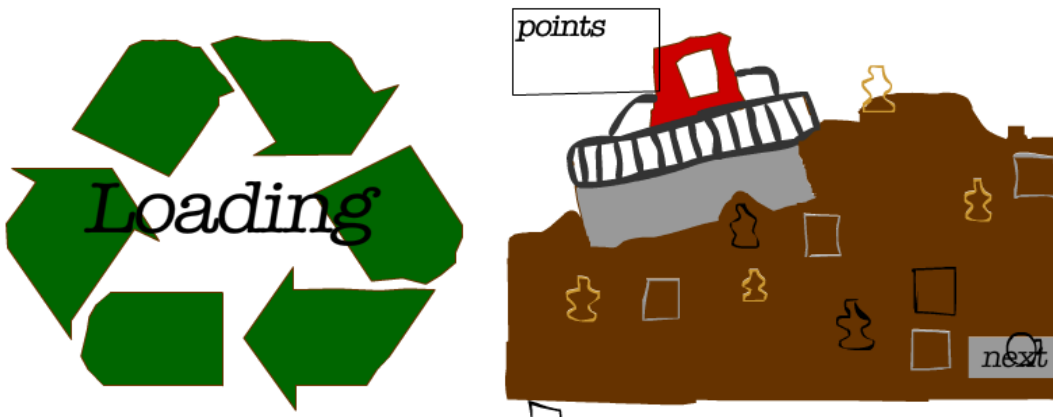
Team Introduction: The name of the members of JAC in the BOX are Cathy, who is a senior, Jonathan, who is a junior, and Andrew, who is a sophomore. Jonathan and Andrew have experienced video games. Cathy is our main drawer and, to a point, organizer and supervisor. Most of the group shares its responsibilities; If we see something that needs done and we know how to do it we'll jump in and get it done.

In introducing the team, the group members state that Cathy is the key artist in the team, that she is in a leadership role, and that everyone is involved in getting tasks done when required. In the educator's first progress report on written September 31, 2008, Mrs. S notes that "*Cathy is definitely a team leader. She is working hard and makes sure their group gets all assignments completed. She will probably do much of the artwork but will probably do a little of everything.*"

Early Flash Game Design Artifacts

Cathy's wiki work in the first half of the semester showed that her work was focused on completing syllabus assignments to create files that would be used in her team's final game. Figure 6 shows two screenshots from her game design work on her project page. The first image represents the game's loading screen, and although it is not captured in a static screenshot, the recycle arrows rotate clockwise. The second screenshot also contains animation, as some of the objects seen in a landfill move from top left, down to the bottom, and then jump back to the top to fall again. These postings are evidence of Cathy successfully learning how to animate objects in Flash.

Figure 6: Screenshot of Landfill Destroyers Game Animations Created by Cathy -- Loading Screen and Creative Animated Landfill Screen with Moving Objects



Mid-Semester Game Presentation

At the mid-point of the semester, JAC in the BOX gives a presentation of their in-progress game. The game at this point includes a few actual screens and animations, and some side graphics are presented that reside on the wiki, that the team states will be included in their final game. Cathy begins the presentation by introducing the group and noting that she is the team's artist. Jonathan, who is discussed below in the 2nd case study, explains that he will be doing the music and share in the programming of the game, which Andy will help him with.

As they walk the audience through different screens of their game, all the examples shown in the video is design work that Cathy has completed, as evidenced by its position on her personal project page, and not the team page. Figure 7 is a screenshot from their presentation, as the team presents Cathy's loading screen to the audience. It appears in the video that so far, her efforts are leading the group.

Figure 7: Video of Student Mid-Semester Class Presentations-- Cathy's Team Chooses her Loading Screen, and Presents Game to the Class



Most of the material students are introduced to in Globaloria is entirely new to them. The syllabus is designed to lead students towards a growing understanding of each varied component of a game, and ultimately, how each component contributes to the working whole. Students may not see the big picture right away. Thus, evidence of a growing understanding of the ways each module is building towards a

finished product reflects important advancement in systems thinking. At the end of this initial timeframe, Cathy begins to demonstrate a growing understanding of how different pieces of her project will fit together. For instance, in a blog post dated October 23, 2008, she explains that “today I went on the wiki and learned how to add sound to a slide. I put sound on my start clip and the sound was of a mouse being clicked on. Sound is going to help in the game a lot.” This post indicates three steps: a) inquiry to find resources on the wiki, b) modeling the task she learned about, using Flash software, and c) systems thinking regarding how sound effects will add to her game.

Game Design I – (Second half of Fall Semester, November-January, 2008)

The second half of the semester took place between November 1, 2008 and January 21, 2009. During this time, students focused largely on group work for their game, and were also given assignments from their educator such as their “9 Weeks Test” (a Flash movie that the students had to complete independently, demonstrating 5 concepts they have learned in the class).

In Cathy’s test file, she demonstrates, among other skills, that she has learned how to make functional buttons, basic animations, objects controllable via arrow keys, and morphing animations. Figure 8 shows the example of morphing objects from her wiki (the image at left transforms into the letters at right).

Figure 8: Screenshot from Cathy’s “Nine Weeks Test,” Showing Morphing Animation and Evidence of Flash Skills Learned and Recalled



The presence of a 9-Weeks Test given by the educator indicates an effort to assess students on a common scale, to ensure that the given set of skills had been achieved. This was an effort that she herself initiated; it was not part of the Globaloria curriculum. Ultimately it served as a way for Mrs. S. to note a grade for each student mid-way through. It may be that not all students actually used the skills she tested in their final game implementation, because the feature tested was not part of their original game idea. In Globaloria, the curriculum is flexible so that students’ development and build-out of their original ideas drive their learning.

Observations from Mrs. S on Cathy’s Performance

The remainder of the work for the semester posted to Cathy’s wiki appears to indicate that while Cathy emerged as a team planner and artist during the first half of the semester, during the second half, she became more involved in the Actionscript programming. Confirming this observation, in her progress report on December 6, 2008, Mrs. S notes that Cathy is “working with another student to do the coding for their game.” In her later March progress report when Mrs. S reflects back on Semester One and how it finished up, she writes that “Cathy became her group’s programmer when the person who was supposed to in their group didn’t do it.” Further, in a post-hoc interview, Mrs. S states that while programming became challenging for her other team members, that Cathy “can’t stand to leave things unfinished.” Thus, Cathy took responsibility for some of the programming activities originally intended by the male students in her group, to advance the game so the the team would have a playable game file to present at course end.

Further Evidence of “JAC in the BOX” Team Member’s Shifting Roles

Our findings confirm Mrs. S’s observation that as the semester progressed, the team dynamic of JAC in the BOX shifted. Jonathan, for whom we also provide a case study in this report, was Cathy’s team member and it appears that he had expected to be the main team coder, given that he held a prior interest in engineering. However, as the semester progressed, his interest and focus narrowed in on creating the audio for their game using the software program Garageband. The other team member, Andrew, posted only a single audio file to the team wiki and was otherwise not active in learning programming.

As a result, Cathy took on more responsibilities, learning Actionscript coding to a greater extent than her male team members, because she was highly motivated to finish a complete game. She realized that in order to achieve their goal, she would need to lead in programming to piece together the game files and build interactivity into the game.

Cathy’s Struggles and Successes Learning Actionscript

As the fall semester progresses and Cathy continues working on learning Actionscript programming, her blog posts and progress notes present an elevated level of affect towards the work (both positive and negative). Cathy uses the blog to vent frustrations and also to express messages of perseverance. On her wiki, she writes some text above 2 files that appear exactly the same, stating “the screen may look the same, but that is because i have worked on the same coding for the past couple of days. And am still having a little difficulty with it.” At another point on the projects page she notes “so this is all I have to show all though it looks the same as the others i went back over my coding looking for problems but still couldn’t find problems, even though they are there.”

As she struggles with coding, she begins to fear that her team’s game will not be completed. In a progress note dated December 16, 2008 she writes that “Today i got to the point where i started to worry about if the game is going to get done. I have tried to fix the same coding and even different codings for the past two weeks and i can’t seem to get them to work.” Yet, Cathy perseveres. The following day she states “frustrated but can’t wait to get it to work so that all my hard work will be noticed.” On January 2, 2009 she states further, “unfortunately my coding still doesn’t work, but that doesn’t mean that im going to give up and quit. There has to be a way to figure it out so why give up when you are so close. Besides it will feel good knowing that you have succeeded, in something.”

Cathy’s fellow students appear to have ceded coding responsibilities altogether to her. In her mid-semester survey, Cathy writes that coding was the most difficult thing about the course, and what she disliked the most. In discussing why this is, she stated, “one little object would mess up all of it.” She also revealed that she finds this course more challenging than most, observing that “It’s kinda harder because you learn coding on your own mainly. And if just one little item is wrong it all wouldn’t work.”

Cathy also observes in the mid-survey comments in December that while coding is difficult, the class “teaches you how to figure out problems on your own. And allow you to push yourself.” In fact, in listing the most important things that she learned from the class, Cathy states that she has learned “how to figure out a problem on my own” and that “it made me learn to never give up.” The frustrations expressed here contrast with her positive attitude and self-driven initiative toward the learning. These contrasting results provide evidence that Cathy may have enjoyed the autonomy provided, but could have benefited from having some additional support and guidance in her Flash learning at this stage. It also appears her fellow students gave up learning Actionscript because they were less motivated to engage in self-driven inquiry to use the resources available to meet their challenges with programming. It appears that more hands-on

Actionscript programming guidance from the educator might have helped the students get past design hurdles in the moment.

Comparison of Early Design Plans and Final Game

A comparison of JAC in the BOX 's paper prototype and the final game is presented as follows. This comparison demonstrates the extent to which students' original plans match up with their final versions, evidencing the Flash skills students learned to translate their early ideas into an actual, functioning game. The comparison also highlights work-around solutions and alternatives students needed to take, from prototype to final game creation due to the opportunities and constraints they encounter as they learn game design in Flash and Actionscript programming. Achievement of original goals offers evidence of CLA 2, project management.

The first drawing in the prototype is the loading screen, one of the first digital screens Cathy completed as seen above. The title screen also matches up consistently between their original prototype and their final project. Figure 9 shows the version of the title screen from the paper prototype, and the version in their final game as Cathy presented it to the class.

Figure 9: Paper Prototype and Final Game Presentation--
Evidence of Cathy's Success at Transforming Initial Hand-written Design Plans into a
Working Interactive Flash Game, January 2009

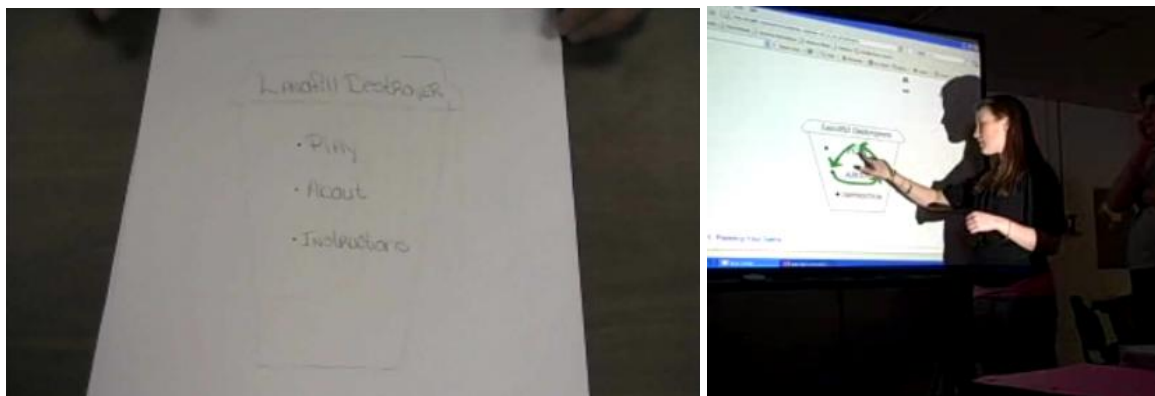
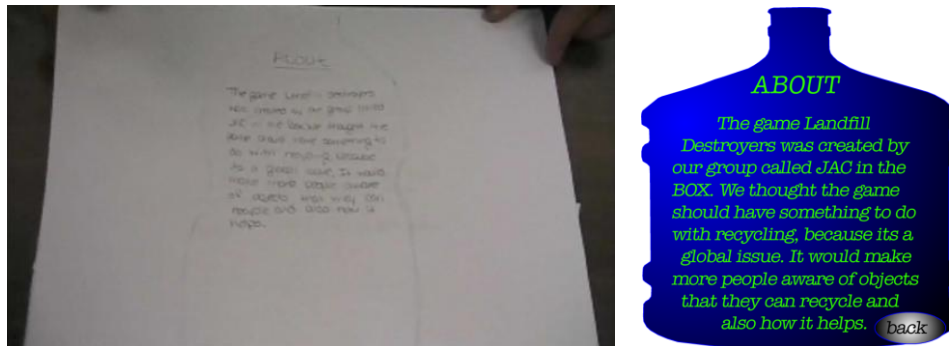


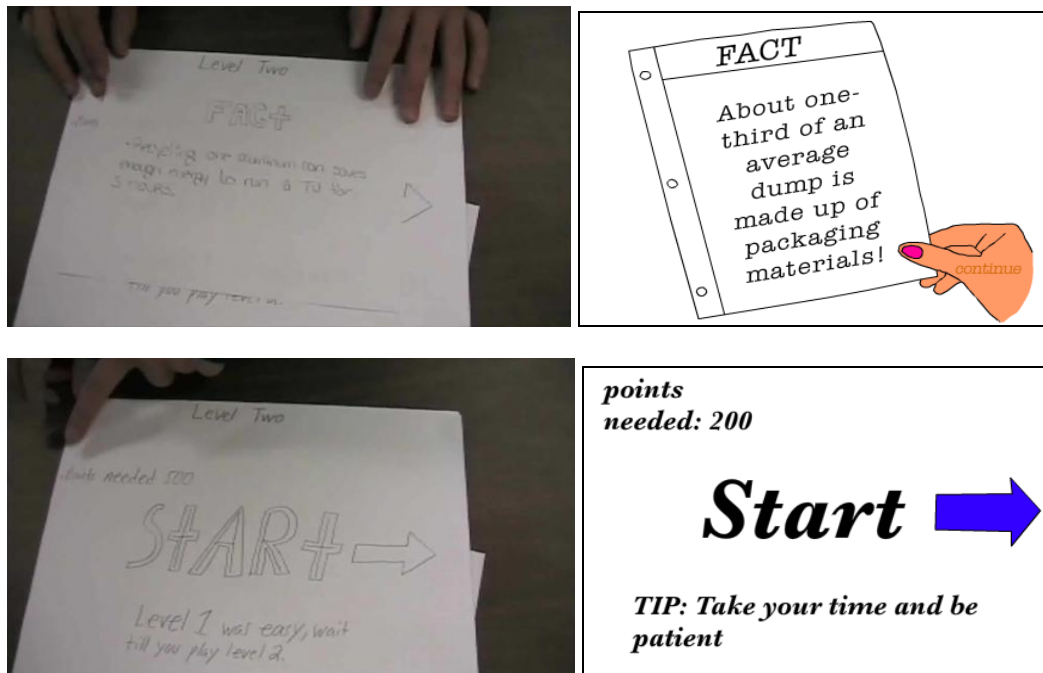
Figure 10 shows the “about” screen of their game which looks very similar from the prototype to the final version. Consistency in design is evident throughout the game’s screens. The loading screen is made of a recycle sign, while the title page, the about page, and the instruction page have text written inside of shapes that represent elements of recycling.

Figure 10: Comparison of Team Paper Prototype and Final Landfill Destroyers Game, “About” Screen – Evidence of Alignment in Game Plans and Final Outcomes



Choosing the start option from the menu provides instructions for level 1, explaining how many points the player needs to earn to continue to the next level, and how the game is played. The player then presses a start arrow to begin. These screens are illustrated below in Figure 11. While the look of these screens changed somewhat between the prototype and the final version of the game, the ideas remained essentially the same.

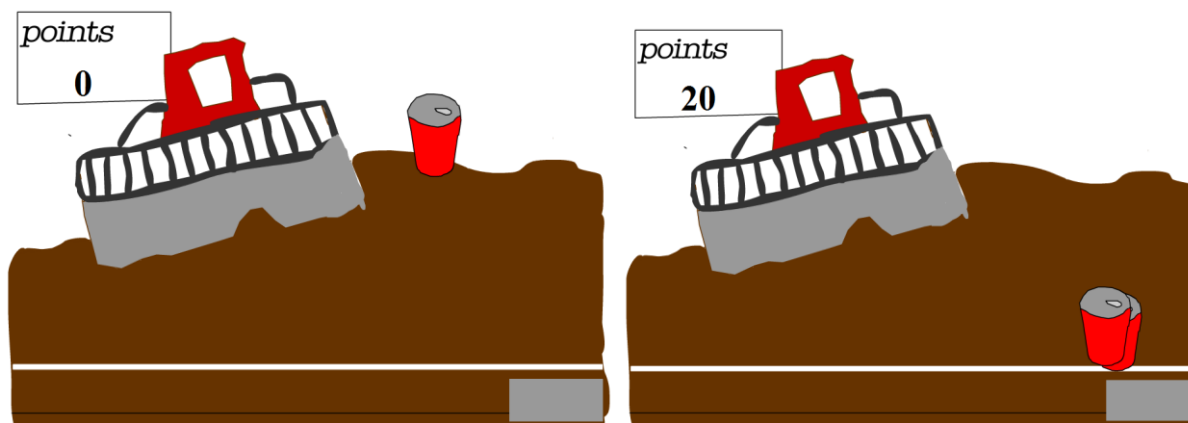
Figure 11: Comparison of Team Paper Prototype and Final Landfill Destroyers Game, “Facts” and “Start” Screen – Evidence of Alignment in Game Plans and Final Outcomes



The students were able to experiment with a score board feature as well, which requires more complex programming than simple buttons. In the final game file, the falling objects eventually come to rest at the bottom, in a landfill heap. The arrow keys make the cups move. If the user gets the cups into a gray box on the bottom right hand side of the screen, 10 points are awarded. However, as the game is unfinished, only

two cups fall, and the user is unable to get more than 20 points. While they were not able to fully build out the scoring feature, their initial attempt demonstrates programming knowledge. The following two screen shots from the game reflect the scoring.

Figure 12: Landfill Destroyers Scoring Feature, Evidencing Increasingly Complex Actionsript Programming



While the functionality of the final game does not meet all of the goals of the original design plan, Mrs. S's March Progress Report provides a summary of the Semester One activity, praising Cathy's Actionsript learning. Her progress report notes that "I nominated Cathy for my Student of the Semester because of her dedication to try to finish their game."

Content Analysis of Landfill Destroyers Game

Students across all pilot location schools in West Virginia in Pilot Year 2 created a total of 95 games. RTC students created a total of eight team games during the fall semester, of which Landfill Destroyers was one.

In order to evaluate all games on a common scale, we content analyzed all student games created in Semester One and Semester Two, using the process and coding scheme described in the Method section. Out of a total of 26 possible game attributes that we included in our coding, the Landfill Destroyers game achieved an overall value of 14. The table that follows indicates the final tally. The codes detect the presence of the student designers' skills in CLA categories 1 and 2.

