Don't Give Up: A Case Study on Girls and Video Game Design

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ABSTRACT

This case study examines the experience of two sixth grade girls who participated in a game-design class in a class taken by all students at their school. Questions were: How do the experiences observed demonstrate engagement with a story drawn from the participants' own lives?; and: How does the experience observed reflect experiences leading to competency, perseverance and science, technology, engineering and math (STEM) self-efficacy and the development of interest in STEM careers? Findings were that the students were highly engaged with the chosen topic and demonstrated growth in the attribute of perseverance and self-efficacy in STEM skills.

Introduction

According to a US Bureau of Labor report, approximately one in six employed Latinos, aged 25 and over, have completed a bachelor's degree, less than half the proportion of employed Whites, indicating an education equity gap. Between 2000 and 2011, this gap grew from 17.6 percentage points to 20.1 percentage points. In addition, Latino/as employed in professional, scientific, and technical fields made up just 7.1% of the workforce in 2011. Looking at both gender and ethnicity together presents an even starker picture: the percentage of computing occupations held by Latinas was 1.5% in 2009. Meanwhile, computing has been identified as one of the fastest growing professions, with a projection of 800,000 positions to be filled by 2018 (Bureau of Labor Statistics, 2012). As educational inequality and

professional opportunity gaps widen, the need to reach Latinos, and young Latinas in particular, with more targeted and effective opportunities for advancement is clear.

The Globaloria program is a game design intervention that aims to introduce students to game design and social media by putting them in the role of a game designer and developer, offering one approach to mitigating these gaps. The program embodies the theoretical instructional design principles of Constructionism and distributed cognition (Harel & Papert, 1991; Salomon, 1997), and is being implemented in middle and high schools serving economically disadvantaged students in several U.S. states. Participating students engage in collaborative game design within a formal, in-school elective game design class offered for credit and a grade. Students in many participating classes create a social issue game that also includes some academic content such as math or science. The primary goal from the students' perspective is to create a functioning interactive web game by the end of the school year, which can teach other students about their chosen social-impact topic. To complete a game, students participate in several integrated technology-supported activities such as inquiry and collaboration in teams to meet a range of instructional objectives towards achievement of "constructionist digital literacy" (Reynolds & Harel Caperton, 2009).

In this case study impact report, we meet a team of two sixth grade girls who call themselves the "Blue Flowers," and are part of Globaloria as it is being implemented at a charter middle school in East Austin, Texas. The team consisted of students who were both English Language Learners from a high poverty neighborhood. At this school, the 6, 7, and 8th grade students take the game-design class across all three years of middle school and many will also continue throughout high school. Our report focuses on ways in which the team's identification with the main content of their game design project (connected closely to the team members' personal lives) appears to have supported their acquisition of the Constructionist digital literacy learning objectives. The study draws upon Social Cognitive Theory (SCT) to examine the connections between the student-centered game design experience and the development of students' STEM related self-efficacy. Theoretically, it may be that for some students, creating games about a social issue to which they have a personal connection leads to greater affective identification with the activities themselves, which may in turn cultivate their interests in careers in the STEM disciplines.

Literature Review

The game design intervention employed by the students in this case study, called Globaloria, was influenced by previous research on Constructionism, which is a philosophy and framework for learning and educative action (diSessa & Cobb, 2004) developed by Seymour Papert and colleagues at the MIT Media Lab (Papert, 1980). Constructionism builds on Piaget's theory of constructivism, in which learners are young scientists and inventors whose active creative work in theory building and testing develops their knowledge of how the world works. Consistent with sociocultural theory perspectives, learners benefit from social interactions and sharing throughout the process of creating a computational artifact often involving programming, in which the artifact expresses conceptual knowledge in a dynamic way. Within Constructionism, educators act as expert mentors and facilitators, and peers also guide each other, operating within a workshop-based environment. The mentoring and collaborative peer relationships also serve to provide the social support and vicarious modeling for the development of stronger STEM self-efficacy (Zeldin & Pajares, 2000).

