GLITCH GAME TESTERS: THE DESIGN AND STUDY OF A LEARNING ENVIRONMENT FOR COMPUTATIONAL PRODUCTION WITH YOUNG AFRICAN AMERICAN MALES

A Dissertation
Presented to
The Academic Faculty

by

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In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in
Human-Centered Computing in the
School of Interactive Computing, College of Computing

Georgia Institute of Technology
May, 2012

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To the Glitch Guys: Atari, BallBoy, Beast, BigDawg, bkaVontenn, Book2010, burnout, capoCRUSHNem, Collque, Crybaby, Dr. Who, Grim610, Hero, JayDragon, Joker, KillRoy, King1, lo349, Montana, Primetime, Ringleader, Sandman, Shortstuff, Superman, and ThatDude

ACKNOWLEDGEMENTS

I want to acknowledge the generosity of game testers who were a part of the program described in this document, the *Glitch Guys*. Thank you for sharing with me and teaching me about being a young black man.

There were also other *Glitch Guys*, African American men who believe in giving back, and gave generously of their time to make Glitch happen. A special thank you to Terris Johnson and Corey Steward who were with me from the beginning. You amaze me with your patience and maturity while I fumbled, learning to think and talking about race and gender. Thanks to Marcus Austin and Dr. Ken Perry for being kind and generous teachers. Thank you Dr. Charles Meadows for not laughing me out of your office when I just showed up at Morehouse one day – your belief in this idea is one reason I pursued it. I must acknowledge Cedric Stallworth, for making Glitch the first squatters on the 3rd floor of the CCB, securing surplus computers, and making sure the administration let us do our thing. Thank you Asante Bradford, for getting us clients and helping us sell this idea in the real world.

I also want to thank my committee members. Dr Kevin Crowley for giving me the freedom and resources to learn so much at Pitt. Without your encouragement I would have never pursued a PhD. To Dr. Willie Pearson and Dr. Lisa Nakamura, our talks and your work have shaped my understanding of race, media, science and technology and given me the opportunity to reflect on my own whiteness, gaining a better understanding of myself. To Dr. Janet Kolodner and Dr. Mark Guzdial, you have taught me the fundamentals of learning sciences and computer science education. Thank you for the frameworks to build my research career. Finally, I would like to thank my advisor Dr. Amy Bruckman. There are many things I can thank Amy for, but particularly I would like to acknowledge her for both encouraging me to work outside of established paradigms and expecting excellence from me. I hope that I have learned from you how to bring out the best in students.

To the members of the Electronic Learning Communities Lab, Jill Dimond, Sarita Yardi, Kurt Luther, Jose Zagal, Casey Fiesler, and Andrea Forte, I am sure that I owe you a beer or two. To the other PhD students who helped me in many ways (but mostly to pass HCC2), thank you all and particularly Ben, Brian and Brian, Carrie, Chris, Christina, Evan, Ja-Young, Kim, Lana, Mike, Tammy, TJ, and Yan. I would like to acknowledge all of the amazing work of Dr. Tom Mcklin and the Findings Group, Ltd as outside evaluators on the Glitch project. I would also like to acknowledge Dr. Karen Head, who went far beyond a writing coach and became my writing therapist.

This work was primarily supported by the National Science Foundation (NSF) Broadening Participation in Computing initiative grant 0837733. Support and gifts also came from the Blank Family Foundation, EA Tiburon, Yahoo! and Microsoft Xbox.

Finally, I would like to thank Carl, Evy and Josie, for their sacrifices and their love during these years. There is little I can say to acknowledge how much you mean to me, but know that nothing else I have done is equal to being a part of your lives.

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LIST OF ABBREVIATIONS

AA	African American
AP	Advanced Placement
BPC	Broadening Participation in Computing
CAQ	Computer Attitude Questionnaire
CCB	College of Computing Building
CMU	Carnegie Mellon University
CPATH	CISE Pathways to Revitalized Undergraduate Computing Education
CS	Computer Science
DiGRA	Digital Games Research Association
Georgia Tech	Georgia Institute of Technology
GUI	Graphical User Interface
HBCU	Historically Black Colleges and Universities
HCC	Human-Centered Computing
IT	Information Technology
JES	Jython Environment for Students
MBI	Microcomputer Beliefs Inventory
MMO(RPG)	Massively Multiplayer Online (Role Playing Game)
NBA	National Basketball Association
NFL	National Football League
NSF	National Science Foundation
QA	Quality Assurance

RQ	Research Question
S&E	Science and engineering
STEM	Science, Technology, Engineering and Mathematics
US	United States of America

SUMMARY

The implementation of a learning environment for young African American males, called the Glitch Game Testers, was launched in 2009. The development of this program was based on formative work that looked at the contrasting use of digital games between young African American males and individuals who chose to become computer science majors. Through analysis of cultural values and digital game play practices, the program was designed to intertwine authentic game development practices and computer science learning. The resulting program employed 25 African American male high school students to test pre-release digital games full-time in the summer and part-time in the school year, with an hour of each day dedicated to learning introductory computer science. Outcomes for persisting in computer science education are remarkable; of the 16 participants who had graduated from high school as of 2012, 12 have gone on to school in computing-related majors. These outcomes, and the participants' enthusiasm for engaging in computing, are in sharp contrast to the crisis in African American male education and learning motivation. The research presented in this dissertation discusses the formative research that shaped the design of Glitch, the evaluation of the implementation of Glitch, and a theoretical investigation of the way in which participants navigated conflicting motivations in learning environments.

CHAPTER 1

INTRODUCTION

In the 1990s, much research and attention was given to "bridging the digital divide" (Ebo, 1998; Warschauer, 2004; Jackson, Zhao et al. 2008). This "divide" represented an acknowledgement of the differences in access to technology between young people in the United States. There was concern that without access to computers and technology, groups that were already marginalized in our education system would fall further behind. It was hoped that bridging the digital divide and providing students with access to technology would allow for equal opportunity for students and a growing pipeline of students interested in studying technology.

In the past 20 years, access to technology has changed. Schools and afterschool programs now offer computer access across most sectors of our society. Broadband Internet access at home has increased to include 63% of US adults and the gap between those who traditionally have or have not had access to technology is narrowing, with groups such as African Americans showing large increases in their use of broadband Internet in the home (from 40% in 2007 to 46% in 2009) (Horrigan, 2009). Beyond the use of Internet and computers, computation is reaching saturation among American consumers with the prevalence of mobile devices, digital games, and other technologies. This widespread access has not, however, resulted in broader participation in computing; women and many minority groups are still underrepresented in computing. Perhaps more concerning is the fact that access has not improved the educational outcomes of marginalized groups. For no group is this more apparent than African American males.

Their educational achievements have been falling further behind those of their peers. The resulting impacts on their lives and our society are significant.

To better understand technology use and learning with technology, race and gender can be used as an indicator of the type of interaction an individual has with computation. Today, the digital divide can better be defined as a computational participation spectrum, ranging from those who are only consumers, to those who create with technology tools, to those who produce computation (Figure 1.1). The intersection of race and gender becomes an indicator of where someone will be situated on this spectrum.

Figure 1.1

Computational Participation Spectrum

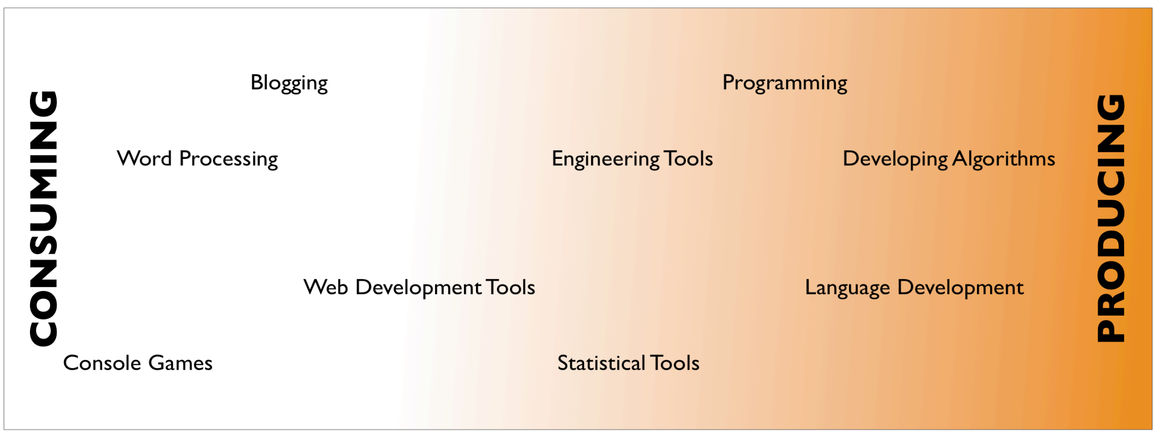

Figure 1.1 Sample activities and where they might fit in a computational production spectrum.

