

**Contributors to Student Learning and Success in Creating Civics Web Games
A Case Study of the Winning Team in the
2010/2011 Globaloria Civics Game Competition**

Rebecca Reynolds, Ph.D.
Assistant Professor
Department of Library and Information Science
Rutgers University

Annette Radziszewski
Undergraduate Researcher
Loyola University Chicago

Introduction to the Team

The Carrot Wizards Team won the 2010-2011 Civics Game Competition. Hailing from Tygarts Valley High School, Team Carrot Wizards consists of three male 10th-grade students named T, JD, and JC. The boys participated in Globaloria for an entire year, Monday through Friday, for about 45 minutes every school day. Instructed by Diane White, a business education teacher, Team Carrot Wizards exemplified a team of self-motivated students who succeed in the program given strong initiative.

The Carrot Wizards team members meshed well from the beginning. T, described by his teacher as the “leader of the group” and “mother of his team” (Teacher Report), originally wanted to create a math game. Described as impatient but efficient, JD preferred to create an adventure game. The “creative genius” of the team (Teacher Report), JC intended to craft a STEM game that focused on technology. The boys complemented each other in skills – T was the practical planner and task masker; JD became a great team player, “learning from his partners... allow[ing] his teammates to teach him aspects of drawing and coding” (Teacher Report); and JD came into his own as the “coding guru” (JD’s blog post) and “flash addict” (Teacher Report).

In their blogs, the boys discuss their different duties; T talks about incorporating sound into animation and learning from online tutorials. JD draws the backgrounds and vlogs. JC hand draws many of the elements, scans them in, and digitizes them. All of the boys are keeping busy on their discrete, though interrelated, tasks. The boys sporadically hit rough patches primarily due to problems with coding, but they always surmount these challenges. As the end of the semester approaches and as they move into more technical aspects of coding, the group faces a slough of new challenges. JD reports that T and JC actually switch roles, which illustrates an interesting coping strategy for overcoming challenges. By switching roles, the boys are able to face their problems from fresh perspectives. The entire team also becomes more well-versed in all of the different aspects of game design.

The Carrot Wizards team became quite adept at sharing duties and working efficiently. Despite entering the program with different expectations for the game, the boys managed to compromise on a game idea. In a blog post, JD offered insight into the maturity with which the boys handled the situation. He wrote, “with collaboration also comes strife and conflict... If we just talk about how to incorporate all of our ideas into the game, rather than try to get our own idea in, we could do awesome.” The boys managed to do exactly that and settled on combining their ideas to create the winning civics game.

What characteristics made Team Carrot Wizards unique and successful? Our case study findings indicate that the following factors appear to contribute to their success.

1. Strong Initial Excitement About the Program
2. Consensus on What Makes a Good Game
3. Sustained Effort and Willingness to Persevere
4. Perpetual Editing and Improvement of Existing Game Parts
5. Ability to Persevere Through Challenges
6. Exceptional Devotion of Time
7. Development of a Flow in Team Process
8. Desire to Have a Successful Game
9. Review and Incorporation of Past Game Elements from Prior Years

This case study presents an overview of the winning game created by the Carrot Wizards team, and then highlights the evidence we found that supports our identification of these factors.

Game Description

Team Carrot Wizards created The Adventures of Henry the Hedgehog, a civics-focused game in which the goal is for players to “to learn about past histories so that we may become concerned about our government's welfare and making us an overall better citizen” (TEAM PAGE). The player avatar is Henry, a hedgehog.



Figure 1

The game begins with a screen that offers players the option to read about the team, play the game, or learn how to control the hedgehog (figure 1).

After pressing the “Controls” button, players are taken to an instructional screen (figure 2). The controls require the player to press the up arrow or space bar to jump, the right arrow to move right, and the left arrow to move left. From both the “Information” and the “Control” screens, players are able to access the game.



Figure 2



Figure 3

After clicking on the “Play” button from either the main screen or the Controls screen, gameplay begins with Henry talking to an alligator named Dr. Vann Der Shaff. Dr. Vann Der Shaff gives Henry a time machine to travel into the past to gather political knowledge to help the town’s mayor (figure 3).

The player exits the Doctor’s office into an American town (figure 4). Navigating Henry through this level, the player encounters a variety of characters. Hand-drawn by the group, the characters are personified animals that inform Henry of historical and civic information (figure 5). At the conclusion of the level, the player is quizzed over the information taught by the characters in the game.

Almost all of the characters featured in the game were animated, adding much vibrancy and creating a playful mood.



Figure 4

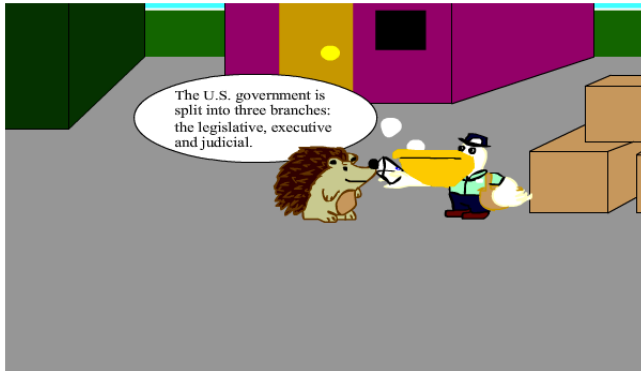


Figure 5



Figure 6

Occasionally, Henry must jump over obstacles such as giraffes (figure 6) and collect floating documents. These maneuvers enliven gameplay. After moving through the level, the player meets the mayor, who quizzes the player over the facts learned during gameplay (figure 7).