The game-design program places young learners in the role of game designers who model the behaviors of professionals, such as computer scientists and engineers. Bandura's Social Cognitive Theory holds that individuals can develop self-efficacy in a given domain through modeling and having positive affective experiences in the domain. Self-efficacy is a core concept in (SCT) (Bandura, 1977). Bandura (1995) defines self-efficacy as: "beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (p. 11). He writes,

> People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided. Such an efficacious outlook fosters intrinsic interest and deep engrossment in activities. They set themselves challenging goals and maintain strong commitment to them. (p. 11)

Several studies have concluded that interventions involving successful experiences increase STEM self-efficacy (e.g., Betz & Schifano, 2000; Luzzo, Hasper, Albert, Bibby, & Martinelli, 1999). We expect that engagement in the game design program we investigate has the potential to cultivate positive affective experiences in the STEM game design activities in which students participate.

Further, in a chapter entitled *Social Cognitive Career Theory*, in the book *Career Choice and Development*, Lent, Brown, and Hackett (2002) describe "a complex interplay among goals, self-efficacy, and outcome expectations in the self-regulation of behavior" (p. 263) as it relates to development of *career interests*. Social Cognitive Career Theory (SCCT) posits that personal goals are driven by one's self-efficacy beliefs about the goals themselves, and activities related to the goal. Self-efficacy beliefs influence ongoing development of one's outcome expectations, adding to a process of career interest development. Since the Globaloria program and the charter school addressed here both hold common objectives to offer interventions that prepare students to enter the STEM field, formation of STEM career interests and goals is a focus for investigation. Self-efficacy forms the initial basis for the longer-term formation of career interests. Our research considers apparent changes in students' self-efficacy.

The introduction of students to programming through a meaningful context of computational media production has been found to provide new pathways for underrepresented students and groups to enter into Computer Science (CS) disciplines and appropriate technical expertise (Forte & Guzdial, 2005). Rich, Perry, and Guzdial (2004) found that a CS course emphasizing relevance, collaboration, and creativity provided a pathway for more CS interest, particularly among women. Eisenhart and Edwards (2004) conducted research with younger minority girls in a technology afterschool program. Their findings were that the girls' level of interest and sustained engagement was stronger when they created a project using a topic that was meaningful for them. Such studies support introduction of STEM content through computational media production as is done in Globaloria, particularly with underrepresented populations.

Research indicates that computational media production can be further supported when students identify with the subject matter of their project. Kelleher, Pauscher, and Kiesler (2007) found that girls who used Storytelling Alice, a 3D computer programming environment in which they created stories depicting relationships and ideas from their own lives, had more signs of engagement with programming than those who used a similar tool without support for storytelling. The girls who used the storytelling tool spent 42% more time on programming and expressed stronger interest in future use of the tool than users of the version without storytelling support. The investigation also found a relationship between interest in using the programs and interest in pursuing computer science. This is compatible with the SCCT interest model, which holds that "self-efficacy and outcome expectations regarding activity involvement exert an important, direct effect on the formation of career interests" (Lent, Brown, & Hackett, 2002, p. 265). In this model, people form a

lasting interest in an activity in which they believe they have competence and which will lead to a positive outcome. Minnigerode (2012) reported results of a previous survey study investigating interest development among students in the Texas school of focus here, indicating that many students who started the sixth grade year with no interest in pursuing a STEM career became interested over the course of the sixth grade year.

The literature on students and particularly girls using stories from their own lives as content for a digital artifact indicates that identifying with the subject matter is a motivating factor for engagement in computational media production. The literatures on SCT, SCCT, and other cognitive theories connect competence and success in STEM to the development of enduring interest. The successful experiences, also called mastery experiences, provided by working with technology and engineering skills while also drawing on material relevant to students' lives, may interact to provide a particularly effective potential pathway to STEM career interest development.