Table 5. Landfill Destroyers Content Analysis Results

Game Title: Landfill Destroyers Student/Team Name: JAC in the BOX Team or Individual Game: Team URL: http://www.myclife.org/usa/wv/rtcwiki/index.php/Image:Land5.swf BRIEF GAME OBJECTIVE: Stack the recyclables to earn points.		
CATEGORY	CRITERIA	1= Yes
Game Plan and Demo [Design Template;	Did the students create a Paper Prototype?	1

Prototype]		
	Does the game appear complete/finalized?	0
	Please EVALUATE the Game Design Plan for its written content describing student intentions for their game design (Overview, pitch, scenes, elements/assets, etc.) [0=None; 1=Incomplete; 2=Satisfactory; 3=Thorough/Excellent]	3
Playable Game Design	Are there gameplay instructions?	0
	Does the game play exactly as the instructions specify?	0
	Is there a visual / graphic STYLE that carries throughout the game, consistently? (e.g., color-scheme, character-design, are game-play objects in consistent locations throughout the game)?	1
Playable Game Functionality	In all relevant instances, does the game offer feedback to the user based on actions (e.g., quiz game provides feedback on a response; when a character dies a life is lost or a message appears; rollovers change color or display a pop-up; do collisions elements work properly)?	0
	Do the feedback / response elements add to the challenge of the game, (e.g., the game is over if the timer, lives, or health run out; scoring is variable; the game can be "lost" or "won")?	0
	Are there objects (not characters) that are interactive for the player (e.g., buttons with rollover; objects that can be drag and dropped)?	1
	Are there characters that the player can interact with (e.g., player avatar that moves with arrows, and/or enemies or allies that are animated or moving)?	1
	Do the objects and/or characters interact to cause some effect? That is, do objects detect collisions? (e.g., objects bump and change direction, character gains/loses life when it touches something else, gains/loses points, etc.)	0
	Are there multiple levels, progression of different scenes, and/or increasing difficulty?	0
Audio/Visual	Are visual elements well executed (e.g., are images clear without blurriness or 'fringing')?	1
	Is there background music to the game?	0
	Does the game feature sound effects that happen based on player action or by on-screen objects?	0
	Is the artwork creative and engaging?	1
Playable Game Subject / Narrative	Briefly, in a few words, what is the MAIN TOPIC AREA of the game (e.g., sports)	recycling

	What is the game genre (educational, social issues, or entertainment)	social issue
	Does the game feature a subject that reflects an educational or social issues theme?	1
	Are the educational/social theme elements <i>active</i> or <i>central</i> to the game play (e.g., a game about global warming takes place in a landfill)	1
	Does the game have a cohesive storyline and/or a beginning, middle, and end?	0
	Does it appear that the students did research into the educational/social aspects of the game (e.g., not simply a basic math game, or a “name the capitals” game, but rather teaches players something that is potentially new, and the designer learned something new).	1
Playable Game Presentation on the Wiki	Did the student provide the FLA file for the Final Game on the Wiki?	0
	Did the student provide the SWF file for the Final Game on the Wiki?	1
	Is the final game marked clearly on the Student or Team Project wiki page, specifying it as the final game?	0
	Is the final game provided in the Game Gallery on the Wiki?	1
	Total Tally	14

Landfill Destroyers’ game evaluation value can be compared to the other student games created at RTC, as well as to the games created across all locations, by considering their averages. In the Fall semester at RTC, among a total of eight semester one games created, the average game evaluation value was 14. Landfill Destroyers value of 14 out of 26 equals that of the RTC class mean. When compared to the work of all WV middle school, high school and community college students in Pilot Year Two (which achieved an average game evaluation value of 11.7), this game’s value of 14 is above the average. It is important to note that many factors vary across WV locations and impact students’ learning experiences (including student grade level, number of participation months, prior experience, and game design context as team versus individual) so the comparison is not exactly apples to apples.

Summary, Cathy’s Performance in Game Design I

Overall, the Landfill Destroyers game includes a little more than half of the 26 possible attributes we coded for in each game evaluation category. As discussed in the Methods section, these categories can be linked to student achievement of Contemporary Learning Abilities 1 and 2, in that a) the coding scheme categories of Game Design, Functionality, Audio Visual, and Subject/Narrative indicate that students have had success with invention, progression, and completion of an original project idea for an educational game or simulation (CLA 1), and b) the coding scheme category of Game Plan and Demo (as well as the other categories) indicates that students have had success with Project-based learning and project management in wiki-based, networked environment (CLA 2). Students’ inclusion of the attributes we counted provides evidence that they learned the skills necessary to do so.

It is important to note that at this time, the game evaluation value reflects the combined work of the entire team, not the individual. Cathy contributed to many aspects of the game's design and development and was the main programmer of the game. Therefore, it appears that she gained a more significant level of knowledge in the two most Constructionist CLA categories than her two teammates. As for the other Contemporary Learning Abilities categories (3 – 6), the game coding scheme is not as strong a measure, thus we must rely on other data sources.

We know that Cathy learned how to blog during Semester One, as well as use the Wiki to upload and present files, evidence of some level of mastery in CLA categories 3 (Posting, publishing and distributing digital media) and 4 (Social-based learning, participation, and exchange). Further, Cathy and her teammates engaged in online research to find out more about recycling (the subject of their game) and also to find Flash tutorial resources to help them learn certain game design functions, indicating some level of mastery of CLA 5 (Information-based learning, research, purposeful search, and exploration) and CLA 6 (Surfing websites and web applications).

It is clear from the above files that Cathy made considerable effort in Semester One, appropriating the project (that is, becoming heavily invested in the work) and gaining a strong motivation and interest in the design activities. One contributor to Cathy's success in Semester One might have been her diligence at the start of the semester in completing early assignments with an intention towards her final game artifact. Several of Cathy's early graphics files were used in the final product, and it appears that she was able to build upon the earlier planning and design work she put into the project in order to advance the game in the time allowed. Globaloria participation during Semester One afforded Cathy with the opportunity to ultimately become the leader in her group, integrating the disparate game files (most of which she had also created) into the final Flash game using Actionscript coding. These findings are notable in comparison to our observations of the case study student Jonathan, her teammate who initially intended to be the group's main coder, but who shifts to music composition in GarageBand instead of Actionscript coding. His case is presented after this one.

Game Design II – (First half of Spring Semester, January-Early March, 2009)

After learning new programming skills, Cathy decides to continue on in Semester Two of the school year, taking the Globaloria class again as an elective independent study, Game Design II, with her friend and classmate from the previous semester, Emma, who had been in a different group earlier. The first half of Semester Two runs from late-January through mid-March. Cathy was one of three students from Semester One (out of 23 students from the Fall) and two students from Pilot Year 1 to continue on with the work. It may be that Cathy's success in learning some Actionscript in the fall semester sparked her ongoing interest in continuing learning Flash game design in the spring.

Wiki Edits / Uploads / Posts, Semester Two

Overall, in Game Design II Cathy appeared to perform at around average in relation to the other four continuing students in number of wiki edits and posts made, as indicated in Tables 6 and 7. In February and May, she had the highest number of wiki edits. She was also the student who uploaded the most files in March and May.

Cathy's activity from Semester One to Semester Two in wiki editing and file uploading does not appear to change much, except for her highly elevated activity in May. Cathy's high number of edits and uploads in May suggests that she was preparing their game and presentation to showcase, at the end of the semester.

Table 6: Cathy's Wiki Edits from Game Design II

Month	Cathy's Wiki Edits	Range of Wiki edits, low to high
January	6	1 - 23
February	47	2 - 47
March	13	11 - 42
April	11	1 - 26
May	40	3 - 40

Table 7: Cathy's Wiki Uploads from Game Design II

Month	Cathy's Wiki Uploads	Range of Wiki uploads, low to high
January	4	1 - 7
February	7	6 - 14
March	10	2 - 10
April	1	1 - 6
May	60	5 - 60

Cathy's Semester Two Game Design Process

Cathy and Emma start a new team together in Semester Two that they call "Cosmic Energy," building upon their skills from Semester One. Mrs. S, in her March progress report, observes that during this time "Cathy and Emma work independently and rarely need help from me." It appears that in this new semester, Mrs. S adopted a more hands-off approach with the students.

Regarding Cathy's learning, Mrs. S also notes that at the beginning of Semester Two "Cathy redid some lessons to refresh her coding skills." From Cathy's wiki projects page it appears these assignments included adding interaction, adding animation, adding navigation, and assembling her game, which she completed in about four days. These assignments covered many of the fundamental basics from Game Design I, and her quick completion time in semester two demonstrates her growing fluency and proficiency with Flash going into Game Design II. Her choice to repeat the assignments is evidence of self-reflection on her own skills.

Cathy's one blog post written in the first half of Semester 2, dated February 24, 2009, provides insight into her revisiting of the basics of Flash. On the topic of adding interaction, she notes "there is a little bit of a code you have to use, but its not that long. Its a good idea to know how to make an object interact. In some games you move objects by using the arrow keys." In discussing navigation, she states "now since I know and understand how to add navigation it is easy to do." Her comments regarding these Flash basics also show that she comprehends how different elements of game design synthesize together. She notes that "when you are making a game there is a lot of navigation that one will notice," and that "when a person plays a game, they can be more drawn to it by the type of music you put in it." These comments indicate a growing confidence and mastery over some of the same activities that frustrated her in Semester One.

The remainder of her wiki contents for Semester Two includes elements of the game she is working on with Emma. Mrs. S writes in the March Progress Report that "Cathy and Emma are working on a drag and drop anatomy game. Cathy is working on her sections. She has used the pen tool to trace." The pen tool is a digital device that allows students to trace print images that render as digital graphics. This device is very

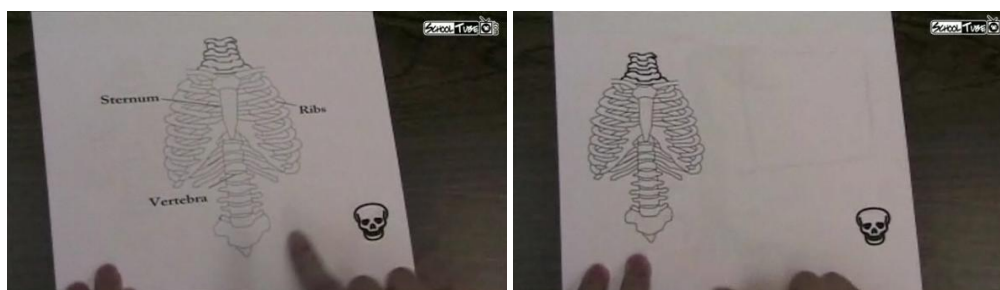
useful for Cathy's Semester Two team game called "Learn the Bones," which requires precision in drawing the skeleton of the body to help the player learn anatomy.

Paper Prototype Video with Game Plans for "Learn the Bones" Educational Game

Cathy and Emma's paper prototype and video presentation of it was completed right before the midpoint of the spring semester, and illustrates on sheets of paper the intended screens and functionality of their second game. Before each level, there is an illustration of bones with their scientific names labeled. After clicking a skull face to continue, the player must then drag and drop bones over the outline of the body part, fitting the pieces on like a puzzle. They note that as one rolls over the bones with the mouse, the names of those bones pop up as reminders.

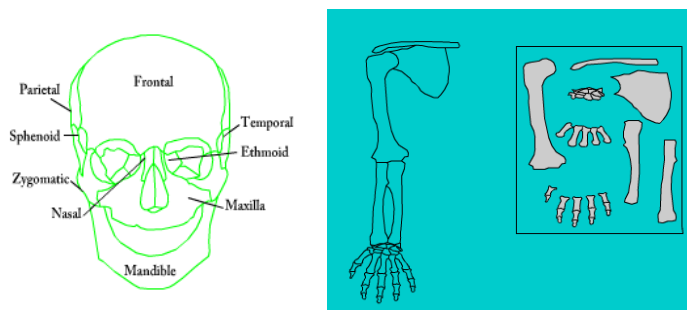
Figure 13 shows an illustration of their second level, as presented in their video presentation of the prototype posted on the Wiki. A player is first presented with an upper-body diagram with labels for various bones, and then must drag puzzle pieces of these bones from a box on the left side onto a chest outline that does not have labels. The player progresses through different areas of the body, including arms, head, and legs, and in the final level, is presented with an outline of the entire skeleton upon which the correct bones must be placed.

Figure 13: Video Screenshots of Cathy's Paper Prototype of the Skull Level of "Learn the Bones" Featuring Traced Objects



The images presented below in Figure 14 show some of the game work Cathy posted on her wiki during the first half of the semester. The second image containing the arm and bone puzzle pieces is a functional Flash file. When the player mouses over the bones, their scientific name appears, and stays on top of the bone while it can be dragged and dropped anywhere on the screen.

Figure 14: Final Game Screens, Learn the Bones, Semester Two



These instructional strategies that Cathy and Emma have built into the game to help the player learn the names of all the bones are noteworthy. They have used Flash to present a visual aid that allows the player

to not only see a diagram, but to manipulate the images. This aspect of their game falls into the category of an emerging type of educational technology called a “virtual manipulative.” These novice students intuitively created this file with the tools they had available, and without prior knowledge of the existence of this genre of e-learning supports.

Game Design II : Second half of Spring Semester, Late March - May, 2009

Cathy’s Mentorship of a Middle School Student Via the Wiki

The second half of Game Design II begins in mid-March. At this time, Cathy was asked by Mrs. S. to help out in virtually mentoring some younger middle school students at another Globaloria West Virginia pilot location (Sandy River). In Mrs. S’s progress report at the end of the month she states that Cathy “has a list of middle school students that she leaves messages for each week.” Mrs. S and another educator at two middle school locations, SRMS and Kasson, decided to have RTC student mentors cross-post on the separate wikis in support of the younger students’ learning. Cathy provided feedback to middle school students on their final games, and her wiki links to the students at SRMS she corresponds with on the discussions pages. This begins on March 16, 2009.

An example of Cathy’s self-introduction to the middle school students is a post on one younger student’s wiki page, stating “hey my name is Cathy and I am a senior at the Randolph Technical Center. If you need any help or ideas feel free to send me a message on my wiki” (as seen on Elmo12’s wiki talk page at Sandy River Middle School). About a week later, there is evidence that Cathy has been checking up on Elmo12 as she writes “hey I just thought that I would take another look at your wiki. I didn't really see any updates but if I over looked them please send me a message telling me where to look,” to which Elmo12 responded, “Thanks, if I need anything I'll ask. Well the reasons theres not many updates is because I haven't here alot lately but im getting ready to do a different tutorial so just look later on in the week. I appreciate the comment!”

A similar comment is posted on Beck’s page at Kasson when she writes “Hey I just thought that I would take a look at your updates. I didn't really see anything updated. Don't forget its important to update all your work. If I over looked it please send me a message telling me so.” A week later after presumably receiving no response, she again leaves a message stating “Just thought I would remind you to update your wiki, to show the people looking at it, like me, what ideas you have.”

Cathy also makes herself available to the students by noting that she is there for them should they need her assistance with anything. This is highlighted in a May 8, 2009 blog post in which she says, “Today I left more comments to the students. One of many students played our game and gave us some good feedback. But she actually had a question for me and it had to do with the scoring in our game. Im glad that she asked, and that i was able to help her with that.”

This type of peer and between-grade-level collaboration in an online Wiki environment is quite rare in today’s schools, and it appears to build the confidence of the older students while providing a model for the younger ones. However, it doesn’t appear that the interactions go much further than a few posts on the Wiki. This aspect of the project was experimental, and is continuing to be further elaborated as the pilot advances.

Continued Game Design Work on Learn the Bones

The majority of Cathy’s time during the second half of Game Design II is consumed by work on her team’s game, as noted in a March 16, 2009 blog post stating “We have been pretty busy with our game. But the

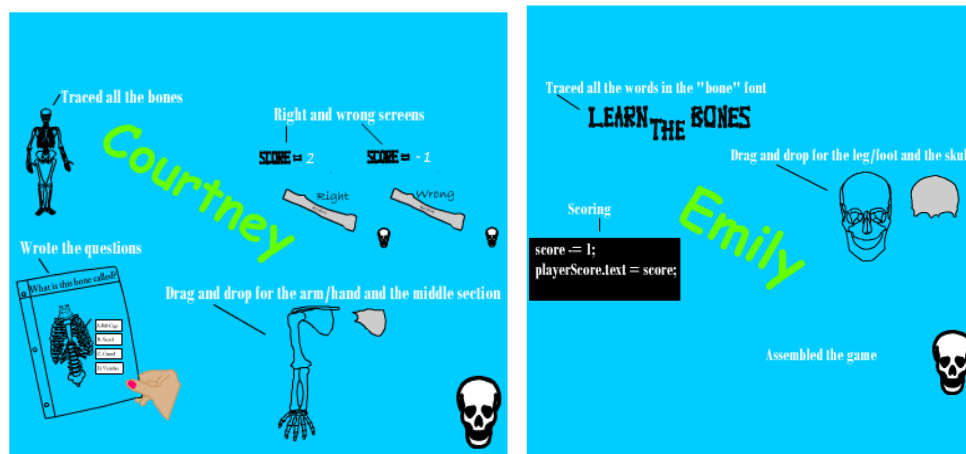
work is getting done.” Cathy also indicates that she has a good working relationship with her partner Emma, writing in the post-course survey, “I enjoyed working with my team mate. It was easy for us to work together and achieve our goals.” Further evidence that they have a strong team dynamic comes from Mrs. S’s final progress report of the year, which notes that Cathy and Emma rarely need any help from her, and they work independently. Cathy’s blog also supports the positive working relationship with Emma as she writes on April 6, 2009, “I made sure that I drew all the bones and the different section of the bones. Then I gave them to Emma and she started putting them together to go from one scene to another.”

Roles of the Cosmic Energy team members

The students present their games to a panel of project funders, state education leaders and World Wide Workshop Foundation staff in May of 2009. Cosmic Energy’s final presentation was videotaped and included on the wiki, and provides data used in the following analysis.

The videotaped presentation includes screens of a Flash file projected on an overhead, discussing the team members’ roles. The Flash fill the students created indicates a Credits screen, and shows how the two partners divided tasks between them. Figure 15 presents the screens, which note that both contributed artwork, with Cathy tracing the bones and Emma tracing the font. When asked about the reference materials for their game, the students indicated that they used an anatomy book and Internet resources. They also discuss having taken a “Human Anatomy” class together in a prior semester, and in a post hoc interview, the educator states that this was a primary motivation for the students’ choice of a game topic. Their topic choice of anatomy might also relate Cathy’s career interest in physical therapy.

Figure 15: Cosmic Energy Team Members’ Varying Roles--
Task Breakdown for Cathy and Emma on “Learn the Bones”



In the paper prototype the students indicate that they are going to implement a quiz in the game. The students use these references to develop the quiz content (which Cathy focuses on), and in their final implementation the game features a combination of text and visual pictures, which helps the learner understand what the bones look like, and, what they are named.