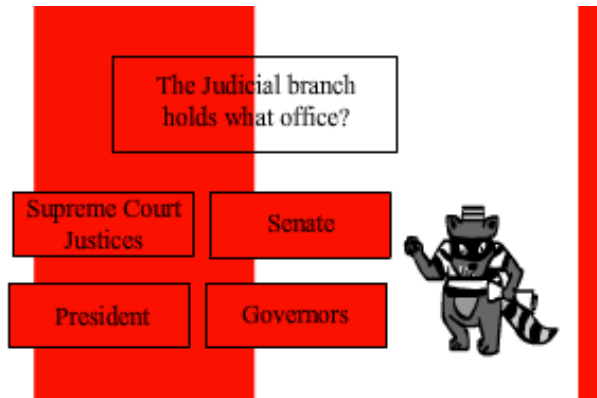


Figure 7

After successfully completing the first level, the player must choose from the Egypt or Rome levels to continue playing (figure 8), which is a feature we see recapitulated from an earlier highly successful game created in Pilot Year 2 called ZeitGeist, a game by five RTC students in a team called the Five Experimental Ninjas. Further, the scrolling platform gameplay also mirrors the gameplay in Zeitgeist (with different characters and graphics). This apparent

remixing of elements from a successful past game demonstrates the network effects and benefits of including a game gallery and archive taking hold.



Figure 8

Both Egypt and Rome are laid out similarly to the American level—Henry must travel through the level, learn facts, and collect historical documents. Each level concludes with the ruler from that location quizzing Henry. In the Egypt level, Henry meets Cleopatra (figure 9). After clicking on her, the player must complete a quiz about the forms and role of government in ancient Egypt. Emperor Nero quizzes the player after the Rome level (figure 10).



Figure 9

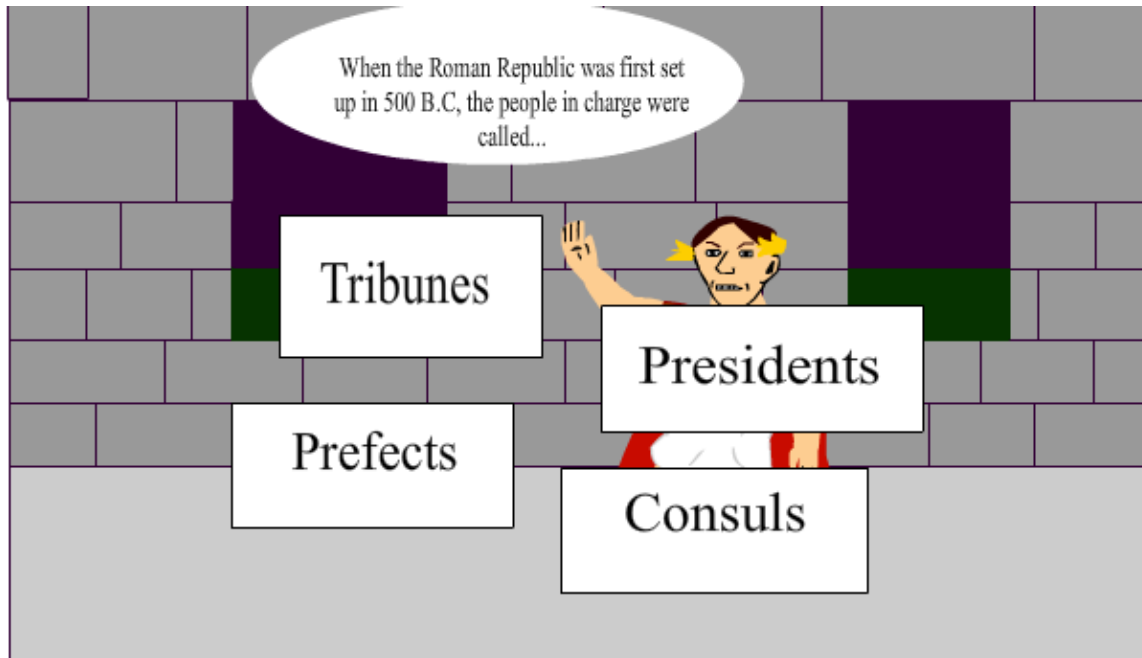


Figure 10

After successfully finishing the Egypt or the Rome levels, the player is brought to an end screen, where they have the option of returning to the time machine to play the Rome or Egypt levels again or the player can return to the main menu (figure 11).



Figure 11

When judging these final games, Dan Norton, Founding Partner and Lead Designer at Filament Games, who was a judge for this competition exclaimed, "This was my favorite game! The character was fun to control, and the different settings were a really cool touch!" Jessica Goldfin, Special Assistant to the President of Knight Foundation, also a judge, added, "I enjoyed

this game's creative design, fun storyline and impressive mix of mechanics.” The game indeed incorporates an advanced level of originality, artistic graphic design, interactive and dynamic gameplay, and creative integration of the Civics theme, with a playful user experience.