In this case study, we investigate the following questions:

1. In what ways do two high-performing middle school female team members demonstrate engagement in game design around a story drawn from their own lives?
2. In what ways do two high-performing middle school female team members demonstrate engagement in game design that appears to lead to perseverance, STEM self-efficacy, competency, and the formation of interest in STEM careers?
3. In what ways does the use of the stories from the girls' lives in game design appear to contribute to their perseverance, STEM self-efficacy, competency, and the formation of interest in STEM careers?

Methods

This initial case study is inductive and exploratory, drawing on an eclectic range of sources. We chose a single high-performing team of focus in the present study and review data from individuals within the team, and the team as a whole.

Participants

Teachers and the parents of the students have given signed consent to

participate in this research project, in accordance with IRB from Rutgers University. The students and their parents gave full informed consent for participation in this study. The students' names are changed per Institutional Review Board requirements.

School.

The school is designed for and attended by students who are mainly from the surrounding economically disadvantaged community. The enrolled students are Latino (80%) and African American (20%). Approximately 40% of students are classified as English Language Learners. The school's mission is to address the need for the educational attainment in Latino/a students and improve the employment picture in East Austin by providing an innovative STEM education experience. The mission of the school indicates a recognition of some the unique needs of their student population in light of the U.S. Bureau of Labor Statistics data cited above, and works to address the gap in support of academic and career goals, in part by requiring all middle school students to participate in the class.

Team.

The case study participants are two female eleven-year-old sixth grade students, Marissa and Benita, who were new to middle school in the year of focus (2010-11). This team was selected as the subject of the case study because its project represents an example of students working with a highly relevant topic that pertains to their local cultural experience, reflecting personal meaning-making, one of the aims of the project. Thus, this case might be considered a "success story." Early in the year, each of the students related to the teacher stories about how she had struggled with reading and English-language arts in elementary school.

In the previous year, both team members attended traditional non-charter elementary schools that maintained a strong focus on drill and practice, in preparation for standardized assessments. Both girls express a lot of interest in technology. Early in the school year, Marissa writes on her blog: *I also want to tell my parents what I have accomplished with using the computers. My parents wanted me to learn about computers so I can teach them.*

The girls became a team called Blue Flowers; formed because of their mutual interest in the topic of drop-out prevention. They began to conduct topical research and at the same time worked with online tutorials and game design topics before they started to work on the game idea for a drop-out prevention game.

Intervention

The students learn to write code in the ActionScript language using Adobe Flash software. ActionScript is the programming language used by the Flash software. Adobe Flash is a multimedia software platform used for authoring animation, audio, and graphics, and is frequently used to add animation to web pages (TechTerms, 2013). In the class, the teacher provides some direct instruction in writing code and guides students to online tutorials that provide step-by-step instructions for implementing the code. The students' game-making process also includes researching a social issue topic of their own choosing using a variety of materials, writing a blog, keeping an online learning log, and collaborating on a design document on a course wiki or site developed collaboratively by users. The students work in teams and each team member posts his or her work in this shared environment. The student teams also give feedback on other teams' projects at several points along the game development cycle.

Analysis

This research uses an inductive case study method, drawing on data sources that include classroom observation of student teams in situ, interviews with students, students' written reflections, survey responses on student self-efficacy related to STEM, teacher interviews, and students' game artifacts. The primary focus of observation is the students' attributes of efficacious behavior in the learning environment as the team learns to develop games. Teacher interviews addressed student behavior and interactions that demonstrated attributes related to problem-solving and efficacious behavior. We examine student reflections about their work in blog entries and posts to the wiki. Students wrote on a blog throughout the year, and these blog posts were analyzed for evidence of the themes of student interest in the topic and perseverance in game design and programming work. Midway through the year, students were asked to write about their aspirations for the future in response to a blog prompt. Student interviews addressed their chosen research topic and the nature of their connection to it. All students are also asked to describe a goal for their future on a pre- and post-program survey.