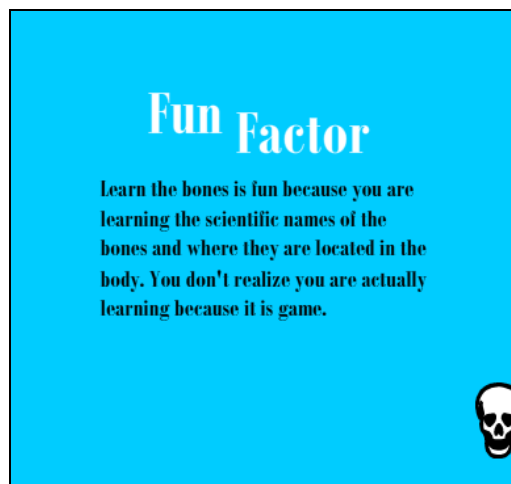
Mrs. S’s final progress report notes that Cathy “did some coding,” and that Emma “did most of the coding” for their game. The screenshots in Figure 15 indicate that both worked on coding that impacted the game’s scoring, as well as the drag and drop element, with Cathy working on more sections of it than Emma. In the questions that came after their game presentation, as seen in the video, an attendee asks how they worked

together in team game design. They explain that they assembled their game as they went along, building one level at a time collaboratively, as opposed to working separately and then combining their work.

Considering that Cathy struggled with coding during Game Design I, the success of her team's game in Game Design II suggests that she has become more comfortable, proficient, and confident in her skills. As she notes in her final survey comments "Game Design 2 was easier for me than the first one because I already knew the basic coding." The experience in Game Design 1 also allowed the students to better understand what they could realistically accomplish in the given timeframe. When asked in their presentation why they chose to create a drag and drop game, they indicated that coding for that type of game was something they were more comfortable with, and they wanted to make sure that the game they worked on was completed on time.

Cosmic Energy's final presentation video also features their game pitch. In Game Design I, the game pitch was posted in text to team wikis prior to work beginning on the actual game. In Game Design II, the pitch is provided as a flash file. Speaking to the fun factor of their game, Cathy's team states that their game "is fun because you are learning scientific names of the bones and where they are located in the body." Figure 16 shows a screen from their presentation flash file, on their proposed game's fun factor.

Figure 16: Game Presentation Screenshots: The Fun Factor as Described in Cosmic Energy's Game Pitch



Other elements of their game pitch include:

Smart Factor: While the students are dragging and dropping they are remembering where the bones go and what their scientific name is. They answer questions and if they get it wrong it will tell them what the correct answer.

Style Factor: The style factor is a blend between cartoonish and realistic. If you get a question right we have a clapping sound, but if you get a question wrong we have a "buzz" sound.

Originality Factor: Learn the bones is original because we found some other bone games online, but they didn't cover scientific names.

When comparing their paper prototype with the final game, as Figure 17 demonstrates, the title page for the game remains constant across both versions, with the exception of the "instructions" screen not being

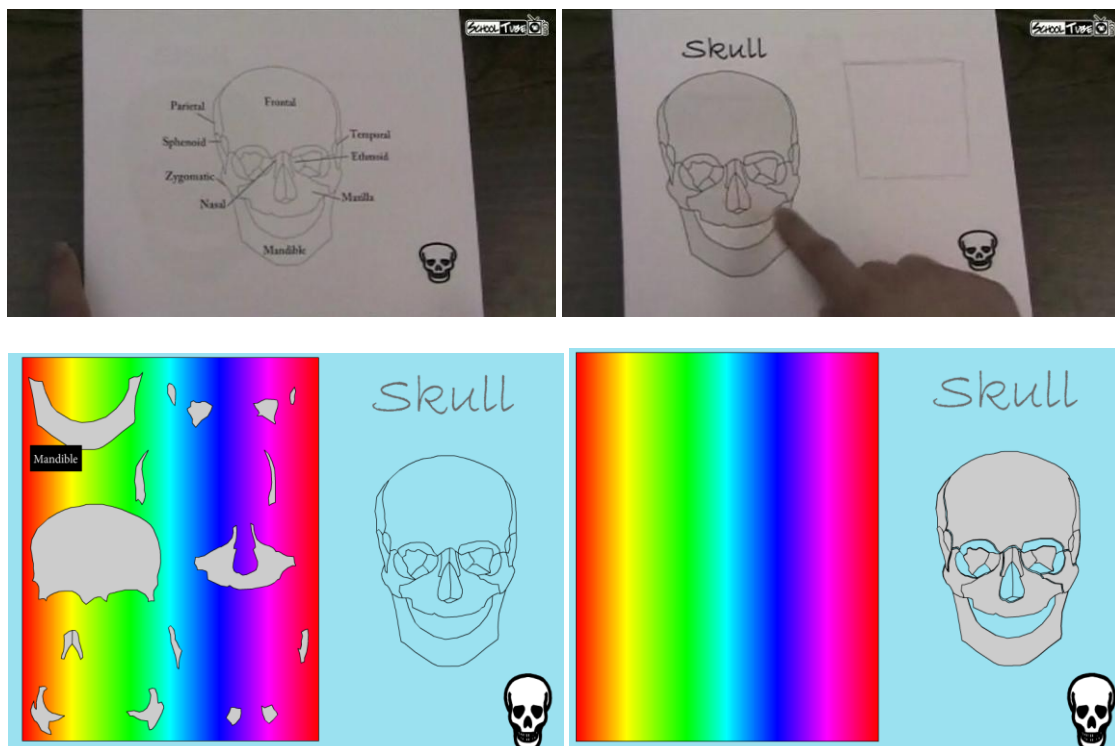
an option in the final version. Rather, in the final version, the player must read instructions after hitting the “play” button before continuing into the game. The bony-style font they use adds an artistically creative flare to the game.

Figure 17: Paper Prototype and Final Game Design Comparison



Once the game begins, the major notable difference between the prototype and the final version is that in the prototype, the player is presented first with a labeled diagram of the bones, and then must drag and drop these bones onto an outline. In the final game file, the player does not receive this diagram, and goes through the drag and drop process with the bone names appearing as pop-ups once the player mouses over the bone. Figure 18 demonstrates differences between level one of their prototype and the final version.

Figure 18: Paper Prototype and Final Game Design Comparison: Level One of Learn the Bones



Following the first level, the player is taken to a quiz. Figures 19 and 20 illustrate the quiz section of the level. Figure 19 demonstrates the outcome of choosing the right answer, as the player is awarded 2 points.

Figure 20 demonstrates the outcome of choosing the wrong answer, which is the loss of one 1 point. The quiz indicates that the students programmed a second instructional strategy into their game in addition to the virtual manipulative, and that is, this quiz to assess the student informally, and to reinforce the student's knowledge. Here these students intuitively experiment in their educational game with another growing area of educational technology development: embedded assessment.

Figure 19: "Learn the Bones" Screenshot Depicting the Game Response Screen when a Player Gets a Question Correct: Evidence of Actionscript Coding

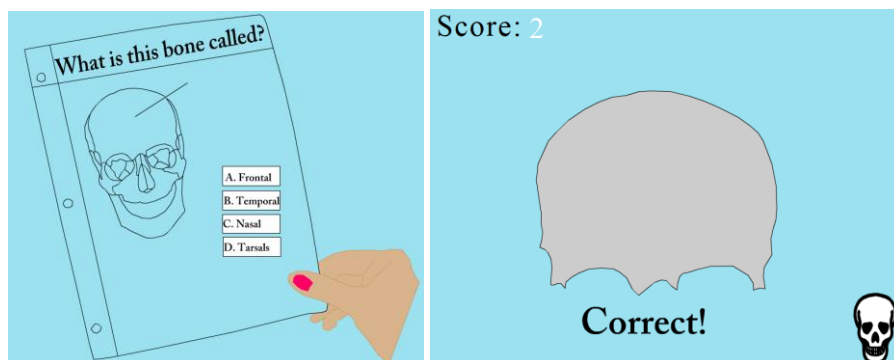
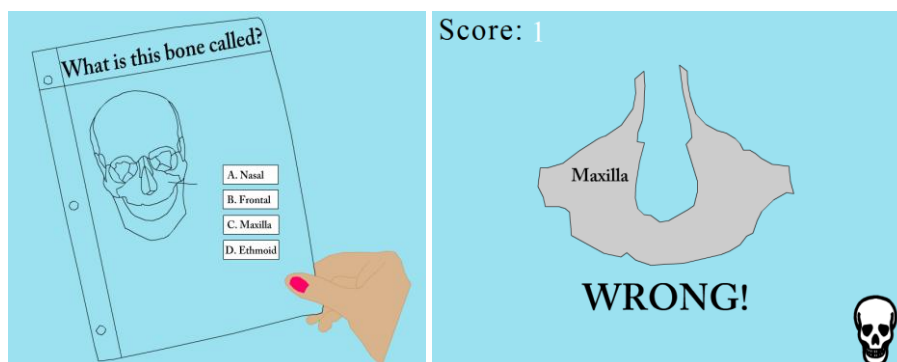
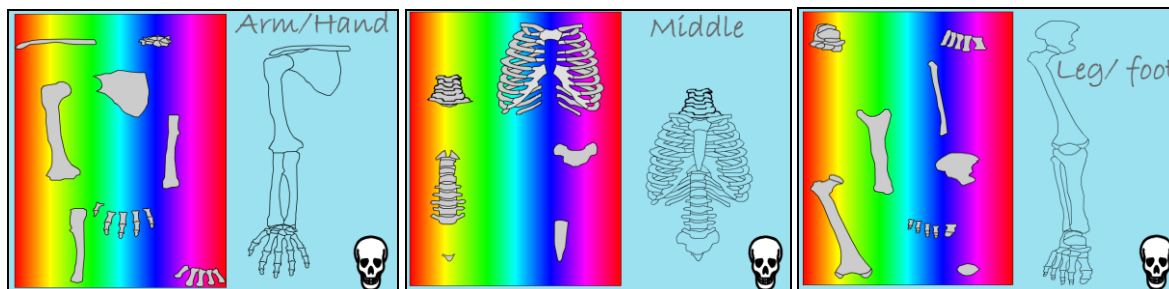


Figure 20: Game Response Screen when a Player Gets a Question Wrong: Evidence of Actionscript Coding



A total of 4 levels are present in the game, covering the skull, arms, middle, and legs. Figure 21 provides screenshots from the additional 3 levels. Following completion of the game, a total score is shown, and the user has the option of clicking a button to play again.

Figure 21: Levels 2 – 4 of "Learn the Bones"



Overall the students' game provided the player with visual imagery of bones allowing the player to interact and manipulate the game images to associate names with objects and memorize the names. When the player gets the wrong answer, the game is designed to correct the player by providing the correct name of the bone. This instructional strategy provides the player with a learning cue to help him or her improve on subsequent plays.

It appears that the students developed this instructional strategy to allow learning of the bones through initial visual play. Then in a second level of the game, the player can test their knowledge, in a quiz that is scored. This approach indicates that students thought about both the player's learning process, and, the assessment of the player's knowledge, and by the end of Semester Two, had the Flash design and programming skills to integrate functionality for both learning and assessment into their game.

Content Analysis of the Learn the Bones Game

During the *spring semester*, five participating RTC students created a total of three team games, of which Learn the Bones was one. Out of a total of 26 possible game attributes that we included in our coding scheme, the Learn the Bones game had an overall value of 20. The table that follows indicates the final tally. The codes detect the presence of game design learning and mastery among the student creators.

Table 8. Learn the Bones, Content Analysis Results

Game Title: Learn the Bones Student/Team Name: Cosmic Energy Team or Individual Game: Team URL: http://www.myclife.org/usa/wv/rtcwiki/images/3/35/EmandCourtFinishedGame.swf BRIEF GAME OBJECTIVE: Learn the bones of the human body.		
CATEGORY	CRITERIA	1= Yes
Game Plan and Demo [Design Template; Prototype]	Did the students create a Paper Prototype?	1
	Does the game appear complete/finalized?	1
	Please EVALUATE the Game Design Plan for its written content describing student intentions for their game design (Overview, pitch, scenes, elements/assets, etc.) [0=None; 1=Incomplete; 2=Satisfactory; 3=Thorough/Excellent]	0
Playable Game Design	Are there gameplay instructions?	1
	Does the game play exactly as the instructions specify?	1
	Is there a visual / graphic STYLE that carries throughout the game, consistently? (e.g., color-scheme, character-design, are game-play objects in consistent locations throughout the game)?	1

Playable Game Functionality	In all relevant instances, does the game offer feedback to the user based on actions (e.g., quiz game provides feedback on a response; when a character dies a life is lost or a message appears; rollovers change color or display a pop-up; do collisions elements work properly)?	1
	Do the feedback / response elements add to the challenge of the game, (e.g., the game is over if the timer, lives, or health run out; scoring is variable; the game can be “lost” or “won”)?	1
	Are there objects (not characters) that are interactive for the player (e.g., buttons with rollover; objects that can be drag and dropped)?	1
	Are there characters that the player can interact with (e.g., player avatar that moves with arrows, and/or enemies or allies that are animated or moving)?	1
	Do the objects and/or characters interact to cause some effect? That is, do objects detect collisions? (e.g., objects bump and change direction, character gains/loses life when it touches something else, gains/loses points, etc.)	0
	Are there multiple levels, progression of different scenes, and/or increasing difficulty?	1
Audio/Visual	Are visual elements well executed (e.g., are images clear without blurriness or 'fringing')?	1
	Is there background music to the game?	0
	Does the game feature sound effects that happen based on player action or by on-screen objects?	1
	Is the artwork creative and engaging?	1
Playable Game Subject / Narrative	Briefly, in a few words, what is the MAIN TOPIC AREA of the game (e.g., sports)	Learning the human bones of the body
	What is the game genre (educational, social issues, or entertainment)	Educational
	Does the game feature a subject that reflects an educational or social issues theme?	1
	Are the educational/social theme elements <i>active</i> or <i>central</i> to the game play (e.g., a game about global warming takes place in a landfill)	1
	Does the game have a cohesive storyline and/or a beginning, middle, and end?	1
	Does it appear that the students did research into the educational/social aspects of the game (e.g., not simply a basic math game, or a “name the capitals” game, but rather teaches players something that is potentially new, and the designer learned something new).	1
Playable Game Presentation on the Wiki	Did the student provide the FLA file for the Final Game on the Wiki?	0

	Did the student provide the SWF file for the Final Game on the Wiki?	1
	Is the final game marked clearly on the Student or Team Project wiki page, specifying it as the final game?	1
	Is the final game provided in the Game Gallery on the Wiki?	1
	Total Tally	20

Overall, the Learn the Bones game includes 20 out of 26 possible attributes we coded for in each game evaluation category. In the Spring semester at RTC, among a total of three semester one games created, the average game evaluation value was 16. Learn the Bones value of 20 is above the RTC Semester Two class mean. This score is well above the Semester One team game score of 14 for Landfill Destroyers, and indicates that Cathy and Emma have gained in their Contemporary Learning Abilities 1 and 2. When compared to the work of WV students in all grade levels in Pilot Year Two (for whom the average game evaluation numeric value was 11.7), this game's value of 20 is well above this aggregate average. It appears from these results that having an entire year to learn game design allows students a greater opportunity to meet the learning objectives of the program.

Summary of Case Study, Cathy

Cathy was a female high school senior who had very little prior experience in using technology. Most students like Cathy enter college and/or the workforce in a similar situation. Through her participation in Globaloria, Cathy had the opportunity to engage in a year-long program of guided, self-directed technology-based learning. Across two semesters, she gained experience working in this virtual learning modality, as well as valuable computational skills.

Cathy's teacher described her as the kind of student who is hard-working in other courses, and it appears she drew upon this motivation, persevering to learn Actionscript coding on her own in Semester One. In Game Design II, she further expands upon her knowledge, starting out by re-visiting the coding assignments from Semester One that were most helpful, to better ensure her mastery and in preparation for her new game design. By the end of Semester Two, she and her teammate had developed a drill-and-practice educational game that encouraged the player's memorization of the bones, and then tested the player's recall, reinforcing the learning.

The team's success indicated that she and her teammate developed an understanding of Actionscript coding, to enough of an extent to actualize their creative goals in expressing their original game idea.

It also appears that within the game itself, Cathy may have recapitulated a learning process that had occurred during her own repetition of several assignments at the start of the spring semester. Repeating assignments at the start of Semester Two helped her re-acquaint with Flash design, which for her had positive learning outcomes. It appears she may have designed the Learn the Bones game to reflect this learning strategy, designing the game to allow the player to repeat a given action to reinforce his or her knowledge of bones to elicit similar successful learning outcomes. This would indicate in Cathy's case the outcome of "learning how to learn" as a result of Globaloria participation.

CLA Development

Across the yearlong timeframe, Cathy shows evidence of developing CLA 1 (invention, progression, and completion of an original digital idea), in that she gained knowledge of origination of a game idea through

two iterations of paper prototyping and design proposals, and then went on to develop and complete two game design projects. Cathy's spring semester game is very original, is well explicated on the paper prototype, and it appears that she has succeeded in overcoming some of her difficulties with Actionsript programming. She also demonstrates that she has excelled in CLA 2 (project-based learning through online project management in a wiki-based network environment), largely by using the experience in Semester One with the unfinished work to more effectively plan, manage and create a complete and functioning game in Semester Two, operating within the constraints of the game idea, the technological functionality, and the given timeframe.

The team members Emma and Cathy suggest that their roles in Semester Two were not highly differentiated and they worked together collaboratively as they built the final game file. The students used a shared Wiki page to post their team game files, so it does appear that they engaged in teamwork in the context of CLA 2, using the wiki to support the collaboration. More research is needed in the future, possibly using on location site visits and observational methods to better understand team dynamics, as well as how students use the wiki when they are working in a co-located way in the classroom.

There is also evidence to suggest that Cathy is proficient in CLA 3 (publishing and distribution of self-created digital media artifacts). The wiki metrics indicate that she is one of the most active students in the class during some months in her wiki edits and uploads. There was ample data online supporting the case study development for Cathy, including paper prototype videos, assignment files, presentation videos, project files and final game files.

Cathy also assumed a leadership role in younger students' project management as a mentor in the second semester. Her mentorship of younger students provides evidence of CLA 2 as well as CLA 4 (social-based learning, participation, and exchange in a networked environment). Also supporting CLA 4 are her self-progress notes as a reflective exercise at times, to share her thoughts with other participants. Additionally, while not frequent, her blogs show a high level of reflective thinking.

Through researching her game topic of anatomy online, there is some evidence of CLAs 5 and 6. She also used a traditional textbook as a resource for the game content, and for her traced drawings of bones.

The results in the case of Cathy at RTC demonstrate that several factors appear to have contributed to her success. One is the interest-driven nature of her chosen game design subject. Cathy indicates an interest in physical therapy as a career, and utilizes the material from her prior vocational prep class in human anatomy at the technical high school. This choice of a prior held "individual interest" (Hidi & Renninger, 2006) as game subject may have contributed to the enjoyment and value that Cathy held for the project.

Another contributing factor appears to have been the base of expertise she had gained in Semester One of the project. In Semester One, she experienced autonomous learning and team leadership as she problem-solved the Actionsript programming in her first game. She also experienced the design process sequencing, and the timing constraints in Semester One, so she was able to anticipate and better plan what features she could include in the time provided in Semester Two. Having a second chance to create another game after gaining experience in Semester One was a successful strategy that we recommend to other educators implementing Globaloria for a full year. The opportunity in Semester Two to choose a new game subject domain and make adjustments to the game design process attempted in Semester One is beneficial.

Post-Hoc Findings: Student Animation Prize

In post-hoc interviews with Mrs. S. after the initial development of our case study of Cathy's learning, we were told that Cathy and Emma submitted their work to the "West Virginia Flash Animation Festival" that was run by West Liberty University, in May of 2009. The festival description featured in Figure 22 below states, "Flash is like a lump of clay. In one person's hands it becomes a functional pot or mug... in another's it becomes a decorative sculpture . . . it is this flexibility that has kept Flash exciting and interesting..."