I introduce this spectrum to frame how cultural constructs of race and gender can be used as a starting point to understand the way in which individuals choose to interact with technology, and how this interaction impacts learning and computation production. For example, using data from large-scale study of American students' use of technology, Jackson, Zhao et al. (2008) found that young African American males primarily use computation as consumers, for the most part as users of digital games. Young African

American females, on the other hand, tended to be the most frequent producers *with* computation, through blogging and interacting on social networks. In contrast, young Asian American males were the most likely to be engaged in producing computation, not just producing *with* computation. The computational production spectrum demonstrates how the intersection of race and gender, as cultural constructs, impacts our interactions with technology.

In this dissertation I will further expand on the use of one technology, digital games, by one group, African American males. I use these specifics to explore how technology practices impact interest in, and opportunities for, learning about computing. I will review the motivations for this work, the way in which I'm situated as a researcher in this field, and finally the framework that will tie the research questions to the chapters that follow.

Motivation

There are several motivating factors for an inquiry into learning environments for computational production with young African American males. First, there is a concern in the United States that we are not training enough citizens to fill the need for computer scientists, particularly since the pool of individuals who historically have filled these positions, white males, is a shrinking part of our population. Second, because of the historic academic underperformance of males of color in the United States (US), particularly African American males, the increase in this demographic have impacts on the national education system. These impacts are felt through high rates of high school dropouts, unemployment, incarceration and death among young men of color that impact the overall performance of our education system. Finally, finding ways to navigate

African American males' rejection of the US educational system may offer opportunities to improve their overall educational outcomes, increasing US educational performance, and increasing their participation in computing, an area that holds the promise of high-paying and secure employment.

Broadening Participation in Computing

There was a substantial effort by the National Science Foundation (NSF) to broaden participation in computing (Gilbert, 2006). Alliances and demonstration projects among academic institutions of higher learning, K-12 schools, government, industry, professional societies, and not-for-profit organizations were organized to increase the pipeline of students interested in computer science fields. These efforts were motivated by a decline in the number of computer science (CS) majors in proceeding years (NSF, 2007). The NSF anticipated that the rate of CS degrees granted would not keep pace with the need for computer scientists unless there were interventions (NSF, 2008a).

These trends correlate with those in other science and engineering (S&E) fields. The enrollment of white males in S&E is declining. This decline, coupled with projections that the population of minorities will increase significantly over the next fifty years, and a growing number of immigrants choosing to be educated nationally or returning to their native country, have scholars asking, "Who will do science?" (Etzkowitz, Kemelgor, & Uzzi, 2000; National Research Council, 2007; NSF, 2009; Pearson, W. & Fletcher, A. 1994; Vetter, 1994).

Consequently, interventions were initiated by the NSF to increase the number of students in computing at the undergraduate and graduate level. Programs such as CPATH (CISE Pathways to Revitalized Undergraduate Computing Education) sought to transform undergraduate computing education nationally by establishing multi-disciplinary computationally-focused curriculum partnerships (NSF, 2008b). Simultaneously, NSF-BPC (National Science Foundation Broadening Participation in Computing) funded programs to increase the retention of women, persons with disabilities, African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders in CS (NSF, 2008a).

These audiences have been identified not only to increase the overall number of students in CS, but also to add to the diversity of perspectives and creativity in the field of computing. A concern is that of a lack of diversity in computing results in computation that is created for the few, without consideration for groups that are marginalized. Stoecker (2005) argues that researchers for community change should use participatory design methods with diverse members of the community, including marginalized groups, to foster consideration of different cultural practices and values in design projects. Le Dantec and Edwards (2008) have focused on the technology cultural practices of the homeless community to shape the design of technologies to support access to community resources. These researchers suggest that cultural practices and values result in different designs and different uses of technology and that we need to broaden the diversity of people involved in producing technology. To help develop this diverse pool of talent, technology learning interventions should be designed to reflect the context and cultural preferences of would-be learners.

Crisis in African American Male Education

The majority group in the US, White Americans, typically perform better on standardized tests and have higher college attendance and graduation rates than underrepresented racial and ethnic groups. As this majority group becomes a shrinking percentage of the US population, there are impacts on the US educational system. With the US predicted to become a majority minority country by 2020 (Lee & Ransom, 2011), the poor performance of students of color, particularly males of color, has a greater and greater impact on the overall performance of students in the US education system. According to recent reports from the College Board, the US is falling further behind other countries in terms of educational performance each year (Lee & Ransom, 2011).

Minority groups (except some portions of the Asian population) perform much worse on most educational measure and males, particularly African American males, perform more poorly than their female counterparts (Lee & Ransom, 2011). This crisis in the educational system suggest that the methods for learning and assessment that have worked in the past need to be examined, and that our educational system needs to be reimagined to serve our changing population.

There have been number of reports that speak to the crisis in African American male education. The Council of the Great City School issued a recent and comprehensive report, *A Call for Change: the social and educational factors contributing to outcomes of black males in urban schools* (Lewis, Simon, Uzzell, Horwitz, & Casserly, 2010). This report was developed from a compilation of sources that reported on the state of education for African American males in the US with a focus on urban school districts. The report characterizes the state of education for African American males in the US as a national catastrophe because African American males perform lower than their peers throughout the country on almost every indicator. This study looks at six areas of African American male achievement to determine what the state of this problem is today.

The researchers found that African American males typically were at risk for poor educational performance in all six areas.

1. Lack of readiness to learn was demonstrated through comparison with White American peers. The researchers found that African Americans are 50% less likely to have health insurance; they are three times more likely to live in single-parent households; and they are twice as likely to live in home with no full-time employment.
2. Achievement on the National Assessment of Education Progress is lower for African American males than for other groups in every area except reading level, on which African American males are tied at the bottom of the scale with Latino males.
3. Achievement on the National Assessment of Educational Progress in urban school districts is even worse, with over 50% of 4th and 8th grade African American males scoring below basic levels.
4. Lack of college and career preparedness was demonstrated through a high school drop out rate that is more than double the rate for White American males. African American males have comparably lower SAT and ACT scores, as well as a lower likelihood of attending college.
5. Lack of school experience was found because African American male students are more likely to be suspended or left behind a grade than any other group. They are also least likely to participate in academic clubs that would give them extra academic experience.

6. Lack of postsecondary experience opportunities was demonstrated through African American males' lower graduation rates, higher unemployment rates, and lower income wages. This is true even for African American males with similar education levels to their white peers. In addition, African American males are the group most likely to be incarcerated, making up 36% of the prison population.

The report indicates that while economic factors intensify underachievement by African American males, they alone do not account for lower performance in these areas. Strikingly, the report found that middle class and non-disabled African American males performed equally to impoverished and learning disabled White American peers. This suggests that the high rate of poverty in the African American community exacerbates problems in the educational system, but economics are not the only issue.

This crisis in African American male education has significant repercussion beyond a deteriorating educational system. For young African American males, poor educational performance leads to unemployment, incarceration, and death. The College Board recently reported that nearly half of the young men of color ages 15 to 24 are unemployed, incarcerated or dead before age 25 (Lee & Ransom, 2011), other research suggests these numbers are worst for African American males (Mincy, 2006).

Opportunities

The historical and nuanced reasons for this low performance are beyond the scope of this dissertation. However, within the scope of this dissertation I hope to make a contribution to issues concerning African American males' motivation to learn computing. Many have noted that African American males' low motivation, disengagement with school, lack of supportive educational environments, and high rates of poverty and financial responsibilities place barriers to academic achievement. In addition, the geek identity often associated with computing may add a barrier for African American males to identify themselves as computer scientists.

However, computing holds promise for financial security that may be appealing to young African American males. There are growing opportunities in the field of computer science that offer high income, job security, and only require a bachelor degree in CS. The Bureau of Labor Statistics (2007a) issued projections for the 30 fastest growing occupations, and among the highest paying were those that required a bachelor degree in CS (See Table 1.1).

Table 1.1.

Five of the 30 Fastest Growing Occupations in the US, 2006 – 2016

Fastest growing occupations that require a bachelor's degree in CS	Employment 2006	Employment 2016	Percent change
Network systems & data communications analysts	262,000	402,000	53.4%
Computer software engineers, applications	507,000	733,000	44.6%
Computer systems analysts	504,000	650,000	29%
Database administrators	119,000	154,000	28.6%
Computer software engineers, systems software	350,000	449,000	28.2%

Table 1.1 Five of the 30 fastest growing occupations in the US from 2006 – 2016 require a bachelor's degree in computer science.

Currently, African American males are underrepresented in these jobs (Bureau of Labor Statistics 2007b) so increasing their participation in CS offers an opportunity to improve the field of computing with a larger and more diverse pool of candidates. CS education also offers African American males access to financially stable careers.

Research Context

When I began studying digital games in 2004 I chose to examine gender and gaming with a focus on studying girls' gaming practices. It was a subject that resonated with me because I self-identify as a female gamer. I play frequently and, when playing for fun, I play primarily what would be considered casual games on a PC or racing or role-playing games on a console. I was not drawn to exploring young African American males' game play because I shared their passion for sports games and first person shooters. My curiosity came from trying to understand why some people leveraged games into learning experiences and others did not.