Variables measured in pre/post-survey tests of difference.

Students also took two sets of surveys associated with the formative and summative evaluation of the program. In addition, all students participating in the program took a self-efficacy survey four times throughout the year. The instrument was derived from Bandura's work with adolescents (Bandura, 2005). In the survey, students are asked to respond to a series of questions in three domains of self-efficacy:

STEM learning, enlisting social resources for learning, and self-regulation for learning. The survey contained 11 items. The students responded to items that described a specific task within the game-design class, and asked students to rate their confidence that they could complete the task with a number along a scale of 1-100. The instrument was developed based on Bandura's work measuring self-efficacy in adolescents (Bandura, 2005) and comprises three study-specific domains of self-efficacy, (a) *learning STEM content,* i.e., student confidence that they can learn the technical content in the Globaloria course, (b) *enlisting social resources for learning*, i.e., student confidence that they can enlist their support teachers and peers as needed, and (c) self-regulation for learning, i.e., student confidence that they can regulate their own learning and persist when the work is challenging. Four items addressed domains (a) and (b) and three items addressed domain (c). It should be noted that this instrument has been studied and revised since the time of this case study. See Appendix 2 for the survey. More information about the instrument and the qualitative analyses conducted with the data collected can be found in a paper entitled *Self-Efficacy in Economically Disadvantaged and English Language Learner Middle School Students Learning Game Design* (Minnigerode & Malerba, 2012)

Results

On the whole, the team members demonstrated high levels of engagement with their chosen topic of drop-out prevention, illustrated by their behavior, final accomplishment, and an analysis of their game. Specifically, analysis of their reflections in writing revealed recurring themes of strong commitment to achieving challenging goals during the tasks of computational and design problem solving. Analysis of the team's game *Don't Give Up*, the game they created, reveals use of advanced features that are not typically implemented by beginning game programmers. The game was playable and challenging, making it popular for repeated use as observed among the other students at the school. The responses the students gave on surveys also demonstrated growth in their self-efficacy related to programming and game design skills and demonstrated development of goals of pursuing STEM careers.

STEM Skills and Perseverance

The students demonstrated improved STEM skills across time, moving from hesitance to self-confidence with the subject matter. For instance, Marissa and Benita worked to create a "type your name" feature for their game even though this content

was not available in the curriculum. This feature was part of the original design for their game as seen in the Paper Prototype of *Don't Give Up* (Figure 1, below). Their classroom teacher reported that in order to carry out their design, the students researched on their own how to develop the feature, and they were successful in developing the feature they had envisioned where a player would choose a gender, and then enter a name. Their final product is shown in Figure 2, below. These results demonstrate mastery of the STEM skills, and commitment to achievement of a goal often described as efficacious behavior.