Figure 22. Flash Animation Festival Description, West Liberty University

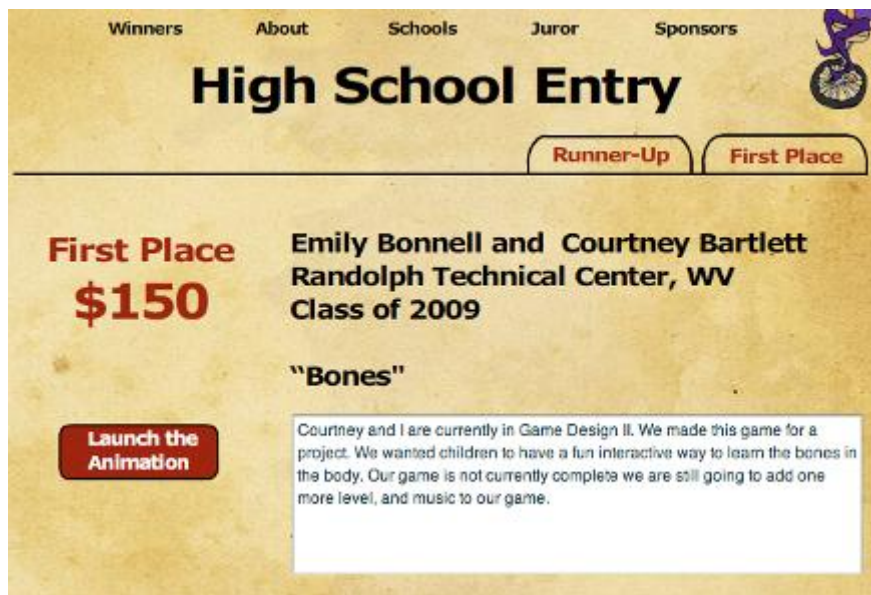


In the follow-up interview regarding the award, Mrs. S explains,

The competition started out as a college competition but added a high school division when they found out several schools were teaching Flash. There are schools in 5 states that were featured, including West Virginia, Maryland, Ohio, Virginia, and Pennsylvania. The girls won a cash prize of \$150. They knew in the beginning of the course that their work was going to be entered in this competition and had looked at past winners to get an idea of the quality. They really did do much beyond the requirements of the class because what they were creating throughout the semester fit the guidelines of the competition.

It appears that this festival was another contributor to the students' motivation in the course. The students submitted their game in May of 2009, and won First Prize in the High School category. They were awarded a check for \$150. Their game is featured on the contest website as the winner, as follows.

Figure 23. Learn the Bones First Place Prize Screenshot, Prominently Featured on Website of the West Virginia Flash Animation Festival



Unfinished Status of Games

In the final videotaped presentation to funders that was available on the wiki, Cathy makes some comments to the panel about how the game is not complete, and exhibits some anxiety about this. Further, Emma's description of the game on the competition website states, "Cathy and I are currently in Game Design II. We made this game for a project. We wanted children to have a fun interactive way to learn the bones in the body. Our game is not currently complete we are still going to add one more level, and music to our game."

Mrs. S in Semester One made the observation that Cathy is a student who feels anxiety when a project is left open-ended and isn't completed. Cathy performed well in the class overall, and yet we are left with the impression from her behavior in the video, and from her teammate's comment above, that she was not entirely pleased with the game's unfinished status.

In the Globaloria program's current iteration, while the participating WV educators are still novices to game design as are the students, students do not necessarily have the experience of working in a context of close, individualized, guided expert scaffolding and mentorship that was central to previous Constructionist work, and that is central to the underlying learning principles of Vygotsky upon which MIT Media Lab's conception of Constructionism was founded. It appears that the capacity of the educator to support students' game design and Flash programming work in the moment is an important variable in the students' experience and confidence.

Globaloria is a pilot project, and the World Wide Workshop Foundation is still optimizing and iteratively developing the curriculum and support materials to arrive at a program that makes it is feasible for students to achieve the development of a fully functioning, complete game in a single semester or single school year of participation. During this exploratory phase of Globaloria, while we are gaining a sense of this feasibility, and while we are simultaneously improving upon and advancing the tools and curriculum, students need to understand their role as pioneers in this experiment. It is important for Globaloria staff to

make it clear to students that their involvement is appreciated, and that their academic record will not be harmed due to their participation. Milestones are important for setting and managing expectations between students and their educators on what students need to be learning, and for evaluating student progress. As it stands now, there is uncertainty in this area among educators and students, and educators are not entirely adept at supporting student learning yet. For Cathy this might have manifested as anxiety about having an incomplete game.

Overall, from Semester One to Semester Two, Cathy clearly expanded upon her experience in the Landfill Destroyers game in the creation of Learn the Bones. Her earlier participation gave her a sense of what was reasonably possible to design and code within a specific time frame of Semester Two. At the end of the students' presentation to funders and constituents, Mrs. S takes the opportunity to make the following comment to the panel: "if I were starting a company I would hire Emma and Cathy and pay for their education. They are both hard working, dedicated students with good attitudes. They come in to class, go to work, and almost never need me. They figure things out on their own or ask Jason or look elsewhere. They are two special young ladies."

This statement indicates that Mrs. S. was pleased with their self-determined work, and that the presentation was an opportunity to express public praise. It also indicates that she recognizes the need to acknowledge students' efforts as pioneers the pilot work. At the same time, we see from Cathy's case study that there were several occasions when she could have used greater support while programming her game in the moment, and she proceeded forth anyway, out of sheer personal perseverance, when other students in the class were not so motivated. While Mrs. S states that the students "almost never need her," it appears that in fact, Cathy did have occasional need for greater support, and this was not provided or afforded in the context of the Globaloria program resources, or from her educator. In Globaloria's Pilot Year-2 iteration, Cathy accomplished many skills as summarized above. Nonetheless it is interesting to speculate what further enhancements her game could have achieved if she had been able to enjoy even greater expert scaffolding and guidance.

Jonathan



Jonathan was a junior in high school at RTC, age 16, in Pilot Year Two, and it was his first year participating in Globaloria. He was one of the male students in Cathy's first semester team, JAC in the BOX .

Regarding Jonathan's background, in his Pre-survey, he states "I was born in Elkins, WV, and I live in Elkins. I have one brother and he is 14." He states he chose to take this class because "I like video games. I would like to be a video game designer one day."

We selected Jonathan because as an avid game player prior to Globaloria, he started the program with strong interest and enthusiasm. A review of his Wiki performance indicates that he finished more tutorials than most of his classmates, and posted more frequently than anyone else in the class.

However, according to his teacher, Jonathan struggled somewhat in his participation in the program in designing graphics and learning Flash Actionscript. The progress reports from his instructor portray him as a competent student who gets along with his peers. However, towards the end of the course, some of the responses in his mid-program survey become somewhat negative in tone, in relation to certain elements of the course. His earlier interest in designing games appears to taper as the need to program in Actionscript to complete the game becomes apparent. In this way, he serves as an interesting contrasting case in comparison to Cathy's, highlighting several important findings about Globaloria's implementation.

Semester One Wiki edits and uploads, Jonathan and his class

Jonathan's individual monthly wiki editing activity is presented in Table 9. Findings indicate that he was quite active in his wiki editing, leading the class in most months at the top end of the range.

Table 9: Jonathan's Wiki Edits from Game Design I

Month	Jonathan's Wiki Edits	Range of Wiki edits, low to high
August	5	3 - 31
September	101	9 - 101
October	94	10 - 94
November	49	4 - 49
December	63	2 - 63

Supporting the results for wiki *edits*, Table 10 indicates Jonathan's wiki *uploads* from Game Design I, in which he added Flash files and images to the wiki. His metrics are again in the high range during this time, reflecting the highest number of uploads in the class during October and December.

Table 10: Jonathan's Wiki Uploads from Game Design I

Month	Jonathan's Wiki Uploads	Range of Wiki uploads, low to high
August	4	2 - 5
September	8	3 - 14
October	25	4 - 25
November	11	2 - 14
December	21	0 - 21

Jonathan's elevated wiki activity presents initial evidence that he is quite engaged in using the wiki environment.

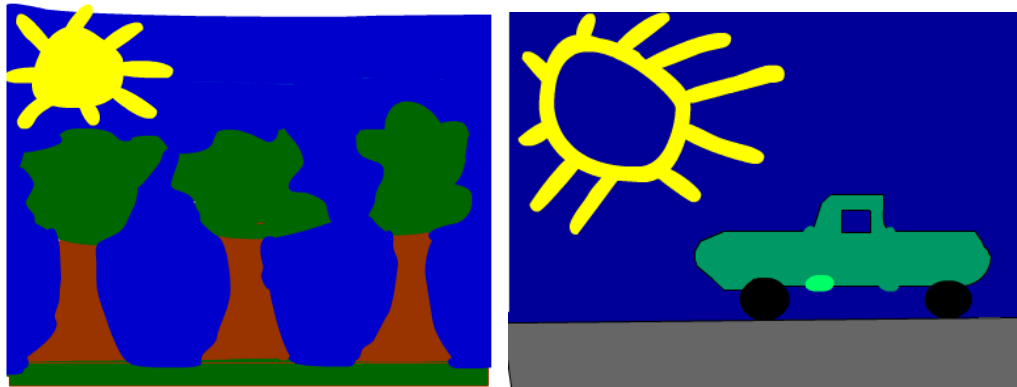
Game Design I – (First half of Fall Semester, September/October, 2008)

Jonathan starts out the semester with strong enthusiasm, noting in his first blog post that he anticipates that "this should be a fun class, since I am a game player." He notes in his pre-survey that he does not have any ideas for an interactive game yet. In the first educator progress report on Jonathan written September 31, 2008, Mrs. S notes that "Jonathan is a good student who tends to get things finished before everyone else. He works well in his group. He will do a variety of things in his group to get things finished. He is talented in all areas."

In the first half of the semester (through October 23, 2008), students proceed through the syllabus Game Design topics, through to the topic, "Adding Interaction." In this timeframe, Jonathan completes tasks on his wiki project page that include "Playing to Learn," "Social Issue Games," "Imagining Your Game," "Navigation," "Animation," and "Adding Sound." The amount of work that Jonathan posts to his wiki project page during the first semester exceeds that of most of the other students in the course. Yet it appears that the files are quite minimalist in their design.

For instance, Figure 24 below demonstrates some of his early work on the wiki. Jonathan has created a hand-drawn landscape scene in the first image. The second image in figure 24 is indicative of somewhat more time and effort, but it does not appear to fit the assignment of "Imagining Your Game," because it does not appear to relate at all to the game that his team has proposed. It appears from these graphic file uploads that he may have been experimenting with the design software, and posting files just to complete the assignment, without significant planning or thought towards the game. This contrasts with Cathy's approach, in using each assignment to build files towards the final product.

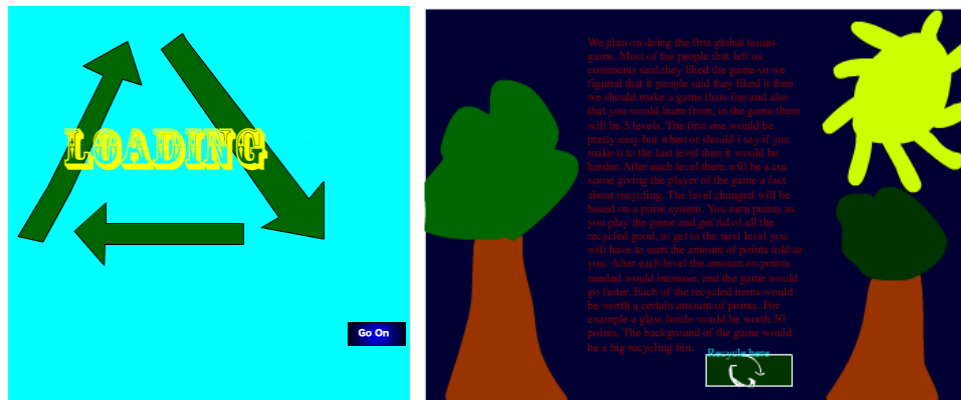
Figure 24: Simple Graphic Files Posted as Jonathan's First Game Design Assignment; No Alignment with Team Game Plan



As of September 9, 2008 Jonathan has joined up with teammates Cathy in 12th grade and Andrew in 10th grade in the team JAC in the BOX. Figure 25 shows more of his work from the first semester from the "Imagining Your Game" assignment. The first screenshot is an animation for the loading screen of Jonathan's group's game, an animation they ultimately did not choose. At the beginning, Cathy had personally identified as the group's artistic designer whereas Jonathan saw himself as a programmer, given his prior interest in gaming and engineering. It appears he was not interested in graphic design in the early phases.

The second image in Figure 25 contains Jonathan's game description. The choice of a dark purple background against red text is somewhat difficult to read.

Figure 25: Jonathan's Team Game Loading Screen Sample (not ultimately chosen by teammates); Game Design Plan



In his individual game proposal on his wiki projects page, Jonathan states:

We plan on doing the first global issues game. Most of the people that left us comments said they liked the game so we figured that if people said they liked it then we should make a game thats fun and also that you would learn from, in the game there will be 5 levels. The first one would be pretty easy but when or should I say if you make it to the last level then it would be harder. After each level there will be a cut scene giving the player of the game a fact about recycling. The level changed will be based on a point system. You earn points as you play the game and get rid of all the recycled good, to get to the next level you will have to earn the amount of points told to you. After each level

the amount on points needed would increase, and the game would go faster. Each of the recycled items would be worth a certain amount of points. For example a glass bottle would be worth 50 points. The background of the game would be a big recycle bin.

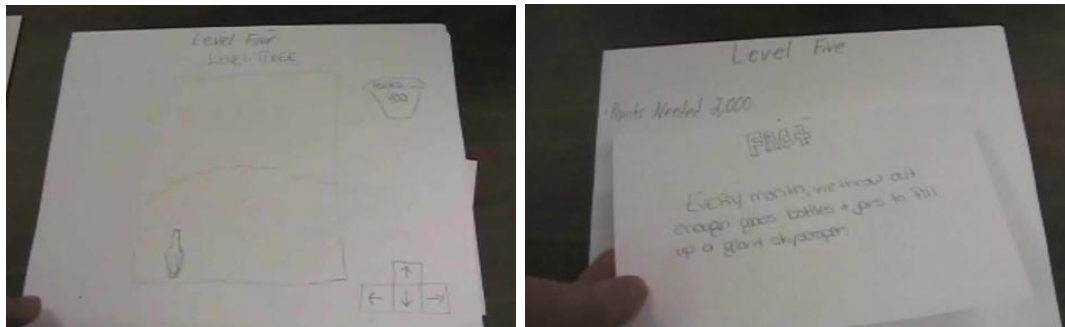
This description appears to be an early draft of the final game plan that the JAC in the BOX team posted on their team page, featured in Cathy's case study. It appears that the idea for having different levels was Jonathan's initially. He reiterates this idea in the paper prototype below.

Jonathan's Role in Team Paper Prototype Assignment

On September 25, 2008, JAC in the BOX present the first draft of their paper prototype for "Landfill Destroyers," narrated largely by Jonathan, supporting his expected role as a team leader. Details about JAC in the BOX's paper prototype and game pitch can be seen in Cathy's case study.

The students note that most of the group will share responsibilities, with the only real role clearly defined being that of Cathy as the main artist and somewhat of an organizer and supervisor. Figure 26 demonstrates Levels 4 and 5 of their planned game.

Figure 26: JAC in the BOX Team Video of Their Game Paper Prototype: Screenshots of Levels 4 and 5, with Jonathan Narrating in the Video, Indicating His Early Semester Role as Expected Team Leader



Each student on the team takes turns presenting different parts of their game. Jonathan explains that he will be creating the music and assisting in the programming of the game, while Andy will help him with the programming. Jonathan covers the part of the presentation that shows how the levels will work, further supporting that this was his idea.

Cathy's case study provides details on the team's Mid-Semester Game Presentation, recorded after they have completed some of the initial game files.

Jonathan's Self-Reported Attitudes on Learning Game Design, First Half of Semester One

Jonathan's progress notes on the Wiki regarding his own work are brief and do not provide much insight into his own self-reflections about participating in Globaloria. He writes comments such as "made level 1 and objects screen in flash," and "put navigation on the loading, and title scene. Did keytrain."

In contrast, his blog posts reflect more of his attitudes and reflections. In regard to the social issue games examples that he tested out and played at the beginning of the semester, he writes on September 10, 2008 that "I think those games were fun and hard. I like games that are hard so I don't get bored with the game. Also, I learn some things from the games like how bad living conditions are in some countries. These games

were educational and fun, and they were not boring.” On October 2, 2008 Jonathan writes in his blog that the section on “Planning Your Game” was boring. On October 8, 2008 he writes, “this was hard at first, but the coding is a lot easier once you use it a few times. I have learn it really quick and I have gotten faster at it.”

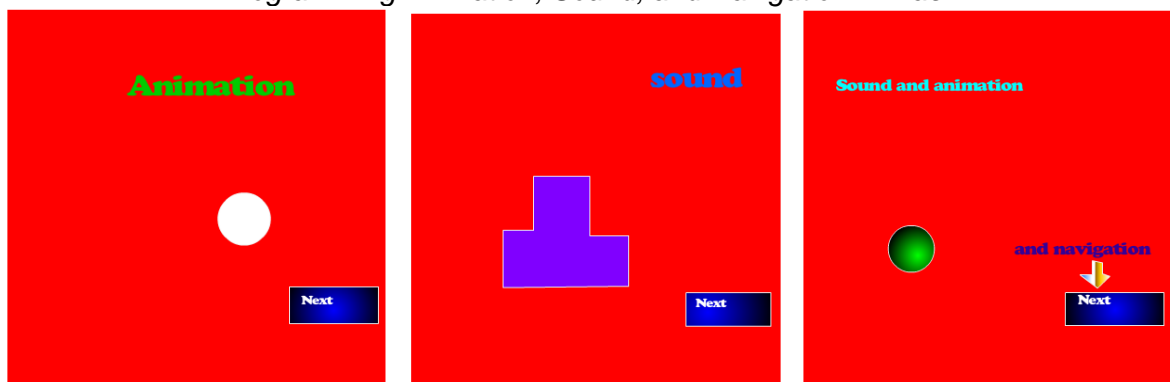
His interest in doing audio for his team’s game seems to have been initially sparked around October 23, when he states, “adding sound was fun and very easy. The hard part about adding sound was what sound you wanted to use. How to put the sound on your object is very easy, and some of the sounds people put on objects is very funny. I made a laser ball.” Overall, by the end of October, Jonathan still appears to be engaged in the class and presents a generally positive tone in his self-reported reflections.

Game Design I – (Second half of Fall Semester, November-January, 2008)

The second half of the semester took place between October 27, 2008 and January 21, 2009. During this time, students focused largely on group work for their game, but were also given assignments such as their “9-Weeks Test” (conceptualized, initiated and required by the educator to be completed independently by each student, demonstrating 5 concepts in Flash design and programming they have learned in the class).