My identity as a female gamer and background in project management prepared me for a position at the University of Pittsburgh Center for Learning in Out of School Environments in 2004. My job was to manage the development of the Click! Urban Adventure game, a mixed reality live action role-playing game that was the cornerstone of a research project to increase middle school girls' interest in science and technology through games. Based on others research, we worked from a premise that if we got girls engaged with games the same way boys were, they would also become interested in technology, just like the boys.

Because over half of the 200 plus participants in Click! Were African American, I began to seek literature on African Americans and gaming that would inform our research the way that literature on girls in gaming had. What I found was that issues around race and gaming had received almost no attention from academics at that time.

What little information I did find came from media watch groups and market research that identified problematic racial representations in games and the large quantity of time young African American men spent on gaming. This caught my attention. If I was working to get girls into gaming because that would increase their interest in technology, then why were young African Americans not well represented in technology fields?

This inspired me to work with young African American males, to understand why they play digital games frequently, yet were not leveraging that gaming into an interest in CS like their White and Asian American male peers. Given the diversity of young African American males' perspectives and experiences, I made some choices about where and whom the fieldwork would include, and this should be taken into consideration. This research concentrates on African American males from lower income neighborhoods in urban settings, and should be seen through this lens.

Because of the many differences in my cultural background—I am a white female raised in a suburban middle class family—I faced some limitations in conducting this research. For example, I am not an avid sports fan and I do not know the subtext when someone invokes the name of one team or player. At times, this made it difficult to understand what was happening during competitive game play, when the bragging, or smack-talk, would get loud and fast. I had to make a choice to either let pop culture references go over my head, stop the natural activity and ask about them, or ask later and lose the nuance of the moment. There was no easy answer to these issues, and I used all three approaches at different times. At the same time, it was true for me that the position of the outsider allowed me to ask questions about the obvious, issues that those who are positioned inside the culture might assume they understand. Some would suggest that this outsider status may be an advantage (Traweek, 1992). However, it is important to acknowledge that outsider status brings with it difficulties in establishing trust and understanding context.

When possible, I tried to mitigate this outsider status. I established an ongoing relationship with participants, first in formative research conducted at an existing afterschool program that helped produce the design of a learning intervention, the Glitch Game Testers program, which became the context for further studies,

Glitch was a work and study program for high school students. These students were paid to test pre-released digital games, full-time in the summer and part-time during the school year. In addition, they spent about an hour of each day in computer science classes or workshops. Through Glitch I established long term working relationships with the high school participants and a number of young African American men who were undergraduates at Georgia Tech and Morehouse. In particular, this research would not have been possible without Terris Johnson and Corey Steward and their insights. They started working with me in the spring of 2008 and continued until they graduated from Georgia Tech in 2011. Their easy relationship with the high school students and the strong working relationship they had with me granted me a certain amount of credibility with the participants as a person who could be trusted and should be respected. I hope that I was able to live up to the trust and respect that Corey and Terris demonstrated.

Research Framing

The central question that drives my research is, *How do different cultural values and technology practices impact participation in the production of computation?* In the context of this question, *cultural values* are the ways an individual chooses to act in the world based upon their family, friends, media, and other influences to which they have been exposed[1]. Frequently, in this document, it would seem that the term *cultural values* could be interchanged with the term *identity*. However, the distinction is that cultural values are externally defined rather than internally defined.

A three-prong approach was taken in this dissertation to address my central question. First, formative work to understand cultural values and technology practices and their influence on interest in computation was conducted. Second, based upon these formative findings, a set of design principles was defined and used to develop a learning intervention that leveraged the digital game technology practices of young African American males into an interest in learning computation. Third, this learning intervention, named the Glitch Game Testers, was used as a place of study to understand the role of cultural values in motivating, or de-motivating, learning to produce computation.

This three-prong approach contributed to answering three research questions:

RQ 1. *How do young African American males' play practices impact their interest in computer science?*

RQ 2. *What are the design principles to leverage technology for learning with those engaged in active non-learning?*

RQ 3. *How does face saving help navigate cultural conflict with learning?*

In the following section I briefly outline each chapter of this dissertation, highlighting the way in which each chapter addresses these questions.

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[1] This way of defining cultural values is developed from Swidler, (1986) who defines cultural values as the resulting strategies of action used by an actor developed from a set of experiences, stories, rituals and worldviews that an individual has been exposed to.

Chapter 2: Related Work

In the related work chapter I explore the underrepresentation of African American males in computer science, the way in which cultural values impact practices with digital games, and learning theory regarding motivation. This work frames the opportunities to leverage young African American males' interest in digital games into an interest in computer science. It establishes where this work contributes to the game studies field, moving beyond content and examining the intersection of race and gender in relationship to play practices[2]. Finally, this chapter contains a synthesis of literature on self-beliefs, disidentification and cultural loyalties on learning motivation to define the term *non-learner* and frame the theory of *presentation of self* in relationship to the *non-learner*.

Chapter 3: Formative Research

The formative research looks at examples of the relationship between cultural values, technology and learning to answer Research Question 1: *How do young African American males' play practices impact their interest in computer science?* It also contributes to the second inquiry: *What are the design principles to leverage technology for learning with those engaged in active non-learning?* by outlining a set of design principles and how they were used in designing a learning intervention for young African American males, a group that frequently engages in active *non-learning*.

The findings from the formative and design research suggest that African American male play practices with digital games do not encourage engagement with computation.

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[2] *Play practices* or *technology practices*, as used in this document, are the accepted norms for behavior when interacting with digital games or other technology among a certain group.

However, this technology does hold opportunities for authentic work. The findings indicate that authentic work, coupled with financial motivations, may be more effective than intrinsic motivations for African American males. These findings also contributed to developing four principles for designing learning intervention that leverage technology with non-learners: 1. emulate successful practices, 2. respect culture, 3. leverage affordances in technology practices, and 4. leverage affordances in cultural values.

Chapter 4: Design Product and Research Environment

The application of the formative and design research studies resulted in the development of the Glitch Game Testers program. This section contains a description of the Glitch program, connections between design choices and findings from formative research and details on the participants in the program.

Chapter 5: Methods for Assessment and Face Saving Study

Glitch became more than a case study of the implementation of these design principles; it served as a laboratory for understanding the intersection of culture, technology and motivation to learn. Methods for assessment and evaluation and methods used to examine the face saving tactics participants used to negotiate motivations to not learn while participating in a CS learning program are detailed in this section.

Chapter 6: Findings on Computing and Face Saving

In this chapter, findings will be presented on the changes in participants' interest and intent to persist with computing in the immediate, short term, and long term. These findings indicate that most participants were on track to pursue computing as a career. The post-secondary educational choices of the participants further support these findings, with over 75% attending post-secondary school for computing. Details on the participants' interaction with the year one curriculum provide insights into approaches to introductory CS with young African American males.

While these studies demonstrated that participants were interested in computing and studying computing in the future, the series of face saving studies demonstrate participants still did not feel comfortable talking about computing or learning with their friends or family. However, the studies also suggest that cultural values, which were considerations in the design may have provided opportunities for face saving tactics. These tactics allowed participants to do "geeky" activities like computer programming while still maintaining a presentation of self they felt their friends and family would respect. These findings contribute to answering RQ 3: *How does face saving help navigate cultural conflict with learning?*

Chapter 7: Discussion

In chapter 6, findings from the formative research are tied to related work to help answer RQ 1: *How do young African American males' play practices impact their interest in computer science?* The design principles and evaluation findings are discussed in relationship to RQ 2: *What are the design principles to leverage technology for learning with those engaged in active non-learning?* Finally the findings from face saving studies are discussed in relationship to RQ 3: *How does face saving help navigate cultural conflict with learning?*

Chapter 8: Conclusion

In chapter 7, future work and broader implications are discussed regarding cultural values and computational production, the implications for African American male learning more generally, and theory on learning motivation.

Outcomes

Through the course of answering these research questions, a number of studies have been conducted, and the outcome of these studies has been disseminated in academic publications and presentations (see Table 1.2). In addition, this work has found a broader audience via popular media outlets, and corporate involvement in launching new technology learning initiatives with young African American males, as well as among youth leaders. Measuring these outcomes is difficult, and beyond the scope of the document. Still, it is encouraging to see educational research spark interest in unlikely places and with opportunities for sustainability.