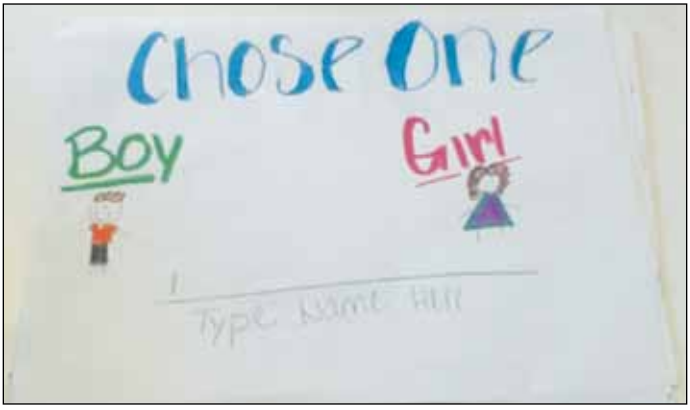


Fig. 1: Paper prototype page with "Type your name" feature

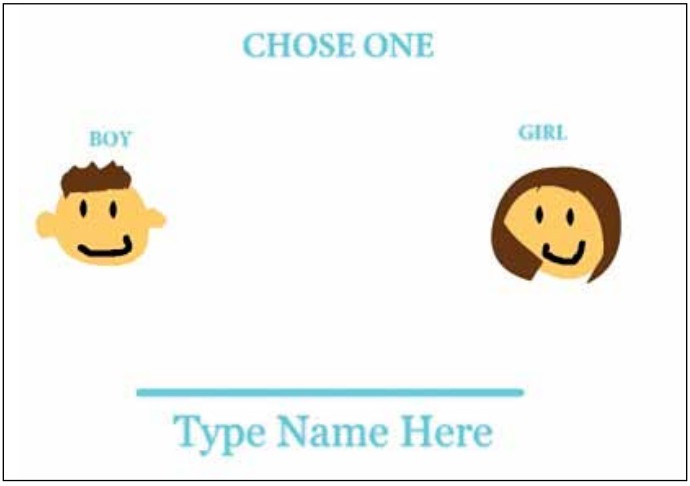


Fig. 2: Implementation of "type your name" feature

Engagement with topic.

The case study students chose the topic for their project because they were very connected to the issue of dropping out, after observing people in their lives who have dropped out of school. The name of their game was *Don't Give Up*. It was so named because, in the words of Marissa, "dropping out means giving up." As Benita writes: *I want them [the players] to understand that if you drop out of school you are gonna have troubles finding a job. And most chances that you are gonna regret that you drop out of school.*

The students' motivation for making the game was a desire to make a difference and the team members maintained a connection with the mission throughout the time they worked on their project. The transcript excerpted in Table 1, below, provides detail about the students' experience.

Table 1:
Interview With Students About Game Topic

MARISSA:	BENITA:
"We should show kids, because nowadays kids are dropping out of school. My cousins dropped out. …. At first I thought it was good because they were going to take care of their kids, but then I saw it was bad because they have to pay the bills and it's hard for them. And my cousin… she doesn't have time to take care of her baby. Because she is working."	"I also have a cousin like that. She works more hours because she needs the money. …Like… if you get a GED you get to choose. Any job that you get, they pay more. But if you don't get one, you have to work in McDonald's and they don't pay you that much. So you have to work extra hours."

The students wrote on their blogs about their goals for the game, describing what they wanted the people who played their game to learn. The blog posts, from February 2011, are included below.

Feb 16, 2011 Blog Post, Marissa:

The topic of my game is that I want players to learn about the importance of staying into school. I want my game to teach the players what the barriers to

> *college are. I want my game to teach people what they have to prevent when they are their way to college. The main theme of my game is to teach them how hard it is when you do not go to college. My game would have stages where you need to avoid the reasons you dropout of school.*

Feb 16, 2011 Blog Post, Benita:

> *The learning goal for my game is about why kids dropout. And I want the people that are going to play to learn that you should not drop out.*

Efficacious behavior and perseverance.

During the course of the year, the researcher observed in the classroom weekly, and followed students' blog posts. From review of their writing, it was clear that the students had a lot of thoughts about perseverance and "not giving up." The students demonstrated these qualities and also sought to communicate about them in their game. For example, Benita writes,

> *Last class we watched a movie called 'The Pact' and it was a really good movie. In the beginning it said that EDUCATION could save ur life and i do agree with him because if you have education you have a chance that you mite have a better life. And another thing i heard from the video/movie that you should never give up.*

Marissa writes,

> *The topic of my game is that I want players to learn about the importance of staying into school. I want my game to teach the players what the barriers to college are. The main theme of my game is to teach them how hard it is when you do not go to college.*

Both of the above comments demonstrate the theme of not dropping out, which the girls embody in their work style and interactions. The examples below describe the girls' commitment to achieving their own goal of making a game.

The team discovered that some of the elements they included in their game design plan required them to go beyond what was available in the class curriculum. They began to figure things out on their own. The girls remained very focused on this task, working until they were able to successfully implement features for type-your-name and scorekeeping.