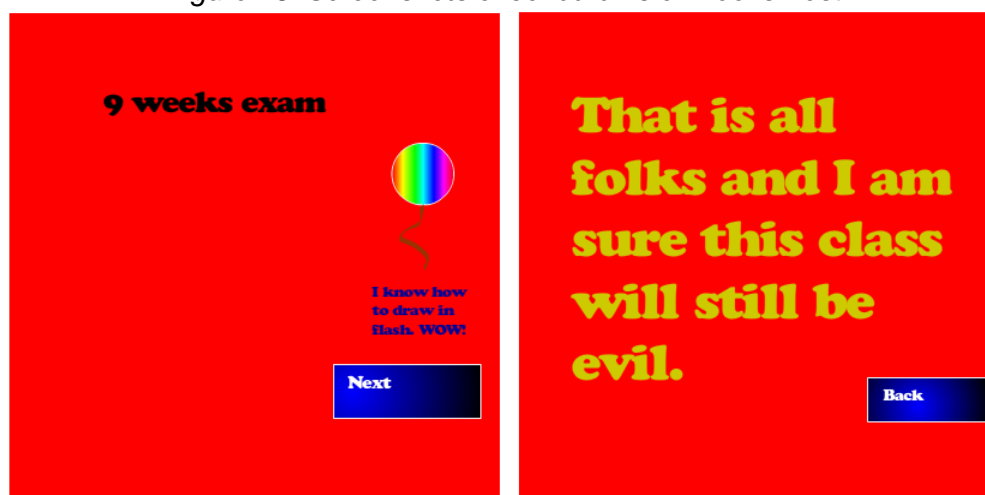
Jonathan completed Mrs. S’s 9-Weeks Test successfully, indicating that he has learned at least the basics of Flash from the first half of Game Design I. In the file itself, he highlights that he’s learned to draw, animate, implement and integrate sound and navigation. His artistic graphic design work continues to be minimalist as Figure 27 depicts.

Figure 27: Screenshots of Jonathan’s 9-Weeks Test Providing Evidence of His Knowledge of Programming Animation, Sound, and Navigation in Flash



Also notable, featured in Figure 28 are screenshots from the 9 Weeks Test that indicate some humor and/or attitude into his expressions. In the file he writes, “I know how to draw in Flash. WOW!” and “this class is still going to be evil.” It is hard to interpret with assurance whether Jonathan was truly feeling negative in these comments written into the Flash file.

Figure 28: Screenshots of Jonathan's 9-Weeks Test



Jonathan's Continuing Completion of Assignments

Similar to the first half of the semester, after the 9-Weeks Test, Jonathan went on to complete more assignments than most other students did during this second time frame. He proceeded through the "Music," "Boundary, Collision, Scoring, Questions," and "Preloader" assignments, however again, these completed assignments seemed somewhat minimalist. The Flash files posted for "Boundary, Collision, Scoring, and Questions" do not appear functional, and consist of plain squares and text. His "Preloader" assignment is the only object that displays animation. In interpreting his approach to these completed assignments, it appears overall that he was most interested in simply checking these tasks off the list. The assignments were completed on his own individually, and do not include files that will contribute towards his team's final game.

Jonathan's Interest in Game Music Composition

Evidence of Jonathan's role in creating the music for his team game is present in a project plan table located on their team wiki in the second half of the semester. For the week of November 3 – 7, Jonathan notes in the table, "I plan on looking for music that would fit to our game and makes it more interesting to play," while on November 10-14 he writes "this week I will to come up with more ideas for the music in our game (levels two through five) by using garageband's recorded music and try to finish the one I already started on." Finally on December 1-5 he states "I am working on some music and helping Cathy find some codes on the internet."

His preference for working on audio materials for his team's game is clear in his second to last blog post on January 2, 2009 which states:

I have worked on music for our group's game most of the time. I have also try to find some coding or coding tutorials to help the person that is coding in the group. They did not help much though. I have worked on the presentation to our game a little bit, but not much. I have been able to create better and longer music since when I first started working on music. Now I can make songs last 3:00 to 3:30. When I first started it was like 0:30.

Jonathan originally expressed an intention to lead in the programming efforts for his team's game with help from Andrew, and with Cathy creating the art work. However, in the blog post above, his comments can be

inferred to suggest that he is following the lead of “the person that is coding in the group,” who is Cathy. He presents enthusiasm toward his work on the music, noting how his skills have improved in being able to produce longer and longer songs. His sound clips on the wiki are rather complex and it appears that through his experience, Jonathan has become quite proficient in creating digital audio files. He is quick to note quantitatively how much longer his music clips now are.

Some Frustration Expressed in Mid-Survey Responses

When we consider his mid-survey comments (administered towards the end of Semester One in early January), there is a clear indication that Jonathan had experienced a growing frustration in self-led Flash and game design learning. When asked about the most important things he has learned in the class so far, one item he lists is “anger control because making a game can get frustrating, but I learn to stay calm so I can help to get the game done,” and when asked about how the program has better prepared him for the future he states, “I think anger control will help me in the future because I want to be an engineer and the projects I will work on will take time and will run into lots of problems.”

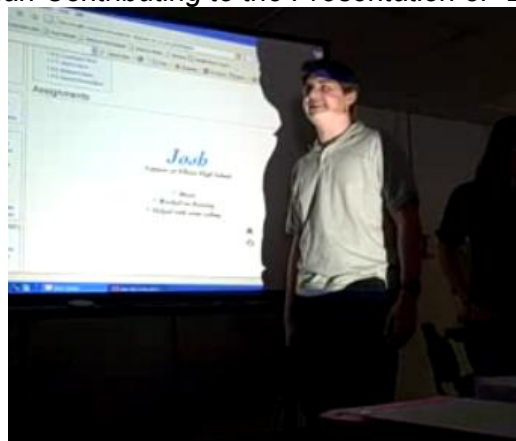
Further, when posed in the mid-survey with a question on his dislikes about the class he notes “I did not like that the teacher could not help us some when we had questions, and we could not figure out any solution,” and when asked how teachers in the program might help him better achieve his goals he explains that, “I wish the teachers would know some coding to help us get the game working right.” He also states that “I did not like that we had to make a learning game.”

While Jonathan was prolific in posting files to the wiki, it appears that he had some trouble with the self-learning aspects of the course when it came to Flash game design and Actionscript programming. However, overall, in her final progress note for the semester, Mrs. S does not seem disappointed in his work. She notes that aside from music, he dabbled a bit in assisting in other areas. She states that “basically he did whatever needs done for his group,” and that he “took an active part in their presentation.”

Jonathan’s Role in Final Game Presentation

As indicated in Cathy’s case, the students made progress on designing and developing “Landfill Destroyers” but the game was not finished by the end of the fall semester. In the final presentation, Jonathan notes that he tried to help with the coding, but states outright that he was unable to understand it. Figure 29 shows Jonathan talking about his role during the presentation.

Figure 29: Jonathan Contributing to the Presentation of “Landfill Destroyers”



In Jonathan's final blog post he writes, "I think that my group's presentation went pretty well. It was sorta hard to practice for the presentation with all the snow day. I just hope that our group got a good grade on the presentation. I think the presentation was 5 minutes."

In his post-course survey comments Jonathan notes that he does not plan to continue working on his current projects from Globaloria, nor does he have plans for new game design projects. He also indicates that he does not plan on using any of the resources from the MyGLife.org wikis or websites in the future. However, Jonathan does comment in his post-course survey responses that "I might go into Game Design 2 sometime later, but not right now."

Summary of Case Study, Jonathan

Jonathan makes an interesting case study student for the contrast he poses to Cathy and Jason, which follows. Clearly, the program did introduce him to one thing he was passionate about, and that was creating digital music. Further, as indicated in his achievement of the highest number of wiki edits and uploads, he has gained skills in CLA 3 (publishing and distribution of self-created digital media artifacts using wikis, blogs, and websites).

Jonathan seems to portray his experience in mixed terms, offering sometimes positive self-reports regarding his experience, and other times indicating that he is having difficulty and is frustrated. He presents as being concerned about his grades, often noting quantitative attributes of his work, such as the length of a music clip or length of his final presentation. While he began the course as an avid game player and expected to excel in game design, by December when asked what is most difficult about the course in the mid-survey, Jonathan expresses openly that he has trouble coding games. He states that "the most difficult thing about this class is the coding. It is hard to find the right coding and get that code to work. Coding is time consuming."

In the post-survey, he states that "I like that we got to work in groups to make a game. I like that we were allowed to research on any site to find coding help." Here it appears that for Jonathan, the autonomy was enjoyable, however these comments contradict his mid-survey comments reflecting that he felt he needed greater support from the educator in learning programming. It appears that Jonathan has mixed feelings about the way he is learning in Globaloria, and lost motivation when he became frustrated along the way.

In follow up interviews with the educator at RTC about Jonathan's case, Mrs. S states the following regarding Jonathan's performance.

Jonathan had taken classes that had always been easy for him, and all of a sudden he had coding and it was hard and he couldn't figure it out. Instead of experimenting he got frustrated and gave up. It was hard. That was one of the things with Cathy – she had struggled in other classes such as math and was used to struggling and working hard; things didn't always come easy to her in school. However, while Jonathan had taken honors classes, in those classes he was provided resources and he didn't have to figure things out independently so much. So in this class, he lost interest and got frustrated quicker. He didn't like self-learning.

Cathy would do her part to communicate in the team dynamic, and at the start, Jonathan and Andrew were doing the coding because the guys came in there wanting to learn coding. When it got hard they got frustrated and weren't working as hard and then Cathy picked it up then because she couldn't stand things not being finished.

Kids who are willing to tinker or try it more than once are the ones who excel better in the program. It's not always the brightest, highest performing kids with the highest GPAs. It was more frustrating for him.

These post-hoc observations from Mrs. S offer insights into the extent of self-efficacy and initiative that are required to be successful in project-based work such as game design. What is most interesting in her comments is the observation that students who are willing to tinker and experiment ultimately find solutions to design problems, whereas some of the high-GPA students who usually excel actually find problem-solving quite difficult and lack patience to figure things out. It appears that Jonathan was not particularly patient and was quick to become angry in the face of design hurdles. He self-reports that maybe Globaloria made him become *more* patient. This finding warrants further exploration.

It is our wish to optimize the program to offer successful learning experiences for all students involved, towards achieving the learning objectives of cultivating 6-CLAs in the participants. Our findings with Jonathan indicate that in a single semester's worth of participation, he did not achieve success in development of *all* the CLAs, and his educator might have done well to encourage him to connect with live expert resources provided by the World Wide Workshop such as virtual office hours. Further, developing proficiency with programming takes time and patience, and he participated for Semester One only.

During Semester One, both Jonathan and Cathy struggled in this beginning phase of the Globaloria class to learn programming and to achieve the goal of creating a fully functioning Flash game in three months. Cathy ultimately persevered because as her educator said, she couldn't stand to leave a project unfinished. As a result, she became further advanced in her CLAs 1 and 2, and gained confidence that spurred her to participate again in Game Design II with greater mastery while developing her second game. However, self-led learning appeared to deter Jonathan who didn't ultimately gain these skills. While he completed many assignments it does not appear he was as successful integrating his knowledge and thinking systematically by piecing together disparate parts using Actionscript. Here, we also see evidence that playing games and making games are two separate skills. While he started the program with great enthusiasm, Jonathan appeared to lose interest when the work became difficult. His comments about anger management however indicate that he has become more self-aware and reflective of his own learning processes.



Case 3: Jason

Jason is a senior, aged 17, who was a return participant in Globaloria's Pilot Year 2, having participated in Game Design I and Game Design II in Pilot Year 1 (2007-2008). In Pilot Year 1, Jason worked with a team of students called the Experimental Ninjas. This group had been comprised of four males, all avid gamers who all had a strong interest in learning game design. This team of high school students developed the most advanced game created among middle and high schools in the previous school year, called "Zeitgeist." The three seniors in the group graduated at the end of the previous year, going on

to attend math and engineering programs at Rensselaer Polytechnic Institute (two students), and Marshall University (one student).

Jason was the only junior in the Experimental Ninjas group in Year 1, and since he had another year left in high school, he was able to continue on and expand his game design expertise through an additional year of participation. He participated in Game Design III as an independent study elective on his course schedule for the entire year.

Additionally, Jason was the first high school student to request an internship with the World Wide Workshop Foundation. The World Wide Workshop and his educator, Mrs. S. decided to experiment with this new intern role for Jason, since he was a second-year student and in his previous year his team was quite successful in their project work.

Therefore, in addition to his work as a student for credit, Jason was paid \$10/hour to complete tasks assigned by the World Wide Workshop. As an intern, he worked about 5 hours per week for the duration of the 2008/2009 school year, as well as during the prior summer. Jason's tasks included working on improving the game design tutorials, helping to make a code library featuring sample code for students' games, and interacting with and helping students in his own and other WV communities to problem solve design tasks. He conducted this peer support work by leaving comments on the wiki.

In this case study, we address Jason's work in both of his roles as student and intern.

Semester One Wiki edits and uploads, Jason and his class

Given his two separate roles, Jason had two different wiki usernames in Year 2. As a student, his wiki name is AdianX which he uses when he logs into the class wiki, whereas when he is using the educator wiki his intern wiki name is jbohon. Jason uses the educator wiki to identify with the other Globaloria educators, share online comments with them, and to post an intern profile page and notes to a progress report itemizing the tasks he has completed and the hours he has worked.

The wiki activity metrics presented below reflects the sum of activity in both of Jason's member accounts, on the educator wiki and on the main RTC class wiki for students. Findings indicate that overall, even aggregating 2 member accounts, his wiki editing is in the low to mid-range, in relation to the rest of the class. Most of the wiki activity presented below reflects posts and uploads Jason made on the educator wiki, relating to his internship role.

Table 12: Jason's Wiki Edits from Game Design I

Month	Jason's Wiki Edits	Range of Wiki edits, low to high
August	30	3 - 31
September	12	9 - 101
October	15	10 - 94
November	21	4 - 49
December	11	2 - 63

Supporting the results for wiki *edits*, Table 13 indicates Jason's wiki *uploads* from Game Design III, in which he added Flash files and images to the wiki. Again, his upload metrics appear low during this time compared to his fellow students.

Table 13: Jason's Wiki Uploads from Game Design I

Month	Jason's Wiki Uploads	Range of Wiki uploads, low to high
August	2	2 - 5
September	3	3 - 14
October	4	4 - 25
November	2	2 - 14
December	2	0 - 21

This activity is of note because overall, in this case study we find him to be quite active in the class in Semester One, supporting other students and creating digital videos.

Game Design III (First half of Fall Semester, September - October 2008)

During the first half of the semester (through October 23, 2008), as the rest of the class worked on the Game Design 1 curriculum, Jason had a parallel track that he, Mrs. S, and the World Wide Workshop Foundation designed specifically for him. This involved Jason's engagement in self-guided study of game design in Flash, revisiting the Game Design I and II syllabus and curriculum, and using the sequence and tutorials to create another fully functioning game by the end of Pilot Year 2.

Jason was also provided a list of tasks in his internship, developed by World Wide Workshop staff. As an intern, his list of tasks in this September and October timeframe includes being an online mentor for KMS, a middle school in the Globaloria program; creating a video documentary; and writing and publishing one blog post per week. Overall, Jason appears to juggle these roles, focusing on game design work on some days, and alternating to his role as an intern on other days.

Internship

As an intern, Jason created his own intern profile page on the educator's wiki site, where he shared game design tips and teaching techniques with the other WV educators. Here he states, "game design is an art," and that "you have to be passionate about it to even learn it." On the educator's wiki, Jason lists game play and design, as well as reading and writing as his favorite outside of school hobbies. He notes that his laptop is his gateway to the world, and expresses that he continues to stay involved in Globaloria as "It's my ideal

job to be a game designer/game design teacher.” His teaching philosophy on his intern profile page states, “Be straight forward. There's always a time for joking around, but don't bore the kids with lectures and worksheets. Play games (again, no pun intended) with the kids, they'll remember it better.”

Jason’s Introductory Video Documentary

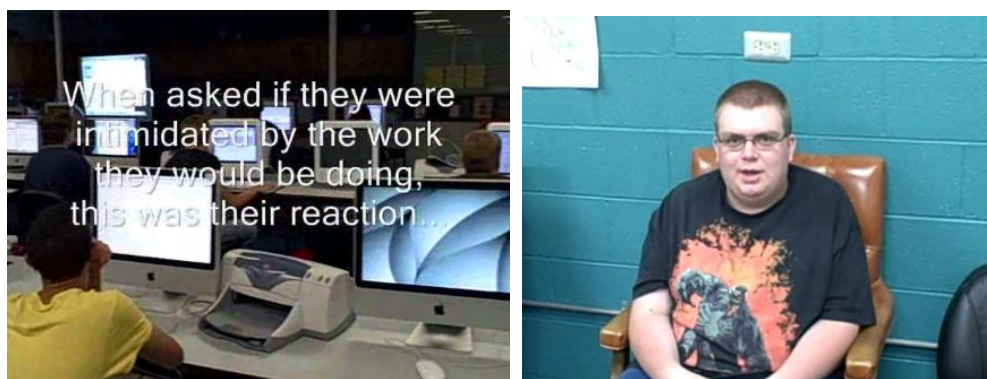
Evidence of Jason’s enthusiasm for video documentary is apparent early on in the semester. On September 4, 2008 he uploaded a video to TeacherTube, an educational video sharing site, and embedded it on the educator Wiki. “Game Design: Ready For The New Term” is the title of Jason’s video, and it features hard rock music playing in the background as scenes of students working are presented, and snippets of interviews are heard. Figure 30 illustrates the title screen of the video.

Figure 30: Jason’s Mini-Documentary Video: “Game Design: Ready For The New Term”



In a set of brief interview scenes, Jason asks a few students in the class if they are ready for the challenges ahead that they face this semester. He then asks a few students who appear in the video what their wiki names are. Then another scene appears in which he inputs text on the screen stating, “when asked if they were intimidated by the work they would be doing, this was their reaction.” A few students respond to this saying no, and the student Jesse, whose wiki name is Sampsonite notes that “It shouldn’t be hard because students in the program are supposed to help each other out.” This student’s reference to the subject of the autonomous self-led learning context in Globaloria is a theme that carries across several videos Jason creates in Pilot Year 2. Figure 31 shows the scene posed and a screen shot of Sampsonite’s reaction.

Figure 31: Images from Game Design Video



The video then shifts into a scene in which the educator Mrs. S is play-acting that she is getting frustrated with the class, saying that since they could not figure out a certain tutorial on their own, she guess she will have to show them how to do it again.

The video then cuts to text noting that this was a staged shot, and that the students in fact are very capable of doing the work that is expected of them for Game Design I.

Mrs. S soon appears again in the video during an interview, noting that she has a talented group of individual students for this semester, and that with all of the material that is posted to the wiki, she believes they will be very successful. Figure 32 shows screenshots of her scenes in the video.

It appears from the video narrative that Mrs. S was allowing Jason to make light of her role as a co-learner in Globaloria. Her statements (at first playful, and then direct) highlight her recognition of the extent to which students' self-driven inquiry and self-led learning through use of online tutorials for teaching Flash are needed in this program, as she herself is still learning to program. It also demonstrates an alternative to the traditional dynamic of authority between students and teachers. In the Globaloria model, the teacher serves as a guide to students' learning and progress, rather than as the primary authority and holder of knowledge. In this clip, Mrs. S. appears to be playing with and making light of this new role, as are Jason and the students appearing in the video.