Table 1.2

Outline of Research, Goals, Methods and Questions

RESEARCH	GOAL	METHODS	QUESTION (S)	OUTCOME
(1) Study of play practices among African American (AA) males	Develop understanding of a situated learning environment that is culturally appropriate	Observations and interviews with high school age African American males (Chapter 3)	How do young AA males' play practices impact their interest in CS?	Journal of Games and Culture, 2008; Race & Ethnicity and (New) Media Symposium, 2009
(3) Critical review of literature on masculinity in AA and geek culture	Place the play practices of AA males and computational producers in broader social context	Review of literature and large scale survey of CS majors (Chapter 2)	How do young AA males' play practices impact their interest in CS?	Foundations of Digital Games, 2010; Digital Games Research Association (DiGRA), 2011
(4) Design research toward culturally appropriate educational interventions	Inform exploratory and formative design methods used in learning science and technology interventions	Alternative design research methods (Chapter 3)	What are the design principles to leverage technology for learning with those engaged in active non-learning?	Workshop Participatory Design Conference, 2010; Game Developers Conference, 2011
(5) Develop game testing and CS work program	Develop a baseline for understanding cultural values and practices in a work study program	Qualitative interviews and observations. Quantitative assessment using surveys, school performance and choices (Chapter 3, 4, and 5)	What are the design principles to leverage technology for learning with those engaged in active non-learning?	DiGRA, 2009; American Education Research Association, 2011; Computer-Human Interaction, 2011; ACM Communications, 2011
(6) Implications of face saving	Develop understanding of multiple faces	Surveys, focus groups, individual interviews, and observations (Chapters 4 and 5)	How does face saving help navigate cultural conflict with learning?	Submitted to Journal of Learning Sciences, 2011

CHAPTER 2
RELATED WORK

Young African American males are underrepresented in computational production. Evidence of this underrepresentation is consistently displayed in their low engagement with higher education and careers in CS. At the same time, the computational medium most popular with African American males, digital games, has been explored as leverage to increase interest in and improve learning of computer science. There has been little exploration of race/ethnicity and gender as they interact with digital games. Contextualizing the relationship between CS and games using cultural identities may increase understanding of why some groups leverage games into an interest in CS and others do not. Background research indicates that computer scientist play practices map closely to geek masculinity. This construct of geek masculinity contrasts with African American masculinity. These cultural differences bring to light the reasons why some groups leverage digital game play into CS learning and other groups, such as Africa American males, do not. Masculine constructs have also been tied to African American males' rejection of educational institutions more generally. To further understand this desire to reject school I look at theories that explain the active choice to be a non-learner, including *self-theories*, *disidentification*, and cultural loyalties. Finally, I look at the theoretical construct of *face saving*, the actions an individual takes when he feels his *presentation of self* threatened, in order to navigate around conflicting motivations.

African American Males in Computer Science

The percentage of CS bachelor degrees awarded to African American males increased from 4.93% in 1997 to 7.55% in 2006 (NSF, 2007). These numbers indicate growth in the number of African American males in CS, and that their numbers are proportionate with population estimates. African American males compose 6.45% of the US population, as estimated by the US census in 2007 (2007).

However, other indicators show that these gains are not filling the pipeline of CS in research careers, academia, or higher-paying CS careers. The Taulbee Survey, conducted annually by the Computing Research Association, differs from the NSF data in that it includes only PhD-granting and research institutions. In 1995, the Taulbee Survey reported that African Americans (both male and female) received 3.14% of the undergraduate degrees in CS (Andrews, 1996). In 2004, African Americans increased their share of CS undergraduate degrees from research institutions by less than one percent (Zweben, 2005). When this is extended to masters and PhDs, the percentage of CS degrees awarded remains flat at around 2% of all masters and PhDs going to African Americans. NSF's report on Women, Minorities, and Persons with Disabilities in Science and Engineering reflects similar numbers at the doctoral level (NSF, 2007). African American males obtained, between 2% - 3% of the doctorates awarded in annually in CS from 2001-2009 (Table 2.1).

Table 2.1

Doctorates awarded in CS, 1999-2006

	2001	2002	2003	2004	2005	2006	2007	2008	2009
All Population	395	410	413	455	500	551	680	667	730
Female	84	102	90	110	103	130	145	153	161
Male	311	308	323	345	397	421	535	514	569
Black Population	9	21	17	18	19	21	30	24	30
Female	4	8	7	4	8	8	12	12	9
Male	5	13	10	14	11	13	18	12	21
% Awarded to black males	1.27%	3.17%	2.42%	3.08%	2.20%	2.36%	2.65%	1.80%	2.88%

Taken from NSF (2011) report on Women, Minorities, and Persons with Disabilities in Science and Engineering. Doctorates awarded to US Citizens and permanent residents in Computer Science.

Source: TABLE 7-7. S&E doctorates awarded to US citizens and permanent residents, by field, sex, and race/ethnicity: 2001–09

The Taulbee Surveys indicate that while African American men are receiving computing degrees, these are not generally from PhD-granting institutions that will place them in computing fields after graduation. Evidence from the Bureau of Labor Statistics indicates that the representation of African Americans (both male and female) in the computer and mathematical fields is 7.2% (Bureau of Labor Statistics, 2007). This is a significant under-representation of African Americans, as the US Census Bureau estimated an African American population of 12.8% in the same year (US Census Bureau, 2007). Of the African Americans who receive doctorates, 33% (compared with 42% Hispanics and 44% Whites) are employed at PhD-granting universities (NSF, 2009). Donna Nelson (2003) conducted a survey of 50 top-ranked research institutions and discovered that out of 1,332 faculty in CS, only 4 (3%) were African American, all of whom were male. These trends suggest that, while African American males may be receiving computer science degrees from 2 and 4 year institutions, this education it is not fully enabling them to become computational producers in industry or academia.

Barriers to African American Males in Computing

Many factors have been identified as barriers to the penetration of African American males into CS: pre-college advanced placement courses, access to computers, computational math, lack of mentors and role models, economic pressures to support family/give back to community, self-efficacy, and isolation (Barber & Tait, 2001; Katz, Aronis, Allbritton, Wilson, & Soffa, 2003; Tatum, 2003). African Americans' enrollment in advanced placement computer science courses has increased slightly, but African Americans still only represent 1.8% of test takers, with a 39% success rate (Nelson, 2003). Katz et al. conducted a study with 65 students from underrepresented groups, including 18 African Americans, and discovered that performance in CS at the baccalaureate level is correlated with computational experimentation as a learning strategy, and cannot be contributed to insufficient computer access (Katz et al., 2003). However, access to opportunities for experimentation is still an issue for African Americans and other underrepresented minority groups because classes are focused on learning applications, not computational experimentation, and computer use is closely monitored for fear of misuse by students (Margolis, 2008).

Opportunities for Engaging African American Males

Riegle-Crumb and King (2010) conducted analysis of large-scale longitude data on gender and racial/ethnic disparities in science, technology, engineering, and math

(STEM) fields. They found that the select group of young African American men who do successfully matriculate into four-year colleges proportionately over-enroll in engineering-related fields as compared to their white male peers. This suggests that African American males are interested in engineering-related fields if they are motivated to participate in higher education in general. This is supported by research conducted by DePass and Chubin (2009). They found that interventions such as role models, mentorship, and computational experimentation, all of which address issues of isolation and self-efficacy increased enrollment in engineering and science programs, in most groups, except African American males. They found that African American males were a unique group that did not respond to interventions targeted to motivate interest in engineering or science. However, they found if young African American males are already motivated for education, they are more likely to go into engineering fields. This distinction suggests that getting young African American males interested in education more generally by addressing their learning motivations may result in increasing their numbers in computer science.

Leveraging Games for Computer Science Learning

While digital games have been explored in a learning context, particularly as an incentive or tool for learning computing, there has been a lack of research on the intersection of gender and race/ethnicity and gaming. On the subject of using games for learning goals, Squire (2002) suggests that cultural and player practices should be emphasized in future research. However, as Ito and Bittani (2008) have noted, there has been little exploration of race in game studies, and even less work that explores the intersection of race and gender with gaming. While a few studies have looked at this intersection from the perspective of game content and character representation (Children Now, 2001; Williams, Martins et al., 2009), little research looks at player practices, as Squire suggests.

Yet, digital games provide a unique opportunity for researchers to make connections between different culturally-defined groups and their interaction with technology. First, the practice of playing digital games is ubiquitous among young people in the United States today, with some groups, including computer scientists and young African American males, showing particular passion for digital games. Second, digital games are powerful pieces of computation that often inspire wonder and are self-reported as being a major influence on computer scientists' interest in computing. Finally, there are differences in play practices among different groups that can help us understand how young people situate technology in their lives, knowledge which will help us design better, more culturally-appropriate interventions.

African American Males and Gaming

Ito and Bittani (2008) express concerns about the lack of scholarship regarding video game play practices in relation to race, ethnicity, and socio-economic status. There is some research that looks at the race, ethnicity and cultural representation of game characters and the online development of "black" or minority characters; however, this research does not address play practices. Research that does explore differences in play practices often focuses on contrasting gender differences.

Race/ethnicity and gaming

What we do know from demographic and marketing research is that while there is a common perception that the young people gaming the most are young white and Asian

American males, this is inaccurate. The Entertainment Software Association has reported annually on the changing demographics of gamers. Their message stresses that games are no longer (if they ever were) played only by adolescent white and Asian American men. These reports and others provide data that video games are being played by over 90% of children and are consumed by Americans across all classes, cultures, genders, and ages (Entertainment Software Association, 2008; Rideout, Roberts, & Foehr, 2005). Some groups, however, are using games more frequently. Reports indicate that young Latino and African American males play games for more hours per day than any other group of young people (Jackson et al., 2008; Kolko, 2003; Rideout et al., 2005).