The following vignette is drawn from a teacher interview to illustrate the students' strong commitment to achieving this goal:

Teacher:

The girls came in after school many times, because they were having a hard time figuring out how to implement the hit-test in their maze game [when an object runs into another object, it triggers a score or other event]. Each section of their maze was a separate object and they had them all pieced together. Eventually Marissa was able to figure that out on her own after school.

Benita reflected on her experience and blogged,

I learned how to make a life [in ActionScript], how to make points and also how to make a button and how to make the barriers move. It was reaaly hard. I am so happy that I was nominated in the Globey Awards like we are so awesome—me and my partner worked so hard to find how to make the points. We took weeks to find out.

Both students attended more than one afterschool work session, and also came to the school on a special weekend workday to spend more time finishing their game. After the game was finished, Marissa wrote: *I was really surprised that I finished my game because I almost wanted to give up but I didn't. This is an awesome experience because I enjoyed to make my game. I liked to find where the codes are.*

The girls' design employed their perceived barriers to high school graduation and success: drugs and getting pregnant and represented them as literal obstacles within the game. In the game, the player must dodge cigarettes and babies and move through a maze while also collecting "lives" and books. The game became one of three finalists in the sixth grade social issue game category of the school's year-end awards, called the Globey Awards competition. See game screen in Figure 3, below.

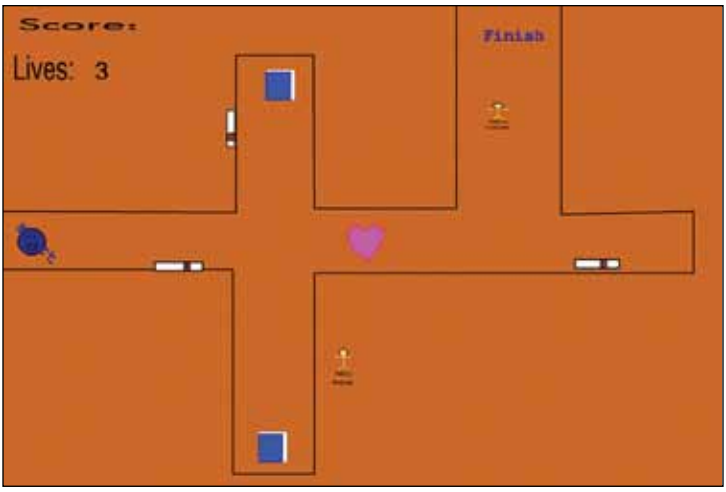


Fig. 3: Level one from the game *Don't Give Up*

The school's end-of-year competition recognized students in categories including Best Programmer, Most Improved and Best Blogger. Best Programmer finalists were selected based on the following rubric:

- Cool use of Flash skills
- Helped others and improved skills outside of class
- Used problem-solving skills

Both Marissa and Benita were nominated and became finalists in the category of Best Sixth Grade Programmer, along with one other sixth grade student. Marissa was selected as the winner of this award, and honored at the end-of-school year awards ceremony. This illustrates that both students achieved a measure of success as STEM learners and problem solvers.

STEM Self-efficacy

All students at the school took a survey designed to measure self-efficacy in the game-design classroom. Three domains of self-efficacy were examined: STEM skills, self-directed learning, and enlisting social resources. For the 6th and 7th grades participating in the project, for the variables connected to all three domains, there were significant differences between average ratings at time 1 and time 3, $t(345)$ 2.45, $p < .05$ and between time 1 and time 4, $t(330) = 2.32$, $p < .05$.

The case-study subject girls appeared to show growth in self-efficacy across all areas. See Appendix 2 of this report for a chart depicting some pre- and post student survey responses. Benita demonstrated the most change in self-confidence in the categories of (a) helping other students and getting help from other students while programming (enlisting social resources), and also in (b) self-confidence to express her thoughts clearly. These results match observations of Benita's behavior in the classroom. When she first began the class she was very reserved; by the end of the school year, she had helped many other teams in the class to implement the "Type-your-name" feature in their games.