Factors Impacting Carrot Wizards’ Success

1. Strong Initial Excitement About the Program

When Team Carrot Wizards began the program in August, all of the members expressed a great deal of excitement. JC begins blogging by stating, “It is a fun class and I enjoy working in it. Soon we are going to get started on making a game, I'm excited for it.” JD echoes this sentiment by blogging that Globaloria is “a really cool program”. According to T’s blog post, “My experience with Globaloria has been awesome.” Language laden with positive affect, such as “fun”, “cool”, “enjoy”, “excited”, and “awesome”, makes explicit the boys’ real excitement about participating. Perhaps this excitement comes from the novelty of the Globaloria class (compared to other less technology-oriented and more traditionally managed classes). In one of his first blog posts, JD says, “Some of us might even be interested in turning this into a career, like me”, clearly indicating that participation in the program stems from profound interest in digital technologies.

Members of the Carrot Wizards team also share a deep interest in playing video and computer games—they are all regular consumers of these types of games and they all mentioned the importance of digital technologies and gaming to their social lives. On his MyGLife My Page, T describes his favorite piece of technology as his “phone and xbox because [he] can talk to [his] friends”. In one of his earliest blog posts, T also mentions his passion for the Xbox game Halo: “My brother and I play Halo Reach (coolest game ever for xbox 360) after we get all of our work done“. On his My Page, JD mentions, “Most of the time I use computers for watching videos and talking to friends”. Similarly, JC also identified his phone as his favorite gadget. All the boys identify using technology regularly for social interaction and as a source of amusement.

Globaloria introduces students to a variety of customizable resources, and given their interest in gadgetry and gaming, these students quickly appropriate the newly available resources into their personal technology repertoire. Quite conversationally, JD writes, “so far Globaloria's treated me well. I have a blog, a G-mail account, a wiki, and lots of other cool knowledge about computers.” These technological affordances set Globaloria apart from other programs and contribute to the individualized, independent nature of the program. Access to such affordances heightens Team Carrot Wizards interest and excitement.

T clarifies that his positive reaction to the program stems in part from the early customization that the students are able to do. According to him, “the idea of being able to make my page to how I want is it is great. To be able to do what I want and make my page how I want it is great as well.” The freedom to personalize the Globaloria experience resonates with the team and once again, increases their excitement to participate.

Finally, the boys may be excited to participate in Globaloria because they look forward to creating games. In T’s first blog post, he writes, “My game is going to be the best game ever...My future game is going to be awesome in every way and it will make everyone feel like that want to cry. That’s how awesome its going to be”. Similarly, JC writes, “Soon we are going to get started on making a game, I'm excited for it... I can't wait to get my game started and I

hope my class enjoys it too.” The creative act of producing a game excites the boys and they approach the program with a desire to make an excellent product.

The boys’ strong initial excitement to participate in Globaloria stems from their fluency and interest in digital technology, eagerness to begin a new and novel program, access and use of a variety of resources and tools (such as gmail accounts and blogs), the customizability of the program, and the experience of creating a game.

2. Consensus on What Makes a Good Game

While planning out their game in the fall semester of the school year, Team Carrot Wizards all blog about various aspects of game play. The boys write about qualities such as animations, buttons, images, movement, and sound effects; they all agree that these features exist in good games and share a unified vision of what their ideal game should contain. The ability of the team to select important characteristics, decide on how these characteristics should work, and then actualize the implementation of these things into their game is a characteristic that makes this team unique.

JC writes that, “most people who wish to buy or play a game do not want the same things happening the whole time in the game that they are playing”—this simple acknowledgement of the importance of variety guides the team into making rich and varied elements in their game. JC continues, “We plan to have different villains, backgrounds, and in some different actions.” JD blogs, “Why are [animations] important you may ask. Well, they bring your game to life and make it interesting. If your game is just a bunch of moving pictures, then you won’t get many positive reviews”, colluding JC’s point that games must be varied to be interesting.

T and JC both agree about the importance of sound in a game. T writes, “I think that [sounds] will enhance and make our game very interesting because as you go through the game as the game changes mood so will the music to give the game a more interesting feel. As the music changes so will the mood of the game and it will make the game have a really fun and more awesome even though our game can’t get any better.” JC blogs, “We plan to add sounds such as music, sound effects, and voices. The music will add a calmness or excite the player depending on the level or mood. Sound effects help the player learn about the setting, area, and how characters act. Voices are very important they tell what the character sounds like or even how mean or nice they are.” These two different postings by different team members both focus on the importance of sound effects for creating a mood and guiding a player. Sound is just one of the many aspects the team members agreed were integral for a successful game, and the team reached a consensus regarding how to incorporate these elements into their own game.

3. Sustained Effort and Willingness to Persevere

Qualitative evidence we uncovered indicates that all three students appear to demonstrate sustained effort in game design and a willingness to persevere. One of the initial assignments for the students at Tygarts Valley High School was to create a mini-game in which the students learn how to program objects (a carrot, a wolf and a rabbit) at varying speeds, and develop collision-detection code and a scoreboard to add or subtract points based on a predator/prey chase dynamic. JD blogs, “just finished making my mini-game. It was quite difficult. Not only was it difficult, it was very fun. I didn’t have too many problems until I added in that stupid pizza. It all went downhill from there. Ugh, it took me forever to fix my coding. But it all worked out in the end, and the bunny still likes carrots”. JD was self-motivated to solve the problem of why his mini-game failed to work once he added an outside element of his own -- a pizza graphic.