With such market saturation among all young people, we would expect to see diversity in the games that are produced. Some attempts to quantify the diversity of games have focused upon the number and type of minority and female characters in games. At least two studies have given comprehensive and slightly different takes on the racial demographics in games. In 2001, Children Now, a community-based organization, provided demographics on characters in video games that suggest there is an under-representation of black characters. Those that are present in games are generally sports figures or characters that promote negative stereotypes of African American males as aggressive and violent (Children Now, 2001; D. Leonard, 2003).

The second study, a "census" of gaming characters, is a content analysis of the characters' impact on the general experience of playing video games, weighted by the popularity of the games and the status of the characters as human- or computer-controlled (Williams, Martins, Consalvo, & Ivory, 2009). In this analysis, black characters represented 10.5% of all characters in video games, and most of these characters were male. Since African American males compose 6.2% of the US population, as estimated by the US Census (2007), this would suggest that black males are over-represented in games. However, because the survey heavily weighted sports games such as *Madden NFL* (EASports, 2008a) and *NBA Live* (EASports, 2008b), which are among the biggest sellers in the game industry, most of these African American characters are representations of real people. These popular sports games have a large percentage of African American characters these characters are based on real life players; for example, in 2006, 67% of National Football League players were African American (Lapchick, Ekiyor, & Ruiz, 2007). There is also significant weight given to black characters in the *Grand Theft Auto* (North, 1997 - 2009) series of games, in which black characters are representations of stereotypical black gang members. There is evidence that an individual player's game selection is tied to similarities in race and gender between player and character, with African American males choosing sports and fighting games such as *Def Jam games* (AKI Corporation, 2003) that have an over-representation of black male characters (B. DiSalvo & Bruckman, 2010; B. J. DiSalvo, Crowley, & Norwood, 2008; Kutner & Olson, 2008).

For many games, particularly online games, the issues of a character's race would seem to be eliminated by the use of player-created characters. Work by Kafai, Cook and Fields (2010), however, outlines how the lack of premade avatar parts in online communities limits the number of options for players of color. Higgin (2008) examines the lack of black or minority characters in online games and the way whiteness is privileged as the default setting in character creation. Leonard has further explored the lack of discourse on race and the larger implications of ignoring "black and brown" characters in games (Leonard, 2009). While this research uses critical reviews of game content to explore race and ethnicity, it does not specifically address the way in which digital game technology is used, and if race and ethnicity impact play practices.

Everett and Watkins (2008) look at what they term "Racialized Pedagogical Zones (RPZ)" in digital games. They explore how the content of games in the representation of racial representation becomes lessons for how race and racism is enacted in the world. They argue that, "by striving to locate players in what are often promoted as graphically real and culturally "authentic" environments, urban/street games produce some of the most powerful, persistent, and problematic lessons about race in American culture." This examination of gaming content as more than just representation, but as a place where people, young people in particular, are enacting race, brings to light how learning and role-playing stereotypes is part of play practices.

.In one of the few studies that considers racial and cultural play practices, Nakamura (2009) examined racist practices directed at gold farmers in *World of Warcraft*. This work looks at how paid workers in Asian countries play games to earn in-game currency or objects of value that can then be sold for real money. In this work, the play practices of these Asian workers are discussed. However, of more interest to Nakamura are the racist practices of others players, who have deemed this behavior unethical and couched their criticisms in racial slurs and propaganda.

Gender and Gaming

The lack of gender diversity in the game industry and technology fields has led to a number of studies to understand how females play. This work on gender and gaming has almost always addressed female or feminine qualities as the "other" in game studies. The findings are complex and sometimes contradictory, though much of the early work addresses the negative and objectified female images in games through content analysis (Children Now, 2001; Yates & Littleton, 2001). Other work has looked at different practices of game play, comparing preferences for game play along gender lines (Greenfield, 1996; Y. B. Kafai & Resnick, 1996). There has also been research on encouraging females to make and play games (Heeter, Egidio, Mishra, & Wolf, 2005; Y. B. Kafai, 2006) so that they increase their interest in games and researchers can study their gaming preferences. This could ultimately create a desire among girls to pursue interests in computing and technology.

Research on gender and gaming has shown us that cultural factors impact the genre of games played and the way games are played (Cassell & Jenkins, 1998; Y. B. Kafai, Heeter, Denner, & Sun, 2008). However, there has been little focus on masculinity (D. Leonard, 2003). Part of this is due to an assumption that studies of gaming practices and game content are normally conducted through a masculine lens. Within these studies, masculinity is an implied homogeneous perspective rather than an explicitly identified cultural factor, one with unique behaviors and values in different cultures.

Computer Science and Gaming

The possible relationship between playing computer games and interest in CS has been of particular interest to researchers considering gender inequities in CS (AAUW, 2000; Cassell & Jenkins, 1998; Kelleher & Pausch, 2007). Research by the American Association of University Women suggests that young men's more frequent video game play has led more men than women into technology careers, and that we should get girls gaming to help increase the number of women in technology fields (AAUW, 2000). This recommendation led, directly and indirectly, to a number of outreach and research projects that focused on developing girls' interest in gaming and game making (Flanagan, 2005; Heeter et al., 2005; Hughes, 2007; Y. B. Kafai, 2006; Van Eck, 2006).

Research based on computer scientists' biographical stories, as well as on ethnographic research with CS majors and young enthusiasts, supports this association between gaming and interest in CS. Stories culled from ethnographic and qualitative work suggest that computer scientists attribute some of their initial interest in computing to playing video games (Barron, 2004; Margolis & Fisher, 2002; Schulte & Knobelsdorf, 2007). This suggests that video games are an important cultural artifact in the development of a computer scientist. However, a survey conducted with over 1,000 students at a technical university indicates that there is only a small relationship between the hours spent playing video games and interest in computing (DiSalvo & Bruckman, 2009). In this survey, students answered an open-ended question, "How did video games affect your interest in computing?" In response, 43% of the students said that video games increased their interest in computing. Of these responses, 70 % of the CS majors or likely CS majors included hacking or modifying games as one way that games sparked their interest in computing, and 60% included interest in the underlying math of games as a way games sparked their interest in computing. These findings suggest that the relationship between gaming and interest in computer science is likely more related to play practices than time spent playing

Masculinities and Play Practices

These play practices also correspond with biographical stories and ethnographic research with "geeks" and computer scientists about the ways in which their video game play practices impacted their interest in computing. To contextualize these play practices with the computer scientist culture I examined literature on *geeks*, who are generally defined as a predominantly white and Asian male computer scientists, technologists, gamers, and hackers (Levy, 2001; Margolis & Fisher, 2002; Pascoe, 2007; Taylor, 2011; Turkle, 1984). While each of these groups is uniquely defined, they share similar cultural norms for performance of idealized masculinity. These traits map directly to the traits that were found in the study of play practices that increased interest in computer science. The mapping is found primarily in a rejection of the body and athleticism and an embrace of agency with technology. In play practices, rejection of the body can be seen in a lack of emphasis on the physical skill of playing games, while mastery over the machine via hacking, modifying or looking at the underlying math of games is highlighted.

In contrast, idealized African American masculinity constructs are body-centric, focusing on athleticism, appearance, and physical relations, with little value on agency with technology. These values map directly to findings, which will be explored in more depth in Chapter 3, that demonstrate a strong value on sportsmanship with little hacking, modifying or engaging with the underlying computation of video games. Idealized African American masculinities also strongly encourage performing masculinity through the rejection of education and educational institutions.

Preoccupation with African American sexuality and bodies has also contributed to the construction of an anti-intellectual depiction of African American masculinity. According to Richardson's reflections on black masculinity in the southern United States (Richardson, 2007) and scholarship on the African American image in athletics (Hoberman, 1997), this strong identity with the body in athletic competition and sexuality can be traced from historic roots in American slavery through the racialization of athletics and science.

Miller (1998) explores how the taxonomies of racism found in earlier scientific studies feed social and cultural attitudes regarding blacks' athletic achievement. He points out variances and alterations in language when authors/commentators described the athletic achievements of whites versus blacks. When describing black dancers and athletes, authors often focused on the body and attributed extraordinary skills to innate abilities. Conversely, when highlighting whites' accomplishments in dance and athletics, authors emphasized intellectual prowess, discipline, and fortitude as explanations.

These racialized body-centric models of African American masculinity have been repeated so often in media, literature, scientific discourse, and commentary that they have caused friction in identity construction within the African American community. The results are frequently seen in a rejection of Eurocentric or geek masculinities, including a rejection of education. This rejection has been described as *cool pose*, whereby American males engage in defensive posturing, rejecting schools and other institutions that actively reject them (Majors & Billson, 1993).

Understanding the Non-Learner

It can be difficult to contemplate why individuals who are capable of learning opt not to. Why would they make an active choice to not learn when learning is tied to stability, success and positive reinforcement? Previous work provides us with explanations for why an individual would make an active choice to opt out of learning. These include *self-theories*, *disidentification*, and cultural loyalties. By synthesizing these different theories as to why students reject learning, the field of learning sciences can better understand and address *non-learning* as a unique property of learning motivation.