Marissa began the year with higher self-confidence and so reported slightly less dramatic changes overall, but one exception was her growth in self-confidence in "figuring out what to do when stuck on something when programming." This finding matches the behavior we observed in class, where she persevered towards a solution; many times using time after school to continue to try to solve the problems she encountered, and finding success in doing so.

Career Goals

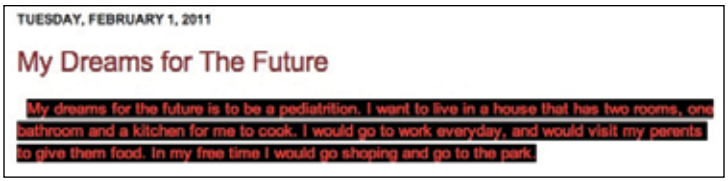
The team members, and all students in the school's Globaloria program, responded to an open-ended survey question with a possible career goal. This question appeared on a survey that they took 4 times during the year. The goals mentioned by Benita and Marissa are found in Table 2, below.

Table 2

Student Career Goals Across the Year of 6th Grade

CAREER GOALS	TIME 1 (PRE)	TIME 2 (MID)	TIME 3 (POST)
Marissa	Fashion Designer	Pediatrician	Teacher
Benita	Marine Biologist	Marine Biologist	Forensic Scientist

At the mid-point of the year, students were asked to write an extended reflection about their dreams for the future on their blogs. Benita wrote about her future career choice: working as a marine biologist with sea animals. Marissa wrote about her dream of being a pediatrician and living in a house with two rooms. Please see her blog post, below.


TUESDAY, FEBRUARY 1, 2011

My Dreams for The Future

My dreams for the future is to be a pediatrition. I want to live in a house that has two rooms, one bathroom and a kitchen for me to cook. I would go to work everyday, and would visit my perents to give them food. In my free time I would go shoping and go to the park.

Fig. 4: Marissa's blog post regarding career goals

Discussion

In this case study, we saw evidence of the project-based game design class as support for the development of students' STEM skills and perseverance, STEM self-efficacy in areas related to problem solving with computer programming, and career goal development during and after their participation in the classroom. It is possible that these experiences were mediated by the students' engagement with the game topic that was drawn from relationships in their lives. At the end of the year, both students in the case study demonstrated very strong engagement in game-design project, and report high levels of self-efficacy. In addition, both have shown some interest in STEM career fields.

It appears that the students' use of stories from their own lives as content of the digital media project, in this case a game, supports their level of engagement, and may also support changes in affect. In this case study, the students are highly engaged in the subject matter, and have a mission of improving the lives of the players who play their game by using its content and mechanics to impart a message. They participate actively in the game design class and create a working final product. At the end of the project, they are recognized for their performance and achievement. In the future, we can test this case study result further in larger survey datasets by including questions on student affinity for the game subject, and investigate the relationship between such affinity, affective shifts, and learning outcomes. A further question for future study is how student engagement in this program contributes to development of a lasting interest in STEM as a potential career goal.

Findings from the Girl Scout Research Institute (GSRI) indicate a strong desire among middle and high school aged girls to "make a difference in the world" and to help people (GSRI, 2012; GSRI, 2008), with the desire to make a difference in the world most frequently cited by girls in the study as an important reason for their career choices. In the current study, we saw that the team members were highly engaged

and developed both STEM skills and improved self-efficacy for some of the STEM skill areas. During this time period, the team members expressed the STEM field career goals of forensic scientist, marine biologist, and pediatrician. It may be that offering girls the experience to build games on such aspirational themes contributes to their interest and engagement. While the students in this case study demonstrated a personal connection to the mission of their game, and sustained interest in the mission. Projected across a year, it should also be noted that the activities of digital game design and programming may provide substantial interest as well, thereby interacting in its effects with the nature of the thematic content of the game.