Despite spending a long time fixing this technical issue, JD's happiness at successfully creating a mini-game overshadows his frustrations with learning coding. JD was able to maintain a sustained effort and put in hard work to overcome this challenge, evidencing quite directly, the class Constructionist outcome of "hard fun."

Contrasting to JD's ability to personally resolve his mini-game issue, JC requires more assistance from his teacher and a peer. With relief, he blogs: "I finally figured out how to make a mini game...with the help of Aaron and Mrs. White of course...I had several trys, but finally it was complete and my carrot would move and so would the bunny and the wolf!" This post indicates that peer and educator scaffolding were integral at points for this student, and enabled his task success. Despite requiring initial assistance, JC develops a passion for working with Flash. In fact, he begins working on a second mini-game solely for his own amusement. He writes, "I enjoy working with flash and have already started on another game that deals with a Carrot Wizzard who has to save Princess Pizza from the evil Wolf Wizzard." Here we see how the mini-game assignment is integral to giving students an initial foundation for understanding Flash programming. In JC's case, this assignment sparked ideas for building upon and remix the elements provided in the original mini-game.

In this case study, initial difficulties using Flash are not indicative of later success. In fact, JD refers to JC as the "coding guru" later on in the school year. In her progress report, Mrs. White describes how JC, "works on Flash when he should be working on other class work. He's a Flash addict! He has two games that he's working on—one is a game he is making on his own and one is the Carrot Wizard's game. He is so focused on writing code and developing the game, that he does nothing else like blogging or updating the learning log or completing lessons on the wiki!" It appears that Flash provides him with a challenging activity, and opportunity to experiment with problem-solving that enables a cycle of what scholars call "productive failure" – that is, failure that leads to greater curiosity, motivation to learn, and later success. The development of JC's interest in Flash stems from sustained interest, effort and working hard. His skill level grows dramatically; he garners the respect of his peers for his skill; and his fluency with technology for creation (as opposed to consumption) increases. The creation of a second mini-game exemplifies JC's burgeoning involvement, enjoyment, and success in the program.

It also appears from the wikis and blogs that T successfully engages in self-directed learning. For instance, through watching a variety of video tutorials on Flash, T actively learns from the videos, is driven to apply what he learns from tutorials to his game, and even goes a step further in mentioning an interest to apply the lessons from the tutorials for fun, just to see if he can make files better than the examples from the tutorials. He blogs, "I learned a lot after watching all of the videos...Now i can make all kinds of funny and cool sounds for my game whenever I need them so this should make my game even better then I thought. Maybe now I should make a new file and try to make my own piano but more life like then the one in the tutorial." T exhibits deliberate and effortful behavior; he does not shy away from the difficulties associated with learning how to add sounds to his videos. He voluntarily watches tutorials and seeks to challenge himself in a new way.

4. Perpetual Editing and Improvement of Existing Game Parts

Another key trait that makes Team Carrot Wizards unique is their perpetual assessment and review of their game and other Globaloria components, in relation to others being created throughout the network. Unprompted, different members of the team engage in reflective behavior as they self-evaluate their work.

T expends effort, energy, and time to improve the aesthetics of his blogger page. He critically assesses and evaluates these pages as necessary to improve. He reports, “This week i have kind of done a little of everything to try to get everything done that I've needed to. I've redone blogger to make it look better, Iv been working on my wiki and I am now a wiki master, I've worked on flash to try to finish my part of the game. I've done a lot this week but I think that I'll be able to get it all done before the end of the year.” This behavior of editing, redoing, and improving existing materials or codes appears quite unique to Team Carrot Wizards.

In his Learning Log, JD records a similar activity:

Drawing a scene	12-10-10	45 minutes	Realized, that there were a couple things that could be improved on the title page, then improved them.
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In this snippet from JD’s Learning Log, JD notices things that could be improved—this indicates a vision of what constitutes good game components. JD critically assesses a completed piece of work and actively chooses to improve upon qualities that were not up to the teams standard. Despite the ease of moving forward and the temptation of finishing a piece of the game, JD decides to edit and improve. Mrs. White notices this, mentioning in her progress report that JD “has improved in his teamwork skills this quarter and has learned the give and take of working with others. He is not strong in writing code, but he is learning from his partners. He has allowed his teammates to teach him aspects of drawing and coding, and his work is good.”

Further, T blogs, “This week all we did was work work work. All this week we made a new video for our team page and JC even figured out platform coding so that really came in handy because now we can make our game a little more challenging. Also we made it so that all of our levels tie together, and in doing so we can make our game better. Our game should be done pretty soon as long as nothing unexpected happens!!!!” At another point he writes, “Lately we have been working on cleaning out our game because we have too many layers that we don't need that are making our game working slowly. So we just decided to take a day or two and try to clean out as much as we can so that our game will work faster, load faster, and do everything that we need it to so that it works and looks amazing at the same time. So JC is actually cleaning out the game so far and JD is actually making a new Russian level to go along with the game.” T’s posts indicate reflection, and strong opinions on what comprises an effective game, which informs his decision to try to make the team game more challenging. He critically assesses areas of his game that could use improvement, and works with and directs the team to engage in extra time on task to improve it.