Fixed Identity Self-Theory

Dweck (2000) ties capacity to learn to theories people hold about their own traits, such as intelligence, personality, and skill. According to Dweck individuals may hold a *fixed trait self-theory* or a *growth-trait self-theory*. Those that have a *fixed trait self-theory* set performance goals for themselves, to validate that they are smart, lovable, capable, etc. Dweck demonstrates that when fixed trait students encounter failure they believe it validates that they are not smart, and believe there is little they can do to change this. In contrast, *growth self-theor*y is a theory held by individuals who believe they have changeable traits and set goals for themselves to work hard so they can become more intelligent, lovable, capable, etc. Through a series of experimental interventions, Dweck and colleagues show that by changing students' self-theories, moving students from *fixed-theory* to *growth-theory*, students work harder, are more resilient to failure, and perform better in school.

Disidentification

Motivation to not learn has been tied to more than self-theories. Osborn (1999) explains black male disidentification with education, an active rejection of any identification with education and educational institutions, as the result of stereotypes, cultural influences, and active rejection of white culture. Work that looks at how racial and gender identity shape self-theories includes work on stereotype threat (Steele, Spencer, & Aronson, 2002). This work found that stereotypes had a two-fold effect. First, stereotypes may encourage a belief (similar to *fixed-theory*) that race or gender predisposes an individual to do well or poorly in a particular subject. Second, the fear that if one performs poorly he will be reinforcing a negative stereotype undermines student confidence and, ultimately, student performance. Stereotype threat can also be seen in self-reinforcing career choices resulting in racial and gender divides, such as white and Asian males' over-representation in professions that rely heavily on quantitative preparation (e.g., engineering, physical sciences, mathematics) and women's over-representation in education and nursing (Bureau of Labor Statistics, 2007; National Science Foundation, 2011).

Some prior research has brought together self-theories and stereotype threat to show that short interventions can change these self-beliefs and impact learning (Aronson, Fried, & Good, 2002). Yeager and Walton (2011) have reviewed a number of quick, effective, and lasting interventions to change students' self-theories to increase identification with growth-theory. While they found that these interventions can be effective, they also found that they are difficult to implement and there is a lack of information about why an intervention works in one setting but not another.

Cultural Loyalties

The culture of the educational system also contributes to students adopting a non-learning stance by asking students to reject their own belief systems. Herbert Kohl (1994) relates his experiences in encountering students who, while capable of learning, chose not to because their culture and values were in direct conflict with the process of learning. He points out that deciding to actively not learn requires considerable skill and cunning. Kohl describes a young African American male who was not only capable of learning but who was passionate about learning on his own terms. He points out that the young man chose to actively not learn in traditional educational settings because he believed they were racist institutions. Kohl found that many of his young African American students made a similar choice, although rarely with such dedication and understanding of why they chose to reject the institutions. According to Ogbu's (1988) *cultural-ecological perspective,* there are significant differences between minority groups based upon their historical origins. He argues that those who voluntarily immigrated tend to see education as a way to achieve socio-economic success in their new country. In sharp contrast, involuntary immigrants tend to perceive educational institutions as controlled by the group that oppresses them (Ferguson 2000). In reaction to these factors there is active rejection of what are perceived as white values and culture, which also leads to a rejection of school and positive academic identity.

Computer Science and the Non-Learner

The CS classroom seems to pose a unique set of challenges in creating and reinforcing non-learning. The CS classrooms is also one environment where interventions to change self-beliefs have not been successful. The use of these interventions in a CS setting may be particularly difficult because of the culture of the CS classroom and the identities associated with studying computer science, identities which strongly reinforce who can and cannot be successful in computer science.

Computer Science and Self-Belief

Simon, Hanks et al. (2008) have implemented self-theory interventions in the CS classroom with little success. In a large-scale study across multiple institutions they used "saying is believing" self-theory interventions that had been successful in previous studies. These interventions had little effect. The authors suspected the lack of effect was due to a shorter intervention period. However, Yeager and Walton's (2011) findings would suggest that the shorter interventions would be more effective. Another factor may be that CS classrooms are particularly resistant to growth self-theories. Lewis (2007) conducted a study with CS undergraduate students and faculty and found that the faculty were more than twice as likely as any of the student groups to disagree with the statement, "Nearly everyone is capable of succeeding in the computer science curriculum if they work at it." If the teachers do not believe the students are capable of becoming good at CS it may be difficult for the students to believe they can become good at CS. Margolis (2008) notes that high school teachers identified students who were naturally gifted with computers, and that teachers felt that some students were not capable of being successful in CS. This belief system may be created and reinforced by an imbalance in content knowledge among students in introductory computer science classes. Some young people have been programming and hacking since a very young age, while others have not seen code before their first CS class. This imbalance makes the CS classroom an opportunity for some students to show off their extensive knowledge rather than engage in a learning community (Margolis, 2008; Margolis & Fisher, 2002). The culture of the CS classroom was studied by Barker et al. (2002). They found that students in CS classes most often asked questions to demonstrate their ability or to mock others in their class. The focus was not on learning, but was instead on striking a pose about who was smart. Students in these classes often had a "defensive" attitude, defending their own ability and using questions in class to demonstrate that ability.

These studies also note that gender and race have played a role in who chooses to persist in CS and who perceives CS classrooms as unwelcoming (Barker, et al. 2002).

Much of this distinction is tied to a disidentification with computing. Margolis and Fisher (2002) found that gender was a significant factor in disidentification with computing. They studied women in the undergraduate computer science program at Carnegie Mellon University (CMU) who felt that they "didn't belong" in the program, in large part due to their minority status. The female participants in the CMU study reported that the overwhelmingly male population and culture convinced many that they should pursue a different major. These studies suggest that the culture of the CS classroom and disidentification with computing may establish and reinforce active non-learning.

Computer Science and Cultural Loyalties

According to Eglash (2002), geek stereotypes are intimately linked with race and gender to the extent that some members of minority groups find it difficult to participate in "geeky" activities like computer science. The “Image of Computing” study by ACM and WGBH found differences between demographic groups in terms of the way in which students viewed and valued computer science, suggesting that the differences in cultural values that Kohl described may exist in computing as well. The study found that among college bound students, there were few racial/ethnic differences in attitudes towards computing but gender was a strong predictor of differences in attitudes toward computing. This suggests that among college-bound African American males, the image of computing is not turning them away from participating. However, the low numbers of African American males who persist in computing suggest that the culture of computing may be a barrier to continuing in the field.

I propose that active non-learning is caused by multiple factors including self-beliefs, disidentification and cultural loyalties. These factors reinforce one another in encouraging motivation to not learn. While the effectiveness of changing self-beliefs has been demonstrated, I suggest that these methods are not working when other factors, such as disidentification and cultural loyalties, are also at play. I further suggest that this may be exacerbated in some learning environments that are tied to strong stereotypes and that are resistant to growth self-theory, such as the CS classroom.

Navigating Around Non-Learning

There has been demonstrated success in changing self-beliefs through work that indirectly teaches about learning and stereotypes. In Yeager and Walton's survey of effective interventions for changing self-belief, they point out that the interventions that were *stealthy*, i.e. not direct persuasive appeal or very brief interventions, were the most effective. I argue that these under-the-radar or low overhead strategies were effective because they did not conflict with individuals' *presentation of self*, as defined by Goffman (1956). This navigating around identity conflict would be better expanded and applied to the design of learning interventions if it was described as *face saving* strategy, which allows the non-learner to maintain his identity or loyalties while learning.

Conflicts in Changing Self-Beliefs

In an overview of social-psychological interventions in education, Yeager and Walton (2011) outline the rate at which interventions that target changing feelings and beliefs lead to lasting effects. They conclude that: "Social-psychological interventions hold significant promise for promoting broad and lasting change in education, but they are not silver bullets. They are powerful tools rooted in theory, but they are context dependent and reliant on the nature of the educational environment." (p. 268)

These interventions may not be easy to perform because a deeper understanding of the cultural values of the learner and the values inherent in the learning environment are important; we can not motivate learning when it is in conflict with an individual's values. Dweck's "hallmark of successful individuals" in the introduction to *Self-theories* provides an example of how these assumptions can be made when designing self-belief interventions. These hallmarks of success—a love of learning, seeking challenges, valuing effort and persisting in the face of obstacles—align with assumptions about middle class, white Americans' views of success. While many groups share some or all of these ideas of success, we must challenge the assumption that everyone does and that everyone should be encouraged to embrace these values. For example, motivation theory suggests that many groups do not value the concept of love of learning; it is not important in many cultures when meeting other needs such as nourishment, safety and shelter are a higher priority (Maslow, 1943; McClelland, 1985). Some groups may not value challenge seeking and believe that conformity in a relatively risk free life is of a higher value. As Markus and and Kitayama (1991) note, "In America, 'the squeaky wheel gets the grease.' In Japan, 'the nail that stands out gets pounded down.'" Furnham and Rajamanid's (1992) qualitative analysis suggests that work values have a strong relationship to gender and nationality. Finally, groups may not believe in persistence to change things and instead may believe that it is God's will that they must accept, and do so with grace and patience (Freire, 1975). It is not our purpose here to argue about which gauges of success are right or wrong. Rather, we simply seek to point out that moving students from a fixed self-theory to a growth self-theory frequently begins with a strong assumption about what is right or wrong. This assumption of shared values may be problematic for groups that do not have those same values—groups that are often disenfranchised from traditional education.