Figure 32: Mrs. S in Game Design Video



The video ends with Sampsonite noting that he is in the class because he wants to learn how to make video games, and that he expects it will be fun. Jason's initial mini documentary provides evidence of his experimentation with digital video technologies, as he has synthesized and edited together audio, video, and text. It also shows his general enthusiasm for the program, and also shows his insight into the ways in which Globaloria differs from other classes he has experienced.

Progress Notes

In order to track his progress and note his internship tasks completed, Jason uses a Progress Notes table where he logs his activity. For example, on August 21, 2008 he writes, "helped Stu and Itay with glitches throughout the school wikis", and on September 3, 2008 he writes, "made a list of vocabulary terms necessary for the RTC Game Design class (for Mrs. S)." The progress notes provide short itemization of tasks complete. He uses these notes to log his activity so that he can keep track of his internship hours.

Semester One Game Project

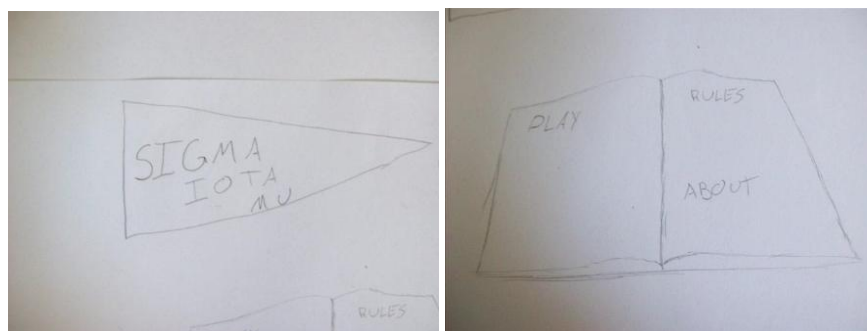
In regard to his work as a student during the first half of Semester One, Mrs. S writes in her September Progress Report that “Jason is working on his game at his own speed. I wanted him and Serena to do a game together but he requested that he do one on his own. I agreed because he had a good idea in place.” Jason’s Pilot Year 2 game is called “Sigma Iota Mu (SIM) University.” In describing the game, he explains on the wiki that “my biggest inspiration was the game called *The Sims*. It 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.” In a blog post dated July 28, 2008, before the start of his semester he notes that “I chose to study college survival, because A) I'll be needing this myself very soon, and B) I want to help those who are planning to go to college.” This game provides Jason with an opportunity to engage creatively with his soon-to-be new identity as an undergraduate college student in the next school year.

Paper Prototype

Similar to the other students, Jason creates a paper prototype of his game early in Semester One, in which he states that the player will assume the role of a college student trying to survive. Players in his proposed game have the option to choose between a male and a female character. At the beginning of the game, the player also has to pick which hobby he or she likes the best. The options are: sports, reading, shopping, or being lazy. The player’s choice will determine which type of dorm he or she is assigned to. In his prototype, Jason demos the “slacker dorm” option, where a player will get sent for choosing lazy. Evidence of Jason’s playful approach to the program is clear as he says he chose to showcase this option of being lazy which is what he likes to do the most.

Jason’s video editing talents are again evident in this presentation. For example, in the main title screen for his game, he shows a broad view that includes his logo and main menu. As he talks about his game, he films a close-up of the logo for his game, and as he talks about the menu, he zooms into a text book he has drawn which features the play options. This is especially noteworthy as the rest of the student paper prototypes in RTC are made simply, with a fixed camera angle and are not edited with close ups. Figure 33 illustrates screenshots of these video edits.

Figure 33: Close Ups on Menu Screen of Page Elements



Blog Posts About Game Design Planning

During the course of the first semester, Jason’s blogging is sporadic, totaling about eight entries. In a blog post on October 21, 2008 as he continues to think about his game plan, he writes, “I’ve gotten each individual dormitories up for the first part, and will work on the other places; the town, the campus, the buildings, blah blah blah. The hardest part will be coding.” He goes on to discuss his consideration of

putting a time element into his game, and the difficulty of this. He then states, “did I ever mention this? Oh, I don't think I did. I HATE CODING!!!”

As a second year student, Jason already recognizes that coding is the most challenging tasks of game design. He suggests here that he hates coding, but does so in a slightly humorous way, so the reader is left uncertain how much he means this, especially given his apparent enthusiasm otherwise for the class activities, for his creation of a game, and his continued involvement in Pilot Year 2.

A little over a week later, in a blog post dated October 30, 2008, Jason writes that he is removing the time element from his game that he had planned to include. He explains “I've decided to take out the time in the game, for a few simple reasons. The first being that it'd take up a lot of meaningless frames and time that I could be using on better music (which I plan on doing), work on the in-game windows and on the overall coding. Second being that in college, time's somewhat irrelevant (in theory).”

Here we see that Jason has decided that including the complex variable of time in his game will be too difficult to accomplish in the boundaries of the game design class. While this present evidence of his own time-management skills in prioritization, it may also be that he feels he lacks the support to learn this complicated programming feature on his own. Overall, his thinking and rationale here involves consideration of the following elements:

- What features and functionalities to include in the game
- The storyline
- His own available time and resources
- How these variables inter-operate

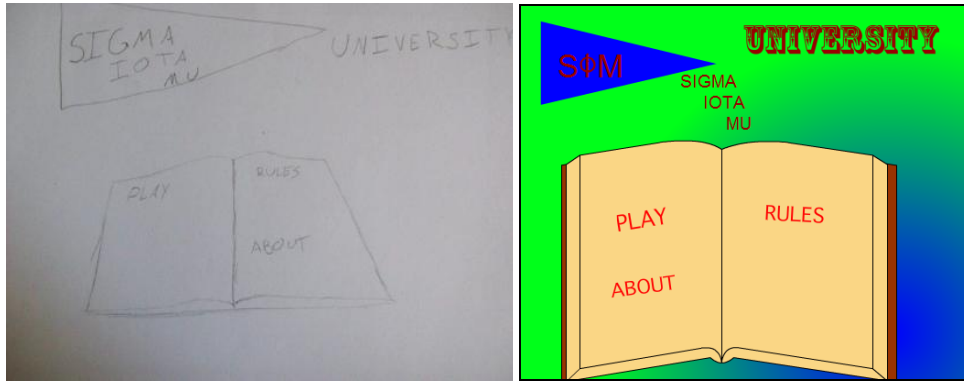
As a second-year student, Jason evidences this systems-thinking and prioritization much earlier than Cathy and Jonathan, who as first-year game design students could not yet anticipate and prioritize to this degree. However, deciding to leave out the time element meant that he did not pursue the opportunity to follow through on an initial interest and curiosity in learning to program a complex functionality into the game. It appears that he might have been guided to consult with an expert in virtual office hours for instance, regarding feasibility of coding conditionals and including the element of time in his game, before ruling out the possibility on his own.

Game Design Progress

In the first half of the Fall Semester, Jason creates an initial structure for his game project in Flash, quite early on. On October 14, 2008, he posts the .SWF file to the educator wiki. It contains the following screens, depicted in the figures below with their aligning paper prototype screens.

Figure 34 shows the main menu screen of his game, which has remained consistent between his paper prototype and his final game. Jason uses elements from university life in his title screen, including a pendent flag and a book to set the theme of the game from the very beginning. The “rules” page notes that the object of the game is to keep one’s stats up and to get high grades.

Figure 34: Paper Prototype and Final Version Comparison of Main Menu



When the play option is selected on the menu, the player then has to choose between a boy and a girl character. Next, the player has to choose what he or she likes the most: sports, reading, shopping, or being lazy (although in the final version of the game, reading has been changed to studying). The game is only programmed to follow the “being lazy” option, which takes the character to the “slacker dorm”, with a pop-up box of going to the slacker dorm appearing over the dorm room scene.

Figure 35: Paper Prototype and Current Version of Choosing Activity The Player Likes Best



In the paper prototype, Jason explains that in the slacker dorm room, there is a bed, an alarm clock, and a desk. Yet, in the current version, there is only a bed and a desk, as well as an arrow that allows the player to leave the room. The alarm clock is missing because he de-prioritized the time element from his game. In the paper prototype, he notes that the bed will allow the sleep action, which lowers certain stats and raises

others, while clicking on the desk will raise up a player's grades but lower all other stats. At this early phase, the game is not yet programmed to do this.

Jason's advanced knowledge of Flash in relation to his peers is apparent from his game. Working alone, he was able to accomplish by October 14, more than most of his peers would accomplish across all of Semester One. The game still does not feature several of the attributes he has noted he plans to include. For instance, the variables at the bottom of the page are still static, as are all of the classrooms.

Game Design III (Second half of Fall Semester, November 2008 - January 2009)

The second half of the semester took place between November 1, 2008 and January 21, 2009. Jason continued working independently on his game and his duties as an intern. In Mrs. S's December progress report she states, "Jason is working on his game at his own speed. He has learned coding items and I just let him do his thing."

A post on his student project page during this timeframe states the following:

I started to do research on what Roman characters I could use for the name; Sigma(S) Iota(I) Mu(M) University! Why not? It's a simulator, and your playing it in a college setting, so it seemed to fit. Some things you'll need to know if you need something to make a simulator is the counter. It's hard to explain how it works without the file (I'm typing this from my home over my Thanksgiving break without Flash on my computer, but I will edit this part out once I have Flash and can do this from home again), but making it easy to understand: when you click on this named button, increase this number by however much you want."

Here Jason explains further his use of symbols for the Greek fraternity system in his game title, while cleverly interweaving the concept of simulation. Secondly, he notes that he is working on his project from home, indicating that he has both access and motivation to work on this project outside of school. Finally, he explains more about the game functionality. Overall however, in this timeframe, Jason's wiki editing and uploading are not particularly remarkable during this timeframe.

Internship

Mid-Term Game Design Video

Jason's other blog posts during the last half of the first semester discuss a second video documentary he created as a follow-up to the first one at the beginning of the term. This was the third video created this semester thus far.

On November 8, 2008 he posts the video on the wiki, and states in his blog "the idea behind the video is to have the students contrast their expectations at the start of term to what they know is expected of them now. Also, I wanted them to describe what they felt they could do better on. Mrs. S graciously took time out to give me an interview for this, which I'm glad for."

The "Game Design Mid-Term Video" starts off showing scenes of the class working, with hard rock music playing again in the background. This fades out quickly as the interviews begin. The first thing Jason asks Mrs. S is if she sees the students working diligently in her class, to which she responds, play-acting again, "yeah, most of the time."

The video then cuts to a humorous scene of two students horse-playing in class, contradicting what Mrs. S has just spoken. Figure 36 provides screen captures from this scene.

Figure 36. Mid-Term Video



Shortly after this, Mrs. S then provides a more serious response to her expectations noting that if the students can continue to work diligently, and if they can stay on task, she expects them to produce some great games. She notes that she is pleased with the ideas that the students have come up with for the semester. One such idea is explained by a student with the screen name TTacy on the wiki, who explains that his is an emergency room game, in which players can learn what types of instruments should be used in a particular operation.

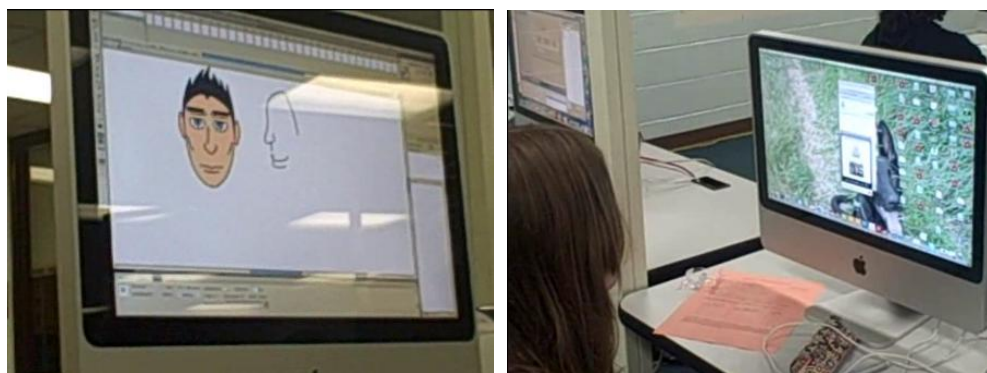
Mrs. S notes in the video that each student brings something special to the table with strengths in specific areas. She notes that she has been especially pleased with the art that some of the students had produced this semester, and also states that students who are not great artists typically demonstrate other strengths such as skill with music.

In the video, Jason also asks what the students struggle with the most. His video shows three students responding that coding is the most challenging aspect of the program, and Mrs. S agrees with this. These

comments appear to align with the comments of Cathy, Jonathan, and Jason throughout the case study observations.

The video then depicts a scene of a female student seeking out help with coding by discussing her difficulties with a Globaloria staff member via remote web conferencing, who states that he will locate a tutorial on her problem area and post it to the wiki. Figure 37 shows this student's artwork in progress, and the student web conferencing for assistance. It is clear from this video that the students understand that help and support is available to them from Globaloria staff. It is unclear to what extent they actually pursue this option in their day-to-day work.

Figure 37: Students Working During The Second Half of Game Design I



Toward the end of the video, Travis states that Game Design I has been a lot of work, and has not been an easy class, but that he has learned a lot from it and enjoyed taking it thus far. Jason finishes the video through shots that show students working as he narrates: “while the students had trouble with the work, and while they had different ideas what to expect, they enjoyed the class”.

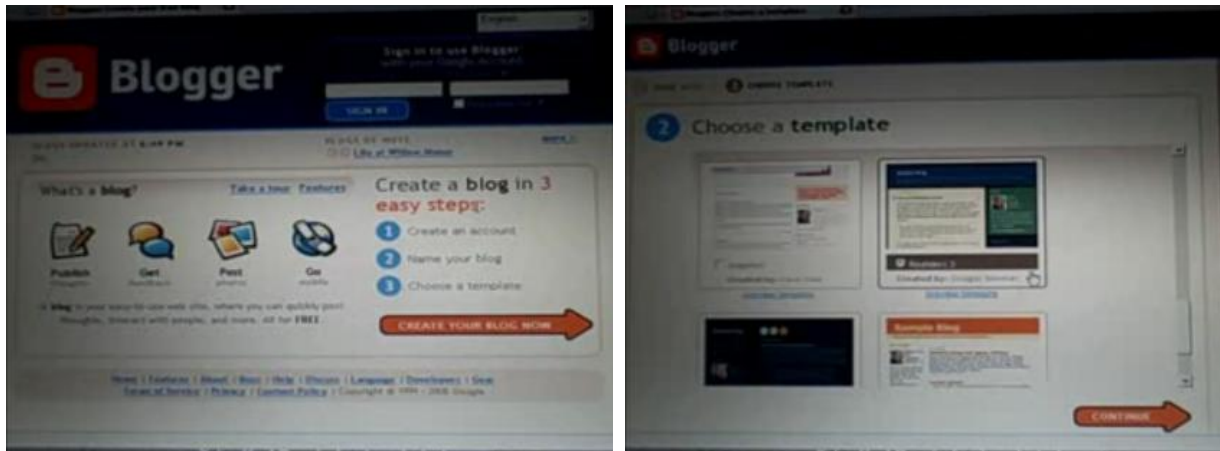
Overall, the conclusion of this video gives the impression that Jason feels the students in Game Design I had some “trouble with the work,” and that their expectations coming in differed from their present experience. His overall summary appears to be supported by the case study of Cathy and Jonathan, for the timeframe of Semester One only.

Video Tutorial for Middle School Students

The fourth video that Jason completes in this time period is a learning tutorial on how to create a blog, which he designed for the students at KMS. While the video is approximately 13 minutes, and provides a very meticulously detailed lesson that spans signing up for the blog, to making posts. He goes through each step and feature very slowly, anticipating a level of detail that young students might need. Figure 38 shows screenshots from this tutorial.

Jason's tutorial might be useful for younger students such as the KMS students who are just starting out, because the new students can watch it all the way through before starting, so they know what to expect when they go online to create their own blog. It is unclear to what extent KMS students used this tutorial.

Figure 38: Jason's Blog Tutorial



Summary, Semester One

Overall, in Semester One Jason engaged readily in both his roles as student and intern. As a student, he created one video (his paper prototype video outlining his game plan). As an intern, he created three videos in his internship role: an introductory mini-documentary video; a mid-semester mini-documentary; and a tutorial for younger students. He has also kept progress notes on his wiki, discussed his game design plan on the wiki and blog, and has begun to design game elements and piece together his final game.

His paper prototype on “Sigma Iota Mu University” shows a game that is both unique and educational. The game features he plans to continue building out will require advanced coding skills over and above the other first-year students, which is appropriate since he is taking this course as “Game Design III.” While Jason shows some frustration about coding, and has de-prioritized a key element in his game, “time,” which requires learning how to program conditional statements in Actionscript, he has still chosen to create a game that requires some new features he has never coded before, in order to challenge himself. Overall, his progress, initiative, and ability to anticipate and prioritize his game design plan indicates that he is developing project management skills and engaging in a level of systematic thinking in his approach to the project planning and prioritization of his game design.

Semester Two Wiki Edits / Uploads / Posts

In Semester Two, Jason was one of five students who continued on again, working again in both his student and intern roles to supporting other students’ learning while also finalizing the game he started in Semester One.

Tables 14 and 15 indicate that among the smaller group of 5 students participating in Semester Two, Jason led in wiki edits in March and April. As for uploads, in February, he posted a number of different versions of a screen from SIM University that never made it into the final .SWF game file. He led in uploads in April, though the high of 6 was not remarkable.³

³ It is important to note that wiki numbers provide a baseline but do not reflect a) the work students perform locally on their computers using software, or b) other social media websites used in the class. In the case of Jason, it is important to note that these metrics belie his active use of video tools in the class. A digital video that has been uploaded to a streaming video site such as Youtube or Teachertube can be embedded on the course wiki in a single click with a simple paste of a URL.

Table 14: Jason's Wiki Edits from Game Design III

Month	Jason's Wiki Edits	Range of Wiki edits, low to high
January	10	1 - 23
February	17	2 - 47
March	42	11 - 42
April	26	1 - 26
May	21	3 - 40

Table 15: Jason's Wiki Uploads from Game Design III

Month	Jason's Wiki Uploads	Range of Wiki uploads, low to high
January	1	1 - 7
February	10	6 - 14
March	3	2 - 10
April	6	1 - 6
May	5	5 - 60

Game Design III – (First half of Spring Semester, January-Early March, 2009)

The first half of the second semester runs from mid-January through mid-March. During this time, Jason seems to embrace his intern role considerably more than his role as a student. He has stopped updating his student blog. Mrs. S only briefly mentions his game work in her March Progress Report which states, "Jason is working on his game. He is doing mentor work for Globaloria. He is also helping my students in Game Design II as they ask for help. I also have him help my digital imaging students with Flash."

Semester Two Internship Work

Mentoring

During the first half of Semester Two, Jason adds his contact information onto his educators profile page. He lists two email addresses, and his instant messaging screen name as ways for them to get in touch with him. Jason's listed contact information indicates his willingness to help out other students and to be a part of the program. These multiple means of contact also suggest that Jason is very comfortable with different forms of computer-based collaboration tools.

His continuing daily progress notes indicate that Jason has been diligent in his activities as an instructional intern. For example about a conference call dated February 25, 2009 he writes, "talked to Shannon, Brian, Maitreyi, Charles, Jeremy, and Trevor [World Wide Workshop staff] about the new tasks the interns are assigned throughout the course of the next few months." And regarding his mentorship tasks he writes on March 3, 2009 "introduced myself to the RTC, Kasson, Crittenton, Pressley, and Eastern Greenbrier wikis."