5. Ability to Persevere Through Challenges

Another factor that makes Team Carrot Wizards unique is their perseverance in the face of challenges. The primary obstacle for Team Carrot Wizards to surmount in the second semester of Globaloria related to programming. T complains that the codes provided on the Wiki tutorials are no longer compatible with the newest edition of Flash. He writes, “All of the wall codes that I have found don't seem to work correctly and I have watched every video to try to learn but nothing seems to work. So I am still wondering if it would be possible if we could get some new codes on the wiki that would help us out in the long run.” T tries to learn new codes to incorporate into his game, but cannot use the Wiki page as a resource because it is outdated. His process of watching the tutorials and then finding the codes useless after attempting to use them appears a frustrating process. The lack of current codes on the Wiki delays Teach Carrot Wizards game progress; T hopes Globaloria staff will read his blog request for help.

JC writes about the same issue, “sometimes I become stressed with code and I just can't deal with that... Wiki really needs to get codes for platforms. My team has been having issues with being unable to find a working platform code. It upsets me that I have not been able to make my character jump upon objects. Since this helps the character to get through the game; its very important. There are codes on the Wiki but they do not work. I find this to be very annoying. All I'm asking for is a platform code. It's going to affect my grade and I cant afford that.” Clearly, JC is working hard to try to solve this problem. He attempts to tackle it to the best of his abilities, but is impeded by hurdles in finding adequate resources. This delay puts a time crunch on their schedule and may cause them to miss an important deadline, thus adversely affecting their grade. The team feels helpless and stressed out because the program fails to help them reach these important, project-oriented milestones.

Mrs. White, the boys’ teacher, feels similarly frustrated, reporting in her progress report that:

04-26-11	1 hour	Students are working on finishing their games. JC is very frustrated with a jumping code that will not work. I don't know what to do to help. The code is written directly from file that works, but it is action script 1.0.
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Although she would like to help the boys, she does not know the how to help them. In this instance, the opportunity for co-learning arises but is thwarted by a high level of difficulty that leaves both students and teachers feeling frustrated. Our case study data does not indicate how exactly the students resolved this problem. In a follow up interview conducted with the educator about this specific challenge, the teacher Ms. White, indicates that in this circumstance the boys just skipped completing the desired game features. She states, “For the AI, he coded around it, and didn’t use it in the game as he had originally planned.”

At another point in the semester, JD struggles with embedding AI codes into the game and exhibits strong patience. He resourcefully reaches out to a Globaloria staff member for support, and writes, “I'm waiting for Angie to email me back so I can work out the enemy AI problems and setup a scoring system. But until then I should at least do some stuff like try and get some cool text and character effects.” JD understands that he may need to wait for a solution and thus puts aside his AI assignment and focuses on other segments of the game that can be worked out. By multitasking and prioritizing, we see JD emerge as a hard-working group member who finds a temporary work-around to his AI difficulties. Unfortunately, as we can see from his Learning Log, JD emailed Globaloria on 3/16/11, and does not resolve his issues with AI for almost 15 days, indicating on 3/29/11 that he was “close to giving up.” It is unclear in what ways the Globaloria staff responded to his issues, but the lag time seems a de-motivator. He does appear to have his problem solved, though, the very next day, and perhaps just in time. It is unclear whether he solved it himself or received guidance from staff.

Wiki tutorials	3-15-11	45 minutes	Tried enemy AI and collision detection. It didn't work.
Help! And friend making.	3-16-11	45 minutes	E-mailed Angie about some coding. Made some friends from Webster County.
Wiki tutorials	3-17-11	45 minutes	Read some wiki tutorials on platform gaming.
Wiki tutorials	3-18-11	45 minutes	Finished reading those wiki tutorials, updated my learning log, and blogged

Read wiki tutorials	3-21-11	45 minutes	Read tutorials about text effects.
Read some tutorials	3-22-11	15 minutes	Got back from the writing assessment and read tutorials.
Worked on the team page/blogged/updated learning log	3-23-11	45 minutes	I answered some questions on the team page and updated my blog and learning log.
Updated everything for our exams	3-24-11	45 minutes	Had to update a lot of stuff for our midterm exams.
Tried to figure out coding	3-28-11	45 minutes	I tried to figure out some coding regarding enemy AI.
Still can't figure it out	3-29-11	45 minutes	Close to giving up.
Finally did it!	3-30-11	45 minutes	Figured out my coding so I looked up some tutorials on how to add collision detection.

This category of findings (persevering through the challenges of self-driven learning) indicates that in some cases, students and teachers may feel somewhat adrift in Globaloria's co-learning model. It appears that occasionally, learners produce signals that could alert program management of trouble – including blog posts, learning log messages and indeed direct emails to program staff. The Globaloria social learning system may need to provide greater responsiveness to such hurdles, to further student learning – whether responses are interventions in the form of teacher help, peer help, resource support from the e-learning platform, and/or other sources such as experts employed by the non-profit to monitor wiki, blog and email communications.