Cultural Values and Presentation of Self

These different cultural values, which are the strategies of action used by an individual based upon experiences, stories, rituals and world views he has been exposed to, shape how an individual acts and wishes to be seen in the world (Swidler, 1986). How an individual wishes to be seen, or presentation of self, can change in different circumstances. Presentation of self, as defined by Goffman (E. Goffman, 1956), examines human actions as fundamentally social in nature, ranging from conscious and intentional communication to the less conscious expressions we give off through things like gestures and clothing. For Goffman, the expressions we consciously "give" and the expressions we unconsciously "give off" can be in symmetry or asymmetry with each other, but culminate in a presentation of self. One aspect of the presentation of self is the concept of *face* or *face saving* in conflict situation. *Face* is the conscious façade that we present to our audience, the identity we try to protect in moments of embarrassment (E Goffman, 1955). Methods of face saving are strongly linked to an individual's cultural values (Ting-Toomey et al., 1993). Studies of face saving among adolescents have noted that country of origin and gender play a significant role in what areas students must save face in among their peers, family, and teachers (Juvonen, 2000).

Face Saving in Learning Environments

Examining learning environments for face saving can expose conflicts between learning goals and students' values. Using this sort of analysis, designers or educators can focus not only on the underlying reasons why students choose to learn or not learn, but also on the availability of justifications for them to participate in learning. Students use a variety of methods to give justifications for their good and bad performance. To examine the use of face-saving tactics, researchers have introduced hypothetical scenarios to subjects and obtained feedback on the acceptableness of responses according to themselves and different people in their lives. This method of presenting scenarios has been used in very realistic deception studies, as well as in interviews, focus groups and surveys (Bond & Lee, 1981; Juvonen, 2000; Ting-Toomey et al., 1993). These findings have demonstrated students' different uses of face saving tactics and their repercussions. For example, students who use the excuse of "bad luck" for their computer science course performance will more likely fail in computer science classes (Wilson and Shrock, 2001). For those who performed poorly, a lack of work or effort was frequently the excuse (Juvonen 2001). In similar work on self-handicapping, Urdan and Midgley found that students did not prepare for tests as a method to deflect attention away from performance (both good and bad performance).

In Kohl's (1994) writings on his experience as an educator, he observes that individuals choose not to learn because their presentation of self is threatened, and describes effective methods for navigating around these threats rather than trying to change individuals. Similarly, Yeagar and Walton's (2011) *stealthy* intervention could be interpreted as having low identity demand, thereby allowing the would-be-learner to maintain face while participating in learning. Tactics such as these allow students to choose learning without giving up their identity or cultural loyalties, becoming, in short, first-class citizens of their own culture rather than second-class citizens of the institution.

Moving Non-Learners to Learning

The ways in which non-learning occurs are complex and can be attributed to self-beliefs, disidentification and conflicting values. Historically, the field of computer science education has addressed groups that disidentify with computing by focusing on access to technology and computer science education. However, if non-learning is a factor for disidentification, access is only half of the story. Self-theory and cultural-values-based approaches have both been implemented through various interventions, including specific CS interventions, seeking to change students' beliefs about learning. The success of these approaches is inspiring but I seek to understand the limitations and difficulties in implementing them.

Computer science education has often focused on access to technology and education. A recent study of minority high school students in the Los Angeles Unified School District (LAUSD) focused not on motivation, but on access (Margolis, et al. 2008). African American and Hispanic students in this study *did* report interest in studying computing, but had difficulty gaining access to computer science classes. Margolis et al. argue that more minority students would be interested in computing if those students had access to relevant education. The schools argued, conversely, that their students were not interested in or prepared for CS classes, which is why they did not offer the classes. The issues raised about actively not learning suggest that both of these issues may need to be addressed. I am concerned with how to move students from non-learners to CS learners.

Another common thread of research in CS education has focused on motivating student interest through application context as a way to improve the retention of the students who do choose to study computer science. The content of these courses remains unchanged, but computing is explained and used in terms of an application area, a tactic which has had a positive impact on retention and student motivation. Media Computation is an approach to learning computing in which students manipulate and create digital media in their computer science classes (Guzdial, 2001). Students, especially female students, report increased motivation to succeed in these classes (Forte & Guzdial, 2004; Rich et al., 2004). Studies at four different institutions have reported improved retention through use of Media Computation (Simon et al., 2010; Sloan, R.H. & Troy, P. 2008; Tew et al., 2005). Similar results have been seen when robotics are used as a context for introductory computing (Summet et al., 2009). In these studies, the focus has been on providing an *interesting* context that plays to students' existing sense of identity, motivating them to pursue and succeed in computer science.

Kohl has spent his career working with students, teachers and administrators to develop curricula and learning environments that allow for multiple student identities. Seeking to understand students and teach to their values can be complicated and relies heavily on well-trained teachers who can astutely read and navigate the cultural loyalties of their students, and the way in which these loyalties may conflict with learning goals. Though this approach may be ideal, it relies on quality teacher training and administrative support, and has many opportunities for failure.

Kohl's work is based on analysis of his career as an educator working with students to navigate cultural loyalties. This study of navigating cultural loyalties is a rich space for systematic research that may provide generalizable approaches. Chapter 4 contains a description of a systematic study of face saving in the Glitch Game Testers, a learning intervention that was co-designed with the intended audience. This participatory design process, described in Chapter 3, allowed for cultural values to be central in the design of the Glitch learning intervention (DiSalvo et al. 2010).

CHAPTER 3

FORMATIVE AND DESIGN RESEARCH

Formative and *design research* was conducted to understand the context, culture and technology practices of young African American male gamers. Formative investigations contributed to Research Question 1: *How do African American males' play practices encourage or discourage computer science learning opportunities with digital games?* These studies provide evidence of the impact of cultural values on digital game play, uncovering the reasons why digital games have an affordance for learning for some groups while not providing those same affordances for other groups. Many of the formative research methods were drawn from the field of design. Within the design field, and for the purpose of this document, these methods are referred to as *design research*. Design research provided methods to elicit dialogue and thoughtful reflection from participants, and to better understand affordances in cultural values and technology practices. Findings from formative and design research methods contributed to answering Research Question 2: *What are the design principles to leverage technology for learning with those engaged in active non-learning?* These design research efforts informed the development of the set of design principles that were used in creating Glitch.

These studies were deployed from the fall of 2007 through the spring of 2009. This work consisted of mentoring at an afterschool program, observations, interviews, participatory design activities and prototypes. In this section I will review the methods used in the formative and design research activities, as well as the present findings, which directly impacted the design of the Glitch Game Testers.

Formative Methods: Location and Context

Formative and design research were contextualized by two different venues for engaging young men. First, research was done in the context of a local afterschool program, the Intel Computer Clubhouse. Second, two prototype game testing programs were run at Morehouse College and a local Boys and Girls Club. In this section I will describe these environments. Background on these environments is important to contextualize my participant/observer status, and because the prototype workshops provided information that was critical in making logistical choices for the Glitch Game Testers.

Computer Clubhouse Location

Fieldwork consisted of participant observations and design research studies at the Whitefoord Intel Computer Clubhouse. This afterschool program serves residents of the Whitefoord Elementary School District. Whitefoord Elementary School, where most of the Computer Clubhouse members went to elementary school, has 99% African American students, and 95% of the students are economically disadvantaged. This Computer Clubhouse, which is located on the block next to the elementary school, is part of an international network of afterschool programs that provides young people access to technology for creative expression. On the Clubhouse's website they describe their "Mission and Vision Statement":

> The Computer Clubhouse provides a creative and safe out-of-school learning environment where young people from underserved communities work with adult mentors to explore their own ideas, develop skills, and build confidence in themselves through the use of technology. (2011)

My role as a mentor was to interact with members one or two afternoons a week from 3:30–5:30 pm. Sometimes this mentorship consisted simply of being an audience, listening to the students' latest beats or watching their videos. At other times, I taught introductory programming with Scratch (Resnick et al., 2009) or software basics. The majority of my time was spent one-on-one with the various students, working with them on homework or creative projects that ranged from writing poetry to designing logos. As a mentor, I worked with male and female members, but because the director of Clubhouse understood and supported my research agenda, he arranged for me to work more frequently with male members. Most of the participatory design activities also took place at this location. I worked regularly as a mentor from October 2007 to May of 2008 and continued to drop by and lend a hand when needed for the next year.

Prototype Game Testing Workshops

Fieldwork was also conducted in two game testing programs that I developed to prototype the concept of game testing as a learning environment for computer science. In these venues I conducted interviews, surveys, design research, and observations. One of these programs was a three hour workshop to gauge interest in game testing among young African American men, and a second was an 8-week program that met once a week at a local Boys and Girls Club. All participants completed a survey to gather demographic information and general information about their gaming habits. To participate in these programs students were required to obtain parental consent and assent to be part of the research.