Jason's messages to the students he is mentoring are posted on the talk page of their wikis, and consist of comments such as, "Hey, this is Jason, an intern for Globaloria. I just wanted to let you know that if you need something to go ahead and leave me a message on my discussion on AdianX on the RTCwiki. I hope to hear from you. – Jason."

As for interactions and dialogue, in the first half of Semester Two, Jason left a thoughtful comment on Emma's page at RTC who was Courtney's partner (see Case 1) on the game "Learn The Bones." Jason's note states, "Great job on the game! Just a few little things you might want to consider: 1) Make a colored background behind everything. It's not necessary, but a suggestion. 2) It might just be how my laptop's configured, but the font looks really small, to the point I can't see it. Either increase the size or make the font something bold that contrasts the black, like a bright red or possibly a blue. Hope everything else is going well!" These comments are constructive, and the recommendations were applied by Emma and Courtney in their game design (as indicated in Cathy's case). The students created a rainbow-like background behind the animated objects.

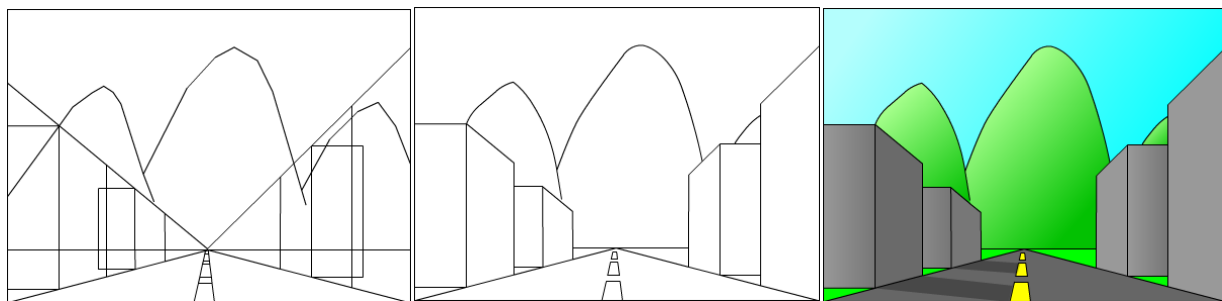
Tutorials

By February, Jason had developed enough of an understanding in drawing and coding in Flash that he felt comfortable sharing the details of his personal work and learning with other students in the program. He created some learning tutorials during this timeframe that appear to have been inspired by his own game design work.

In Jason's game SIM University, the player can leave the dormitory and explore the town. One of the tutorials Jason created has instructions on how to make first-person-perspective graphics in Flash, representing the technique he had used in his own game. He begins the tutorial by stating *"In making graphics in a first-person perspective, it is difficult to get all of the graphics in proportion. So I will walk you through step-by-step in my personal process."*

His tutorial includes a few short steps, and six different images to emphasize the written instructions that he provides. Three of these images from his tutorial are presented here in figure 39.

Figure 39: Images from Jason's Tutorial on First-Person-Perspective Drawing in Flash



Jason's other tutorial on his project page is about the coding he used in his game to make pop-up screens and menus. It is very technical, but descriptive. An excerpt from a screen of the tutorial is as follows:

One of the features of SIM U. is the ability to click a button and make a menu screen come up.

1) Create a button. We'll name it *button* for now.

2) Create a menu and make it into a movie clip. Name it *window* and move it off the stage.

3) Create a new layer and name it *coding*, then type this in:

```
button._x = xxx.xx;
```

```
button._y = yyy.yy;
```

In creating and posting these tutorials, Jason is sharing his knowledge with other students, and contributing valuable resources to the growing archive of online game design supports available through the Globaloria wiki.

Game Design III – (Second half of Spring Semester, Late March - May, 2009)

The second half of Semester Two ran from mid-March until the end of the academic year. During this time, according to Mrs. S's progress report, Jason continued working on his game however it appears from a review of his activity on both the student and educator wikis, and on the intern blog that he was more active in continuing in his intern duties, and somewhat tapered off in his game design efforts.

Internship Work

Mentoring

In this final course timeframe, Jason continues in his attempts to tutor and assist students both at RTC and at other locations. On March 17, 2009 he writes on the intern blog, "At KMS, a student has said that she doesn't like the focus of her game even though she thought it would be a good game idea. I suggested, since she already had some coding done, to just change it to something like skating. So, we'll see where that goes." Sure enough, on Jason's wiki talk page, there are exchanges between him and the student in question, who is named Samantha. He first posts his usual greeting and offer of assistance to her, but notes that she must like the ocean because that's what her game is about, and asks her why that is. The following is an excerpt of an online dialogue between them, with Jason posted comments appearing on Samantha's talk page, and hers appearing on his:

Samantha: "I dont really like the ocean I just wanted to make a fun game. I wanted to make a action game"

Jason: "You don't like the ocean and you want to make an action game? Hmmm, well what else interests you? Maybe you could try to do something with the coding you've already used. My suggestion would be a skating game. I don't know how it's viewed in K [town], but a lot of people here think skating is for punks. Maybe you can teach them to think otherwise? If you have something you like and think it can be made into a game, go for it."

Samantha: "A skating game, that sounds fun. I may try that if its O.K with Mr. Cowley. Nobody really says anything about skating is for punks. I could probably use the same coding like when I go from scene to scene. My game is coming along pretty well too!"

Jason: "Sorry for the confusion, but like I said if you think it can be made into a game, go for it. Just keep working on it and I'll be around to help you out when you need it. :) Good luck"

Samantha: "Thank you for saying you will help me with my game. I haven't ran into any complications so far, but I probably will."

The Talk feature of the Wiki is somewhat difficult to navigate and is very open and unstructured. From the dialogue above, it is apparent that Jason attempts to reach out to Samantha with the idea to make a game about a topic she is more interested in (while offering a suggestion of a topic that *he* is interested in -- skating). The communication appears to offer encouragement to Samantha.

The dialogue provides insight into a new form of online communication that the wiki enables, between an older high school student game design mentor, and a geographically disparate younger middle school student – two students who in the regular school context rarely have a chance to interact. The communication between them is centered on the game artifact. It appears that Jason interprets into Samantha's lack of a game idea that she might like to create a skating game. Skating is often viewed as a sub-culture among young people and Jason appears to offer it as one alternative for the younger Samantha to look into.

The dialogue doesn't go much further than these initial few exchanged lines, but provides insight into the potential for this type of virtual communication and mentoring in the Globaloria network in WV. Such communication might be greater facilitated using synchronous chat, or a more structured comments feature on the pages of the wiki.

More Tutorials

While experimenting with a new game feature for SIM University, namely, how to code lip-synching for a game character, Jason again sees an opportunity to document his learning in a tutorial that might help others. He ends up developing a highly detailed text-based tutorial on this programming task, an excerpt of which is presented as follows.

Once you've gotten an idea on how the mouth's look, draw them out off the stage; we'll move them into the frame later. Also, while on this step draw out the "Idle" mouth; the idle mouth is the mouth when it says nothing and is at rest. It's important to note that you do not need to recreate each mouth for a new pronunciation of a letter or series of letters, you can if you want but this will just add onto the time.

Once all the mouths are drawn out, it's time to import the sound file. Locate it and import it to the library. Make a new layer, naming it "sound" or "music" and drag it from the library to the timeline.

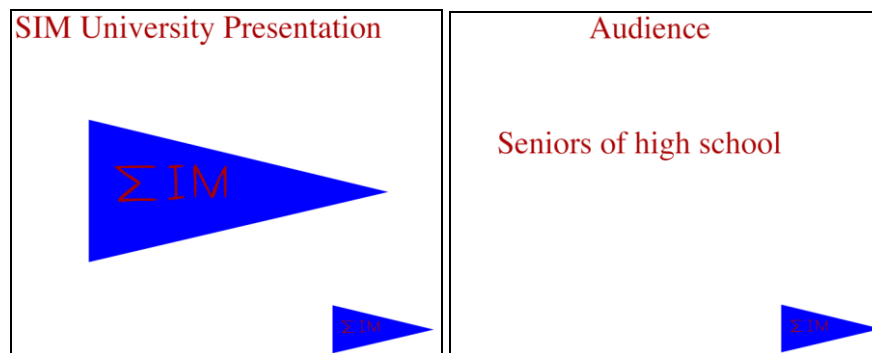
Overall, Jason's creation of tutorials while he learns new programming skills demonstrates strong project management skills and synthesis, in that he is leveraging a task in his student role, to fulfill an internship task. It also shows he enjoys sharing his knowledge with other students. Further, it may be that documenting the given task's instructions as a tutorial reinforces Jason's own learning and serves as a reminder if he needs to go back and review in the future.

This is an important finding. First of all, this practice could serve Jason well in his future learning in college classes, and in collaborating in future project-based work he encounters. Further, the finding relates to Globaloria's growth and expansion. As more students engage in the program, our learning model anticipates a potential network effect to occur as knowledge sharing flourishes. For instance, we expect users' own contributions of highly relevant tutorials and Actionscript code samples will help new students advance more quickly as they become involved in game design efforts, in context. As a second-year student, Jason is a Globaloria "super-user," and his translation of personal game design learning into instructional tutorials for knowledge sharing provides initial evidence of the feasibility of this type of network effect.

Jason's Final Game

Jason notes in the final filmed Globaloria presentation that SIM University was an idea he had conceived of shortly after the end of Game Design II, and although it was in an incomplete stage at the time of his presentation, he plans on finishing it before he goes to college in the fall. Jason presents the pitch for his game during his final presentation. Figure 40 shows two screenshots from this pitch, the first being the start page, and the second being the audience element of his game.

Figure 40: Flash Game Pitch



Jason states that the audience of his game is seniors in high school, and that his game is about teaching students how to manage college resources and maintain happiness. His game pitch outlines the game further:

Game Play: No winning. Players attend class and tend to their needs to keep playing

Smart Factor: Develops study habits, time management, prioritizing

Fun Factor: Able to do what want. Random events

Style and Originality Factors: 1st-Person perspective, Cartoonish, "Pop-y" music. Live as a college student and play as yourself

Reflections: Complex coding; more complete

The game features that Jason created in the fall semester, depicted earlier in the case study, remained the same in his final game. Overall, in the spring semester, Jason has added some conditional code that changes the player stats based on user actions. When asked about the level of difficulty he has faced in coding his game, he notes that he is trying to learn and implement conditional coding in his game. Conditional coding would be used to program the game so that if a given player stat reaches a certain level, the game may end, or a specific event will occur. Likewise, if a student chooses a hobby such as sports, their subsequent actions may then affect their stats differently than a student who chooses the "laziness" approach.

The variables / player stats that Jason wants to apply conditional coding to are hunger, hygiene, rest, and happiness. Another is grades. These reside on a bar at the bottom of the screen along with other player information. Figure 42 shows the stat bar full, and then diminished based on the player clicking on the bed in the room, which is as far as he took the conditional coding.

Figure 41: Slacker Dorm from Current Version of Game

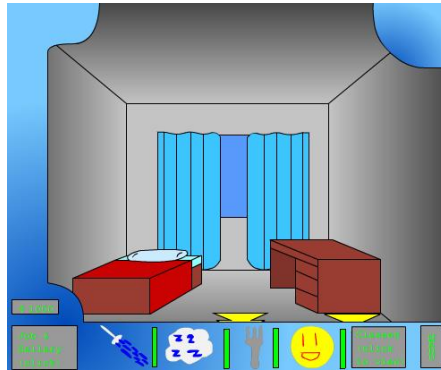
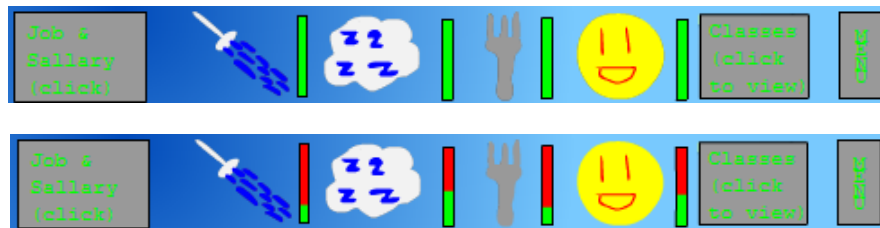


Figure 42: Stat Bar Changes Based on Player Actions

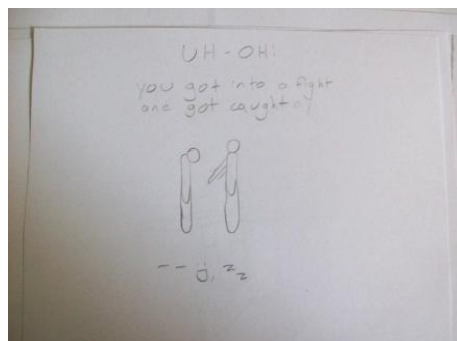


As the game is still unfinished, these meters are not fully operational. Once a meter reaches the bottom, another click on an object will cause it to start over, showing it to be full again. This is clearly not Jason's intention.

Also of note on the stat bar, are boxes that read "job and salary," "classes," and "menu." The job and salary button is not yet functional, while the classes button brings up a report card that has empty grades no matter what actions the player takes. The menu button brings up a pop up box that allows the layer to either start the game over, or to turn off the background music that Jason has integrated into his game.

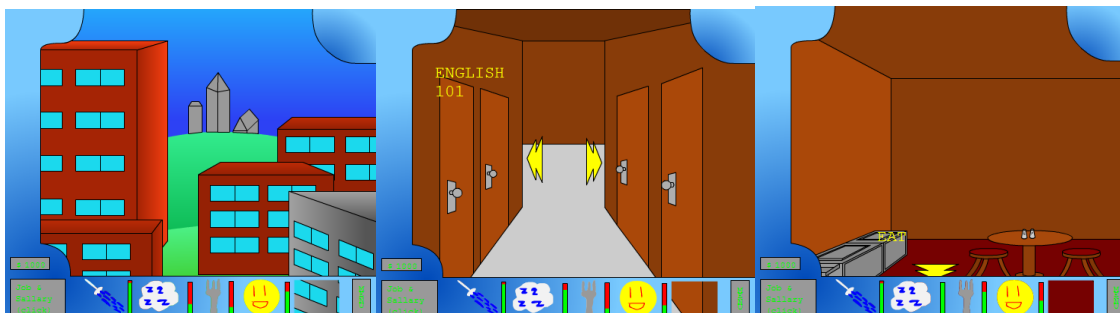
In concluding his paper prototype presentation, Jason explains that sometimes random events will occur that will also affect the player's stats. The example he provides is that of getting into a fight and being caught by a teacher. In this particular event, the player will lose money, enjoyment, and rest. Figure 43 represents a screenshot from this random event. This is a feature that does not seem to be implemented yet in his current version.

Figure 43: Random Event of Getting into a Fight



In the final game, when leaving the dorm, one can then choose to go to the science, art, or literature centers, as well as the cafeteria or even back to the dorm, depicted in Figure 44. Clicking on any of the buildings takes the player to a unique location, typically with different doors that, when rolled over, state a different class name such as English 101 or Art 103. Clicking on any of the 101 class doors makes the sleep and enjoyment meters go down. The 101 doors are the only functional clickable objects on these screens. Clicking on the bar in the cafeteria makes the meter for the fork icon go up. There are doors or arrows in each of these areas that bring the player back to the campus.

Figure 44: Campus, Literature Center, and Cafeteria



Overall, it appears that Jason has some ambitious plans for his game that would have required him to learn some challenging conditional Actionscript coding. The ideas were original and well-conceived. It appears he is thinking a lot about his future, when thinking of the variables that factor into the life and outcomes of a typical college student. Here Jason is imagining his own future, anticipating what his life will be like in the coming years, thinking about a quality that he himself states he has (laziness) and what its potential impact on performance might be. Overall, he is playing with his own future identity, in the context of his Globaloria game.

His game demonstrates a high degree of imagination. However, in her final progress report of the year, Mrs. S notes that that, “Jason continued to work on his game and he did his presentation. His game was so involved that he did not get it finished. I would have liked to have seen a finished product.” It appears that Jason might have benefited from greater game design support, especially in programming conditionals. The content and originality of Jason’s game however is quite evident. And, Jason’s engagement and play during the planning and prototyping stages with the concepts of player stats, life variables, and their outcomes, might have been beneficial psychological and identity-development activity that helps him imagine, prepare for and negotiate a significant up and coming life transition.

Content Analysis of Sigma Iota Mu (SIM) University Game

Jason created the SIM University game over the duration of the whole year. RTC students created a total of three team games during the spring semester (a single semester timeframe). Out of a total of 26 possible game attributes that we included in our coding, the SIM University game achieved a total numeric value of 16 in the content analysis. The table that follows indicates the final tally. The codes detect the presence of game design learning and mastery among the student creators.

Table 16. SIM University Content Analysis Results

<p>Game Title: SIM University</p> <p>Student/Team Name: Jason</p> <p>Team or Individual Game: Individual</p> <p>URL: http://www.myclife.org/usa/wv/rtcwiki/index.php/Sigma_Iota_Mu_University_Page</p> <p>BRIEF GAME OBJECTIVE: Teaching students how the manage college resources and maintain happiness.</p>		
CATEGORY	CRITERIA	1= Yes
Game Plan and Demo [Design Template; Prototype]	Did the students create a Paper Prototype?	1
	Does the game appear complete/finalized?	0
	Please EVALUATE the Game Design Plan for its written content describing student intentions for their game design (Overview, pitch, scenes, elements/assets, etc.) [0=None; 1=Incomplete; 2=Satisfactory; 3=Thorough/Excellent]	2
Playable Game Design	Are there gameplay instructions?	1
	Does the game play exactly as the instructions specify?	0
	Is there a visual / graphic STYLE that carries throughout the game, consistently? (e.g., color-scheme, character-design, are game-play objects in consistent locations throughout the game)?	1
Playable Game Functionality	In all relevant instances, does the game offer feedback to the user based on actions (e.g., quiz game provides feedback on a response; when a character dies a life is lost or a message appears; rollovers change color or display a pop-up; do collisions elements work properly)?	1
	Do the feedback / response elements add to the challenge of the game, (e.g., the game is over if the timer, lives, or health run out; scoring is variable; the game can be "lost" or "won")?	0
	Are there objects (not characters) that are interactive for the player (e.g., buttons with rollover; objects that can be drag and dropped)?	1
	Are there characters that the player can interact with (e.g., player avatar that moves with arrows, and/or enemies or allies that are animated or moving)?	0
	Do the objects and/or characters interact to cause some effect? That is, do objects detect collisions? (e.g., objects bump and change direction, character gains/loses life when it touches something else, gains/loses points, etc.)	0

	Are there multiple levels, progression of different scenes, and/or increasing difficulty?	1
Audio/Visual	Are visual elements well executed (e.g., are images clear without blurriness or 'fringing')?	1
	Is there background music to the game?	1
	Does the game feature sound effects that happen based on player action or by on-screen objects?	0
	Is the artwork creative and engaging?	1
Playable Game Subject / Narrative	Briefly, in a few words, what is the MAIN TOPIC AREA of the game (e.g., sports)	College living
	What is the game genre (educational, social issues, or entertainment)	Educational
	Does the game feature a subject that reflects an educational or social issues theme?	1
	Are the educational/social theme elements <i>active</i> or <i>central</i> to the game play (e.g., a game about global warming takes place in a landfill)	1
	Does the game have a cohesive storyline and/or a beginning, middle, and end?	0
	Does it appear that the students did research into the educational/social aspects of the game (e.g., not simply a basic math game, or a "name the capitals" game, but rather teaches players something that is potentially new, and the designer learned something new).	0
Playable Game Presentation on the Wiki	Did the student provide the FLA file for the Final Game on the Wiki?	1
	Did the student provide the SWF file for the Final Game on the Wiki?	1
	Is the final game marked clearly on the Student or Team Project wiki page, specifying it as the final game?	1
	Is the final game provided in the Game Gallery on the Wiki?	0
	Total Tally	16

Overall, the SIM University game includes 16 out of 26 possible attributes we coded for in each game evaluation category. In the Spring semester at RTC, among a total of three semester one games created, the average game evaluation value was 16. SIM University value of 16 meets the average.