6. Exceptional Devotion of Time

Towards the end of the competition, Team Carrot Wizards devoted very much time towards working on their game, as we saw through a review of their Learning Logs, and the educator's progress report. The team came together and devoted many hours to making sure their game lived up to their expectations. As T describes, the process is filled with "work work work." In this progress report from their teacher, she describes the process of working with this particular team on game design outside of the regularly scheduled timeframe. We see one instance from the semester as the team wrapped up, in which they logged quite an impressive number of hours to their game to meet the final deadline.

These extra efforts demonstrate a level of motivation among participants to complete their game. It also offers insight into the way that Globaloria participation models the experience of real-world technology developers, who also exert similar effort and time on task when approaching release deadlines. The program gives students a valuable experience of the effort it takes to succeed, which they could draw from in the future.

3rd Period- Presenting and Publishing	05-24-11	7 hours	Students worked on finishing up work for the class. The Carrot Wizards needed to work on their game, and I helped them all day. I stayed after school for 2.5 hrs and then worked on it for 3 more hours before it was finally ready to upload to the wiki again. They had an additional level ready to put into the game but it had not been coded and there were a few more things that they had to add to it. They worked all week on this. Today during 3rd block, near the end, the game crashed and wouldn't open in Flash. It had saved and we had 2 copies, but the Flash error was a "parse" one. So, JC and JD stayed out of all of their afternoon classes and worked the rest of the day on the game. Then I took over after school. At midnight, it was finished. Whew!
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7. Development of a Flow in Team Process

Team Carrot Wizards was comprised of three very different boys who managed to work through differences to arrive at establishing a fluid group process, and successful end product. The team seems to have more conflicts initially, and then as the school year progresses, they establish greater flow. Over time, they develop distinct roles in the group, but are also able to shift their roles as needed to overcome challenges.

In her progress report, Mrs. White describes the very different personalities between JD and JC. JD “likes things spelled out for him so that he can get it finished and not waste his time. He is short on patience and wants someone else to do the detail work.” JC, the team’s coding guru “is so focused on writing code and developing the game, that he does nothing else like blogging or updating the learning log or completing lessons on the wiki! ... His teammates JD and T get aggravated with him at times too, but they have given him the job of coding for the team.” Thankfully, the team has T, who is “the glue that [keeps] his team together, and he was the one that ma[kes] sure the team members ke[ep] up with their responsibilities. He is a good worker, and has an eye for details. He is responsible and dependable.” An organic development of different roles occurs as the team begins collaboration.

At an early stage in the year, Team Carrot Wizards struggles to equally assign labor to each member. Originally, the boys had intended to split work evenly, as JD writes: “about our team roles, I'd say that we are all very versatile and good at what we're doing, so we're just going to share team roles.” However, this egalitarian approach falters and in an October blog post, JD briefly mentions, “we’ve been having some team troubles. Troubles as in dumping work on one another, which none of us should do to each other.” In her progress report, Mrs. White confirms that the boys are “having some issues with productivity and with getting along. At times their frustration levels have been rather high.”

From early in the school year, JD blogs that, “with collaboration also comes strife and conflict. I'd say that the troubles we will have the most is thinking that each of our individual ideas are better than the rest of the teams. If we just talk about how to incorporate all of our ideas into the game, rather than try to get our own idea in, we could do awesome.” JD postulates that to overcome disagreements about the game, Team Carrot Wizards must find a way to compromise and incorporate everyone’s ideas. This mature assessment signals a hopeful avenue of overcoming the difficulty the team is having in choosing a topic for the game.

These early growing pains experienced by the team dissipate as December rolls around. Team Carrot Wizards begin to really come together as a team. JC describes how he has been working on “hand draw[ing] several characters for the first and second levels of the game. How we draw the characters on flash is we first sketch them on paper. Then scan them and put them in a file. After they had been placed in my computer I import them into flash and trace them.” JC

mentions that his teammates, JD and T, “work mostly on the backgrounds and scenes.” After settling on a topic, Team Carrot Wizards works itself into a comfortable and productive groove. All team members seem to be putting in an equal share of work.

Then again, into January, we see another hint of group tension from JD’s Learning Log:

Adding Scenes	1-6-11	45 minutes	Helped JC with the stage for our demo.
Snow Day!	1-7-11	X hours	Comments and notes about your work here
Adding Scenes	1-10-11	45 minutes	Had a team discussion about what the fun factor of our game was. (loud team discussion)

The entry on January 6th indicates that JD spent a day helping JC; despite past disagreements, the Carrot Wizards always manage to regroup, work through their issues, and cooperate well on the project. Nonetheless, the boys do still have intermittent quarrels, for instance what JD humorously calls a “loud team discussion” on January 10th over the fun factor in their game. Even teams that seem to work together wonderfully have spats, and it’s great that the Carrot Wizards are able to reflect on their differences with humor, engage in open and honest discussion, and continue to fearlessly plan their game. Teamwork prevails over creative differences.