This case study found that girls in this technology and game design classroom became very engaged and developed STEM self-efficacy across the year. The longitudinal nature of the school's game design program, with classes offered throughout the middle school years, will allow for continued and multi-factored examination into changes in the girls' engagement, STEM skill self-efficacy, outcome expectations and career goals, and the decisions they make as a result. In the future we will conduct a comparative case study of multiple teams, examining how distinctly dissimilar cases can exploit the variability among cases and thus facilitate discovery of appropriate explanations and hypothesis generation (Firestone, 1993). While selecting a high performing team for the case is a limitation, the aim is to highlight *what is possible to be achieved by some students*, and elicit further refined research questions. Future comparative work will investigate the fuller ranges of student experiences. In concert with future research mentioned, additional study of the experiences of students who participate in this game design program will seek to illuminate possible links between the use of stories from the game designers' lives, thematic content, and the potential to make a difference in the world through engagement, and ties to development of career interest in STEM fields using the skills developed in game-design class.

Appendix 1: Self-efficacy for Learning Engineering Instrument

Components and item text of the Self-efficacy for Learning Engineering Instrument

Component of self-efficacy for learning engineering	Item number	For each of the following questions, we are going to use a scale of 1-100. Numbers close to 1 are connected with a low confidence and numbers close to 100 are connected with complete confidence. Numbers around 50 are connected with a medium level of confidence. (Please choose a number from 1-100)
Self-regulation of learning	Item 1	How confident are you that you can finish assignments on time in Globaloria?
Self-regulation of learning	Item 2	How confident are you that you can always concentrate on school subjects during Globaloria class?
Self-regulation of learning	Item 3	How confident are you that you can remember information presented in Globaloria class?
Learning new engineering skills	Item 4	How confident are you that you can figure out new things about editing the wiki?
Enlisting social resources for learning	Item 5	How confident are you that you can get help from another student when you get stuck on something in Globaloria?
Enlisting social resources for learning	Item 6	How confident are you that you can get help from a teacher when you get stuck on something in Globaloria?
Enlisting social resources for learning	Item 7	How confident are you that you can help other students who are stuck on something in Globaloria?
Self-regulation of learning	Item 8	How confident are you that you can participate in class discussions in Globaloria?
Learning new engineering skills	Item 9	How confident are you that you can put your thoughts and ideas into words that are easy for people to understand on your blog?
Learning new engineering skills	Item 10	How confident are you that you can figure out what to do when you get stuck on something doing Flash?
Learning new engineering skills	Item 11	How confident are you that you can search on the Internet to find help when you get stuck on something?

Note. The instrument was designed to measure three components of self-efficacy for learning engineering: self-regulation of learning, enlisting social resources for learning, and learning new engineering skills.

Appendix 2

Some pre- and post-results on self-efficacy measures

How confident are you that you can figure out new things about editing the wiki?

	Pre	Post
Benita	60/100	90/100
Marissa	90/100	100/100

How confident are you that you can get help from another student when you get stuck on something in Globaloria?

	Pre	Post
Benita	30/100	90/100
Marissa	50/100	90/100

How confident are you that you can help other students who are stuck on something in Globaloria?

	Pre	Post
Benita	32/100	90/100
Marissa	90/100	99/100

How confident are you that you can put your thoughts and ideas into words that are easy for people to understand on your blog?

	Pre	Post
Benita	30/100	90/100
Marissa	69/100	90/100

How confident are you that you can figure out what to do when you get stuck on something doing Flash in Globaloria?

	Pre	Post
Benita	50/100	90/100
Marissa	60/100	90/100

How confident are you that you can search on the Internet to find help when you get stuck on something in Globaloria?

	Pre	Post
Benita	60/100	90/100
Marissa	50/100	100/100

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