Jason's numeric value is below the final value of 20 achieved by the Learn the Bones game created by two first-year Globaloria students, Cathy and Emma in the second semester. It appears that while Jason evidenced many skills over the semester while he participated in two different roles (especially in video editing), his final game did not present as many features as his fellow students. It is unclear to what extent Jason had more or less coding and game design knowledge after the spring semester, in comparison to

Cathy. Cathy and Emma's higher score might have also been a function of their teamwork, and having two people working on the game. Overall, it is unclear to what extent his second year of participation led to a *greater amount* of game design skills for Jason over and above Cathy and Emma for instance, who participated in the full year and created two games. When compared to the work of WV students in all grade levels in Pilot Year Two (for whom the average game evaluation numeric value was 11.7), SIM University's value of 16 is well above this aggregate average. Because Jason worked individually, we can say for certain that the numeric value of 16 attributed to Jason's game is reflective entirely of his own, individual learning.

Summary of Case Study, Jason

Jason is a fantastic example of the potential for Globaloria to inspire students to aspire to their full potential in designing games, integrating and sharing knowledge, engaging in imaginative and creative thought and play, and interacting socially with others. He has excelled in his role as a peer mentor and in his role as a student, he has demonstrated a relatively high level of proficiency in Flash compared to the rest of the students, especially in light of the fact that his game was created individually, not in a team context.

In considering the 6 different CLAs that Globaloria promotes, Jason's case study shows the least evidence of CLA 6 (surfing websites and experimenting with web applications and tools) as there is not much data to show that he has surfed the MyGLife.org starter kit, kept track of and bookmarked surfing results, or browsed Web 2.0 websites to make progress in his game. There is also minimal evidence to support practice with activities of CLA 5 (information-based learning, purposeful search, and exploration) as he does not conduct research to support his game idea. This is difficult to discern simply on the evidence in the 2008-2009 academic year; he may have cultivated some of these abilities in the previous year.

Jason expresses proficiency in CLA 4 (social-based learning, participation and exchange in a networked environment); he has demonstrated that he can collaborate using Web 2.0 tools as he maintains a blog, posts regularly to his wiki, and makes himself available to other students via instant messaging. He has also commented on the wiki pages of other students, exchanged feedback with them, and presented his prototype and iterations of his game. He also demonstrates strength in CLA 2 (project-based learning through online project management in a wiki-based networked environment) through his thoughtful planning and prioritization of game elements. And, he presents some of evidence of CLA 1 (invention, progression, and completion of an original digital project idea) in the overall conceptualization of SIM University, and at minimum its intended and planned functionality.

Jason states in his final presentation that he expects that if he had a month or two of uninterrupted work over the summer, this time would allow him to successfully complete the game. It may be that Jason's activity tapered off somewhat at the end of the year, due to the often-observed condition of "senioritis." Jason also states in his final presentation that his participation in Globaloria has inspired him to choose English Education as an intended college major, which will likely lead him to a teaching job one day. He credits his participation in Globaloria with helping him discover this interest in teaching.

His participation in creating tutorials and his interactions with younger students indicates he has a high proficiency in and enjoyment of teaching and presenting educational materials to an audience. In his blogs he occasionally shows frustration when he cannot see students progress, and in his interactions with students on their wiki talk pages, Jason is passionate about helping others grow, become inspired, and understand the learning materials. When asked in his post-class survey what it was about his game topic that surprised him, he takes the opportunity to express his gratitude, stating, "thanks for the great year of experiences that will never leave. I will never forget you all!"

Discussion of Cases

This study posed two research questions at the outset:

- In what ways is the Globaloria program engaging for the participating students at RTC?
- In what ways did students develop new skills and learning abilities through their participation in Globaloria in Pilot Year 2 (2008/2009)?

Cathy, Jonathan and Jason reflect three very different case study students who exist in a single class context, sharing the same educator and the same level of access to a common set of curriculum materials and resources. The findings for these students vary widely, and also share some common threads. The case studies provide significant insights into both research questions posed.

Cathy presented as a student with mid-range prior school achievement, for whom Globaloria brought out qualities of perseverance and problem-solving in her quest to learn programming to complete her team game in the fall semester when other students back out of their intended roles. After struggling in the first semester to become the lead programmer in her team, she decides to continue on in Game Design II in the spring, and along with a partner, develops one of the highest-scoring games in Pilot Year 2, across the entire WV network of schools. While she did not indicate a particular career interest in programming at the end of the program, she developed a valuable set of project management and computational skills across the CLA categories that we expect are likely to transfer into future learning experiences. Her team's Learn the Bones game reflects what the field of educational technology calls a "virtual manipulative" with several useful instructional strategies intact, along with an embedded assessment to test the learner's knowledge.

Jonathan on the other hand presented as a previously high-achieving student who struggled in Globaloria because the program required students to become problem-solvers who are motivated to find solutions to their own design hurdles. Jonathan became frustrated by this and according to his teacher, "gave up." Because he is concerned about his grades, he makes sure to offer contributions to his team's game "Landfill Destroyers," by creating music clips that Cathy then programs into the final product. He also posts often to the wiki, and he states that he did learn some patience in the class. It does not appear that he developed in CLA category 1, which Invention, progression, and completion of an original digital project idea, one of the main goals of the course. He does offer evidence however that he has become more self-aware as a result of his experience.

As a second-year participant, Jason excels in this mentorship role, supporting other students in their game design efforts, developing tutorials, and documenting the class in two mini-documentary videos. In his student role, his final game is attractively designed, imaginative, and receives an above-average game evaluation numeric value. Taking into consideration that he worked alone, it appears that this value reflects a relatively high score. However, his educator was somewhat disappointed that he did not make greater efforts to finish his game at the end of Semester Two.

Jason imaginatively plays with his identity as a college student in the content domain of the game, possibly to prepare himself for this new endeavor. As a second year student, Jason advances in his programming skills, and shows strong evidence across the most constructionist CLA categories for his knowledge gained.

Jason discusses how his participation and involvement as an intern in mentoring students highly influenced his career plans to train to become an English educator as he transitions into college. His creation of tutorials offers initial evidence that when knowledge is developed and learning processes are shared by

students in the form of self-made tutorials, archived versions of tutorials as learning process artifacts might be successfully used by future cohorts of Globaloria participants, and recapitulated in later students' own learning processes.

Recommendations and Conclusion

A further thread that has been woven as a theme throughout all the cases is the extent to which students are expected to engage in self-led learning. All students mention the difficulty of this, and all students discuss and provide evidence of struggling with coding. At the same time, the students also offer evidence of enjoyment in the autonomy afforded by self-learning.

Globaloria's Use of Self-Directed Learning Features

In the field of education research, instructional strategies involving “discovery based learning” have come under fire recently. Kirschner, Sweller, & Clark (2006) claim that programs requiring learners to find their own resources can result in student frustration due to the heavy working memory load (aka cognitive load). The authors claim it is far from optimal to place students in a learning context in which they are tasked with assimilating and accommodating new knowledge, while at the same time being tasked with finding the materials and resources necessary to learn this new knowledge. These authors contend that the cognitive load required in “discovery-based learning” undermines its benefits, stating, “Although unguided or minimally guided instructional approaches are very popular and intuitively appealing, these approaches ignore both the structures that constitute human cognitive architecture and evidence from empirical studies over the past half-century that consistently indicate that minimally guided instruction is less effective and less efficient than instructional approaches that place a strong emphasis on guidance of the student learning process” (p. 75).

Guzdial (2009) discusses this research in a recent blog post (Oct. 2, 2009) clarifying that discovery based learning can take many forms, and that educators often use a combination of approaches and a continuum of guidance. In referring to Kirschner, Sweller & Clark (2006), he notes that based on his own research and observations as a longtime undergraduate computer science educator, he finds that students learn well when they see and interact with direct examples of fully worked-out programming assignments, and then have a chance to apply the solutions to a new set of problems similar to the worked out examples. He cites research suggesting that in such a scenario, students who view the fully worked-out examples learn more, quicker, than those who are asked to solve the problem without seeing it worked out, using related textbook references only. Kirschner, Sweller and Clark (2006) support the modeling and “worked example” strategy that Guzdial also uses in his own pedagogy.

Guzdial suggests that while he may think of himself as a “discovery-based learning” advocate, his practice reflects *guided instruction* that is presented in context of hands-on student-driven experiential learning activities.

Overall, Globaloria adopts a similarly eclectic approach. Globaloria students are provided with game design and programming “worked examples” in every online syllabus topic to review while they are completing their assignments. The assignments students perform are then modeled from these original examples. Further, some educators have gone so far as to complete the assignments themselves and post the completed assignments online for their students. A group of community college students in Pilot Year One particularly appreciated and gave positive feedback on this approach.

As a basis for the Globaloria curriculum and resource materials, an entire children's website full of Flash games (MaMaMedia.com) has been open-sourced for perusal and use by Globaloria students in developing their own new and original game ideas. Students tinker with and learn from the MaMaMedia game code and customize it for their own purposes and game plans. Thus, students in Globaloria have the opportunity to engage in what both sets of scholars cited above agree is an effective learning strategy of repetition of a worked example. The students in Globaloria can create any kind of game they want, in any genre that is capable of being coded using Flash. Sample code exists for several game genres. However, often students are so new to gaming and game design when they start Globaloria, that it takes time to even understand what a game is, before they can think about the type of game they might wish to create themselves.

Overall, Guzdial (2009) points out that he has observed that when instruction is less guided and student tasks are less structured, then *effective learning occurs for only some of the most advanced students*.

Guzdial (2009) also states generally that "This literature is not saying never program. Rather, it's a bad way to start. Students need the opportunity to gain knowledge first before programming, just as with reading. ... There is a place for minimally guided student activity, including programming. It's just not at the beginning."

Overall, in the case of both Cathy and Jonathan, both present evidence as being particularly frustrated during the first semester of their game design learning. While pure and simple, game design requires hard work, based on the scholarly perspectives offered above, it appears that improvements could be made to Globaloria in the following two areas:

3. Improving scaffolding support to students: It appears students participating in Globaloria could use more direct expert guidance and scaffolding when they are beginning to shape the plans for their projects, and when they need design and programming help in the moment while developing their game.
4. Enhancing the structure of the curriculum: It appears that especially for single-semester students, the Globaloria curriculum and resource materials could be reviewed and optimized to enable students to create a complete and final project in the given timeframe.

Regarding scaffolding, in Pilot Year Two, the World Wide Workshop began experimenting with live virtual office hours (web-conferencing offered several days a week in which students could Skype and/or web conference with an expert Flash game designer), however this affordance was under-utilized by students. Moving forward, we will explore the extent to which this can help students. Further, as educators become more experienced in Flash and game design across time, through trainings offered by the World Wide Workshop, and their own self-learning, they will become better prepared for providing on-location support to students in later cohorts.

Regarding the curriculum design and sequencing, the first semester curriculum in Pilot Year 2 had students alternating between two main tracks: completion of assignments, and completion of a fully-functioning game. It may be that students who will participate in a single semester might be aided by choosing and sticking to a particular game genre early on, and primarily learning the programming necessary to create a simple game in that particular genre. This could help students meet the goal of creating a complete game in a single semester. Then, they could try a different game concept and genre if continuing forth in Semester Two.

Wiki Use

In addition, it appears that the wiki is a platform of student sharing, expression and exchange that may be going under-utilized by students due to the lack of ease with which it facilitates dialogue. The RTC educator, Mrs. S, confirmed in a post-hoc interview that in Pilot Year 2 she prioritized students' learning of game design and team work, emphasizing students' learning of Flash and programming. Mrs. S. required that all students create profile and projects pages on the wiki at the start of the year, and required students to post their game files and assignments online, though some students kept up with this more frequently and thoroughly than others. Mrs. S. self-reflects in the interview that she felt she could have more actively urged students to post regularly to the wiki. This comment indicates Mrs. S's acknowledgement that as an educator, her establishment of expectations for students' practices, and certain grading criteria, impacts students' efforts and priorities.

It appears that students used the wiki mostly for creation of profile and projects pages, posting assignments, documentation and presentation of final work. The wiki is also meant to be used for viewing others' work, collaboration, sharing, and in-progress discussion and feedback within and across different teams. It is unclear to what extent students used the wiki for these in-process management purposes. For some wiki activities, such as filling out the daily progress chart, it appears students engage in them mostly because the educator requires it, and assigns it a grade. This extrinsically rewarded activity is different from many students' self-driven naturalistic engagement with other types of social media tools such as Facebook.

Students have become accustomed to using slick synchronous and asynchronous communication interfaces including Facebook, chat and phone texting. Facebook comment features allow for discussion of student posts in a rapid, easy to use interface. Thus, it may be that for today's students, the wiki's organization is not quite optimal in sparking quick dialogue. It may be that the wiki may not yet serve organically as a highly dynamic environment that facilitates frequent online dialogue among students, easy message exchange, and team collaboration.

As the World Wide Workshop continues to develop the wiki platform, we expect to expand its social media features to become more seamless, to encourage more fluent communication among students about their work, in the context of their file postings. Moving forward, further on-location research is needed to explore students' use of the wiki for project management (CLA 2), beyond documentation and presentation of work. And as the wiki platform is further developed, analysis of student online dialogue will be conducted. We need to further explore what learning purposes the wiki can and does serve. Several usability changes to the wiki platform were made prior to Pilot Year 3 (2009/2010) to enhance the navigation and interactivity of the site to make it more fun and engaging to use.

Continued Research

More research is needed in Globaloria to better understand student team dynamics and roles, and how this influences individual learning. Further, we need a better understanding of how educators and students are using available resources. We recommend in-person participant observation in classes, to explore how the class management is occurring by the educators, and what strategies for improvement might be offered back to them. Such research may also lead to improvements in the syllabus and program design. Having an experienced computer science educator evaluate the curriculum and offer recommendations might also yield valuable recommendations.

Our rationale for employing a discovery-based learning approach (what we call Constructionism) is the larger societal context of technological advancement in which we are educating today's youth and training educators -- and the urgent, immediate need to implement programs that bring about a computationally-literate public, now. Instructional design (just like technology development) is an iterative process. The need for implementing digital literacy programs in schools to prepare students with 21st century skills is urgent.

Scholars such as Kirschner, Sweller & Clark (2006) are advocates for the optimization of technology solutions for learning that provide advances in cultivating traditional core curricular domain knowledge in the learner. Globaloria leaders and designers must apply the best practices in computer science education research, ensuring that best practices filter into the iterative design of the learning tools and program curriculum, and thereby into educators' professional development, and ultimately to student pedagogy. Continued research is necessary to improve our pedagogy. However, such research should not be used to hinder implementation and instantiation of technology learning initiatives for young students NOW; it should be built into such initiatives to make them better.

Finally a few notes about the methodology. While the Wiki, student videos, surveys, and educator progress reports proved as very fruitful data sources for case study generation by the authors, who were working remotely, we certainly missed observing a world of phenomena occurring at the local level in the classroom. For the richest findings and highest validity, we recommend that future research draw upon a combination of the data sources included here, *along with* student interviews and on-location participant observation site visits. We expect that this further-triangulation of sources will allow us to better answer questions this study generated, especially in regard to the role the team dynamics of the students plays in their learning outcomes, and, the ways students and their educators are using the Wiki resources, how they might do so more effectively, and what further iterative development is needed to best support students.

Overall, the case study findings provide ample evidence that the project founders and staff, and participating school administrations and teachers are making ample strides in implementing and continuing to refine the Globaloria program, and that the present participating West Virginia students are engaging in positive experiences that are affording them the opportunity to develop contemporary learning abilities, in preparation for successful futures in today's knowledge-driven professional work environments and cultures.

APPENDIX A
Globaloria Pilot Year 2 Coding Scheme

Game Title:		
Student/Team Name:		
Team or Individual Game:		
URL:		
BRIEF GAME OBJECTIVE:		
CATEGORY	CRITERIA	1= Yes
Game Plan and Demo [Design Template; Prototype]	Did the students create a Paper Prototype?	
	Does the game appear complete/finalized?	
	Please EVALUATE the Game Design Plan for its written content describing student intentions for their game design (Overview, pitch, scenes, elements/assets, etc.) [0=None; 1=Incomplete; 2=Satisfactory; 3=Thorough/Excellent]	
Playable Game Design	Are there gameplay instructions?	
	Does the game play exactly as the instructions specify?	
	Is there a visual / graphic STYLE that carries throughout the game, consistently? (e.g., color-scheme, character-design, are game-play objects in consistent locations throughout the game)?	
Playable Game Functionality	In all relevant instances, does the game offer feedback to the user based on actions (e.g., quiz game provides feedback on a response; when a character dies a life is lost or a message appears; rollovers change color or display a pop-up; do collisions elements work properly)?	
	Do the feedback / response elements add to the challenge of the game, (e.g., the game is over if the timer, lives, or health run out; scoring is variable; the game can be "lost" or "won")?	
	Are there objects (not characters) that are interactive for the player (e.g., buttons with rollover; objects that can be drag and dropped)?	
	Are there characters that the player can interact with (e.g., player avatar that moves with arrows, and/or enemies or allies that are animated or moving)?	
	Do the objects and/or characters interact to cause some effect? That is, do objects detect collisions? (e.g., objects bump and change direction, character gains/loses life when it touches something else, gains/loses	

	points, etc.)	
	Are there multiple levels, progression of different scenes, and/or increasing difficulty?	
Audio/Visual	Are visual elements well executed (e.g., are images clear without blurriness or 'fringing')?	
	Is there background music to the game?	
	Does the game feature sound effects that happen based on player action or by on-screen objects?	
	Is the artwork creative and engaging?	
Playable Game Subject / Narrative	Briefly, in a few words, what is the MAIN TOPIC AREA of the game (e.g., sports)	
	What is the game genre (educational, social issues, or entertainment)	
	Does the game feature a subject that reflects an educational or social issues theme?	
	Are the educational/social theme elements <i>active</i> or <i>central</i> to the game play (e.g., a game about global warming takes place in a landfill)	
	Does the game have a cohesive storyline and/or a beginning, middle, and end?	
	Does it appear that the students did research into the educational/social aspects of the game (e.g., not simply a basic math game, or a "name the capitals" game, but rather teaches players something that is potentially new, and the designer learned something new).	
Playable Game Presentation on the Wiki	Did the student provide the FLA file for the Final Game on the Wiki?	
	Did the student provide the SWF file for the Final Game on the Wiki?	
	Is the final game marked clearly on the Student or Team Project wiki page, specifying it as the final game?	
	Is the final game provided in the Game Gallery on the Wiki?	
Total Tally		

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