The boys’ roles become fluid as they switch tasks with each other, showing that they have surpassed their initial clash over division of labor. Each member pulls his own weight and contributes substantially to the game. The fluidity with which the boys switch roles highlights how far their team dynamic and skill levels have come—they no longer quibble about who must do what, but all actively take part in everything to finish before the deadline. This impressive level of spontaneously choreographed teamwork underscores the skill sets that all boys have acquired. JD exemplifies this in his blog with, “since I can’t figure out how to get Henry to kill people, my team and I decided to switch roles a little. JC will figure out that coding, I will work on pickups and animation, and T will make sure everything runs smoothly.”

8. Desire to Have a Successful Game

Team Carrot Wizards begin the year with much excitement for the game making process. After working hard, overcoming challenges, putting time and effort into making their game, the boys never lose their desire to create a high quality product. T blogs, “After all the little problems and the snow days I really want to get this game done so that we can show everyone just how hard we have worked on this even though we haven’t had a lot of school. I’m proud of our game and i think we made one of the coolest games that I’ve seen over the past year while using Flash.” The boys are proud of the game they have produced, and are excited for others to play it and experience the fruit of their labor. Their drive to create a good game informed all of the efforts they expended into the Globaloria program, and the resultant game vindicated their efforts.

At the end of the year, despite the stress of finishing up the game, the boys feel that the program is still fun and enjoyable. T’s pride is palpable as he describes his excitement over the completed game: “I’m proud of our game and i think we made one of the coolest games that I’ve seen over the past year while using Flash.” JD says, “I am loving this class. It’s giving me a better understanding on what goes into making a game and how much work it takes. Not only that it shows how easily something could go wrong. The next time you’re waiting for the new

game that you want to come out, but is taking a good while to be released, remember that they're doing they're best. Now, about flash... I think that working in flash is very fun!”

JD blogs, “So our game is now completely complete, but not without some troubles. ... So now all there is to do is wait until the competition and see how our game does. Hopefully it does well. My fingers are crossed!” Similarly hopeful about the performance of the finished game in the competition, T writes, “now we just wait for the competition and see how good we did. Hopefully we win so we can win laptops so that we can work on this without having to be at school.” The team feels immensely proud of their game and views the competition with optimism. T confidently asserts that the team “believes that this game is the only kind of game that is even close to this and that no one would be able to copy our idea because it is so original.”

9. Review and Incorporation of Past Game Elements from Prior Years

This last quote by the students about copying is interesting, because it appears the boys have drawn upon their knowledge and experience playing and interacting with an existing game from a previous year in the Globaloria network – the game ZeitGeist, created by the Five Experimental Ninjas from RTC. Henry the Hedgehog reflects the same kind of scrolling platform gameplay, and also the choice of incorporating facts from Egypt and Rome. This remixing and borrowing of themes could be considered “copying,” but in fact is an approach encouraged by GLobaloria designers. Students who participate in Globaloria can view and interact with both the produced final game files, as well as the FLA project files, of past games created by previous years’ students. It appears that the Carrot Wizards feel a level of ownership over Henry the Hedgehog, without conscious awareness of the influence of games they had viewed previously – namely the ZeitGeist game. The students nowhere indicate using ZeitGeist as an influence, but the connection appears clear.

This finding may indicate that one aspect of information literacy – citation and sourcing – needs to be better reinforced in the curriculum. The Carrot Wizards’ carriage and remixing of game elements from past student work, into present games is encouraged, and an expected outcome of the network effects afforded through the state-wide model and archived game galleries and code libraries. However, the students are also expected to cite past work, and offer transparency in indicating the influences that informed their creation. This was a learning moment that was not leveraged and that could be pointed out in future educator trainings.

Relation to Six CLAs

The Carrot Wizards team displayed a set of unique characteristics, which set them apart from other teams. The educational game they created grew from classroom interactions, and was created using software, and documented and shared in a digital e-learning environment. The boys generated ideas and realized them through engagement in Flash and the wiki. Each team member had his own wiki page and own toolbox of digital resources from the e-learning environment. All team members were able to work autonomously while co-creating a winning digital artifact.

One of the factors that made this team so unique was their team dynamic, wherein the members were able to shift duties to accomplish their goals, to work collaboratively and help each other. The platforms on which the Globaloria program relies, namely the project wikis, requires students to express and share their ideas and media. To be able to function in this digital environment, the team members had to post, publish, and distribute digital media. Though T was

responsible for maintaining the team's wiki presence and ensuring that files were punctually uploaded, maintained, and functional, all team members were active in blogging and in the creation of different game files and segments.

In articulating the goals for Globaloria, we advance a framework of learning objectives that guides our applied program development and research, based on previous Constructionist literature, the organization's pilot research, and "digital literacy" scholarship. We propose that the 6 Contemporary Learning Abilities with Technology (6-CLAs) emerge through game design in the WV program, and these dimensions prepare students for effective practice in today's knowledge economies and digital participatory cultures:

1. Invention, progression, and completion of an original digital project idea (educational game or simulation)
2. Digital project-based learning and project management (in wiki-based, networked environment)
3. Posting, publishing and distribution of digital media (designs, videos, graphics, notes, and games)
4. Social-media-based learning, participation, and exchange (ideas, process notes, code)
5. Information-based learning, research, purposeful search and exploration
6. Surfing, analyzing, and experimenting with web services and applications

Reynolds & Harel (2009) and Harel & Caperton (2010) establish the bases for this framework. CLAs 1, 2 and 3 are particularly reflective of Constructionist influence. By developing these *abilities*, we hypothesize that participants cultivate a new variation of "Constructionist Digital Literacy." The Six CLAs serve as the learning objectives, outcome goals, and drivers for the continued program design and curriculum decisions made in iteratively developing the program. In reviewing the evidence for this case study team, it appears that the students were successful in achieving an extent of ability across all 6 dimensions. We have traced the team's progress from the beginning to the end of their 10th grade year; throughout the year, various blog posts, wiki uploads, and teacher reports have described the conceptualization, progression, and completion of an "original digital project" – the game entitled "The Adventures of Henry the Hedgehog".

The team relied heavily on one team member to handle wiki uploads, therefore the other team members did not practice this activity as much, raising the question of whether their expertise in this area (CLA 4) is to be considered lower. Though they communicated and collaborated in the classroom, text-based forms of communication among team members in the wiki environment are rare. However, it can be said that posting and sharing artifacts and files is another kind of non-text-based communication. The team members all engaged in uploading media, notes, and game files. Further, the influence of a prior team game, *Zeitgeist*, suggests that the content of prior games has been exchanged and appropriated by a later team. This finding indicates that communication is occurring at the artifact level. It appears that certain norms and values for what makes a good game carries across years through student examination of prior teams' work, and in this case, we see a direct influence of very specific content themes from an earlier game, reflected in *Henry the Hedgehog*.

Motivated to succeed, Team Carrot Wizards put in sustained effort to persevere over various challenges. Often, to surmount the difficulties they encountered, the team members

sought out various tutorials, relied on wiki information, and asked their teacher and Globaloria administrators for assistance. The ability to find, interpret and apply purposeful information (CLA 5) became prerequisite to skill development and game success.

Overall, evidence gathered in the case study here indicates that Team Carrot Wizards displayed CLA's 1-3 and 5. One member, in particular, gained expertise in CLA 4.

Conclusion

Team Carrot Wizards produced a fun, creative, and dynamic product in their year of participating in the Globaloria program. We identified nine unique characteristics that stand out as contributors to their success:

1. Strong Initial Excitement About the Program
2. Consensus on What Makes a Good Game
3. Sustained Effort and Willingness to Persevere
4. Perpetual Editing and Improvement of Existing Game Parts
5. Ability to Persevere Through Challenges
6. Exceptional Devotion of Time
7. Development of a Flow in Team Process
8. Desire to Have a Successful Game
9. Review and Incorporation of Past Game Elements from Prior Years

By identifying these attributes, we may be able to share them with educators so that they know what to look for and cultivate in student team work, an area that is new for most teachers. Teachers need to create an environment conducive to allowing team process and flow to emerge, and may need to intervene at points as it appeared the educator here did, through her close observation of the team's dynamics as seen in her progress report comments. She encouraged the boys to work through their differences.

As a model of success in the program, the The Carrot Wizards team shows us that most CLAs in Reynolds & Caperton's framework naturally emerge through the design of the program. This case study highlights and mirrors back evidence of student outcomes in several categories that align with the program's stated goals and objectives.

There are also some implicit findings we highlight that can inform program improvements. These include:

- A need for further understanding and leveraging the "productive failure" effect, in which students struggle, try, initially fail, and then ultimately succeed soon thereafter in finding their own successful solutions, cultivating a greater resilience, confidence and self-reliance in students towards their future problem-solving;
- In contrast, a need for identifying cases and scenarios in which students' efforts are thwarted, frustrated, and ultimately unresolved, resulting in a de-motivation, due to lack of available support resources for problem resolution;

The above two findings highlight the importance of understanding the difference between productive failure scenarios that will lead to ultimate successes, versus in contrast *unproductive* failures of the program in which scaffolding fails to provide adequate support and structure to

allow students to realize their design goals or achieve the program objectives of creating a fully functioning, dynamic and interactive web game by the end. These findings further highlight:

- A need for developing a system for identifying these two contrasting dynamics at play, and a better institutional understanding of when it is necessary to more directly intervene with structured support in those **unproductive failure** scenarios (which might include enhancements in: e-Learning supports; teacher training; mentorship; peer support; resource provision; or direct staff interaction with students for instance in virtual office hours and web conferencing sessions).

We also identified an interesting finding of student recapitulation of game elements from a previous game. This finding highlights:

- The need to bring the network effects and remixing approaches to a greater level of conscious awareness among leaders, and among participants, as an acceptable and even desirable expectation as a practice, and the development of curriculum that teaches students how to appropriately cite the sources of their past game influences.

It is expected that as the above findings are addressed, the curriculum will continue to bring about greater student achievement and success in building games. Henry the Hedgehog as a winning game begins to exemplify the way that core curricular content (in this case Civics) can be integrated with dynamic gameplay to create an engaging experience for the player. However, we think the expectation and bar for student game messages and narrative storyline should continue to be raised and elevated. It may be that in addressing some of the issues above, we will continue to see an increasing complexity of narrative and message of the core content domain, resulting in even further evidence of enhanced student knowledge building (and subsequent expression) of key thematic messages in the game content. It may be that improving scaffolding of student programming learning will open up more time for creativity and expression in the stories being told in the games.