Prototype 1

The first of these programs was a three-hour afterschool workshop at Morehouse College[3], designed to determine if game testing was appealing to young African American males, and whether it would be more appropriate for middle school (11–14 year old) or high school (15–18 year old) participants. We ran the program first with middle school students and second with high school students. A high school teacher and afterschool program coordinators recruited the students, who self-selected into the program. Transportation was arranged for participants from their local school or afterschool program. While participants were waiting for the program to start they played *Madden 2008* (EASports, 2008a) on PlayStation 3. In the first half of the program they learned the basics of game testing and quality assurance. This consisted of several short exercises to give them an overview:

- Reviewing the types of testing that are done,
- Naming the types of bugs they might find,
- Watching a video of early versions of Electronic Arts Games with many bugs,
- Walking through the writing up of bug reports,
- Writing up bug reports while testing *Madden 2008*.

After the participants completed the quality assurance training, we conducted a computer science debugging exercise that consisted of a simple graphical user interface (GUI) with mislabeled buttons. The participants looked at the code for the GUI and debugged the program. In the two weeks after the program was completed I conducted

[3] Morehouse College is an all male African American institution of higher education, and has a history of educating young men who have become leaders in the civil rights movement, politics, business and the arts.

interviews with the participants at locations that were comfortable and convenient for them, such as local fast food restaurants and libraries.

Prototype 2

The second program was an 8-week afterschool program. The program was held in a computer science lab at Morehouse College for the first two sessions, then moved to a local Boys and Girls Club that housed a Computer Clubhouse. Afterschool activity leaders and our partners at Morehouse College recruited participants.

We met each Wednesday from 4:00 to 6:00 pm. The program was divided into two activities.

1. The primary activity was training and conducting quality assurance as early beta testers for the Massively Multiplayer Online (MMO) game Fusion Fall (Cartoon Network, 2009).
2. Approximately 30 min of each session was spent on computer science projects, teaching the basics of textual programming using the media computation (Guzdial, 2003) approach.

During the last session I conducted interviews the participants.

Participants

Observations were conducted with approximately 12 different participants at the Computer Clubhouse[4] and 17 participants at the two prototype workshops. Surveys were conducted with 17 participants at the prototype workshops. We were able to conduct follow-up interviews with 13 of them about their gaming practices. All participants were

[4] Computer Clubhouse is a drop-in afterschool center and the participants changed day-to-day. As part of our research protocol approval from the Georgia Tech Internal Review Board, we did not keep track of individual participants, so I can only estimate the number of different participants.

African American males living in Atlanta, Georgia, between 13–17 years of age. They attended schools that had a 99% African American student body and over 70% of students received free or reduced lunches.

Formative Methods: Data Collection

In these contexts observations, surveys and interviews were used to collect qualitative data to inform the design of a learning intervention. The objective of this data collection was to gain a better understanding of cultural values and technology practices with digital games.

Observations

Participant observations occurred at the Computer Clubhouse and in the two prototype workshops. There are difficulties in keeping detailed field notes when participating as a teacher or manager, as I often was. However, field notes were kept for any gaming sessions, and observations and reflections were recorded at the end of the day. Observations were not part of the formal analysis. However, they were valuable in informing my general impressions and prompting new questions or design iterations.

Surveys

Surveys were completed by all 17 of the participants in the prototype workshops. The survey asked students about their current interests, future goals and gaming habits. This survey was an opportunity for us to gather demographics and baseline information on their interests and goals to situate the richer interview data (see Appendix A).

Interviews

Within two weeks of the Prototype 1 workshops, interviews were conducted with 10 of the high school participants, and on the last day of the 8-week workshop interviews were conducted with the 3 participants who had continued with the program. The goal of these interviews was to understand the digital game play practices of the participants, to look for underlying patterns of technology use, and to identify opportunities to leverage game play practices into computational learning. I conducted interviews in environments in which participants would feel comfortable, including afterschool clubs, the local library, and fast food restaurants near their high schools. Interviews consisted of open-ended questions about gaming, computer use and the afterschool programs in which the students participated (Appendix B). The interview lengths ranged from 24 minutes to 52 minutes, with the average time being 40 minutes.

To analyze the interview data I created a codebook of 19 items to help organize the text (Table 3.1). The codes emerged in three ways.

1. Codes from themes found in previous studies; for example, cheating and sports had provided information about students' interaction with games in previous studies.
2. Codes for items that specifically addressed educational goals, such as technology and problem solving.
3. Other items that emerged from repetition in the transcripts; for example, the use of terms to describe creativity or anger.

Table 3.1

Codebook for Game Practices Study

Anger	Friends	Single player
Creativity	Level up/unlocking	Skillful gaming
Competition	Maturity	Social
Confidence	Modding/ cheating	Sports
Escaping from reality	Online	Talk
Experience	Other priorities	Technology/problem solving
Family		

Note: The 19 codes were developed from previous studies, educational goals, and emergent themes.

To further analyze the transcripts, a second pass of coding was conducted, organizing the text through the perspective of three themes:

- How students expressed their feelings about video games in their life and as a reflection of themselves.
- How the students expressed their experience with technology, computation and gaming.
- How students expressed their social experience with gaming.

Design Research Methods

A series of design research activities were conducted at the Computer Clubhouse and during the first prototype workshop. The *term design research* describes the approaches and tools for formative and iterative research derived from the field of design. Some methods I used were modeled after cultural probes (Gaver, Dunne, & Pacenti, 1999) that help the designer work with participants to articulate cultural practices and other values based around a shared creative object or activity. Other design research methods were developed from participatory and alternative design perspectives (Schuler & Namioka, 1993) to solicit speculation of new and authentic ways to address learning motivation and make the learning environment appealing. Data collected from these activities include observations and artifacts produced. These activities proved to be a valuable opportunity to center conversations around objects or tasks so that participants were able and eager to talk about games, learning, their community and computer science.

Cultural Probes

Gaver et al. (1999) describe cultural probes from the traditions of artist–designers rather than using science or engineering approaches. Cultural probes are different in that they do not focus on precise analyses or controlled studies, but focus rather on aesthetics, cultural implications of design, and methods for creating ideas and dialogues with participants that are outside of the set of tools with which a designer might normally approach a problem. In this section I will review two cultural probe type activities that we conducted with young African American middle and high school students (although there were more). These activities are the Canary Neighborhood Tour and Make-a-Game. The goal was to create an activity around which researchers and participants would feel comfortable talking and sharing. A second goal was to begin to see patterns in the lives and communities of participants, and to see if they approached the activities in ways I, as a researcher, did not anticipate.

<u>Canary Neighborhood Tour</u>

My first interaction with young African American men in Atlanta was with the Canary Neighborhood Tour. This activity began with showing five middle school students how to using the Canary environmental sensor (C. DiSalvo et al. 2008), and providing them with basic information on air quality. We asked them to lead us on a neighborhood tour. This tour included documentation, with photos, environmental readings, and field notes of their "favorite," "least favorite" and "most in need of change" locations. This process was designed to gain a better understanding of the community our participants lived in, how they viewed that community, and to build trust between researchers and participants.

Make-A-Game

In the Make-A-Game activity participants were led through the software development process as they conceptualized and visualized a game by making a CD cover for their idea game. Researchers asked them about their choices and talked about software development and marketing in relation to creating and selling video games. This activity was conducted with 6 participants at the Computer Clubhouse and 26 participants at the prototype game testing workshops.

Participatory Design

Participatory design methods are traditionally based in designing work systems by engaging the workers in the design (Nieusma 2004). Participatory design has also been used to shape aspects of curriculum and consumer products (Muller 2002). I used participatory design to design the work and learning environments, as well as to brand and create an identity for our project. Similar to cultural probes, some uses of participatory design allow participants to speculate about alternative approaches, and are used to inspire and build context for designers (Nieusma, 2004). Other uses of participatory design engage the final users as co-designers, in a more direct dialogue with the designers and the iteration process. In this section I will describe a more speculative design activity, Stay in School Media Literacy, and two co-design activities, Logo Design and Mad Lib Programming. The continual iterations of the project remain part of the ongoing dialogue with the game testers, and the participatory design of Glitch is an ongoing part of my research.

Stay in School Media Literacy

In the Stay in School Media Literacy activity, a variety of advertisements were shown to eight participants, who were then asked to identify why these advertisements helped sell products or ideas. Following this introduction, individual participants were asked to make an advertisement for staying in school. Through a group critique process, similar advertisements and ideas were placed together. Teams were then created from this grouping. Each time refined their advertisement into one idea, and pitched this idea to the whole club.

Participants were co-designers of the Glitch brand. In the Logo Design activity, four participants at the computer clubhouse were asked to create a logo for a game testing company. They initially brainstormed names, then hand-drew or used Photoshop to create initial logos. These initial designs were then recreated in Photoshop by a Georgia Tech undergraduate researcher, who then presented the new versions to the participants the next week. Over the course of two more meetings, the name, colors, font, and look and feel for Glitch was co-designed by the Georgia Tech undergrad and the participants.

Mad Lib Programming

The Mad Lib Programming activity was conducted with 15 participants, including students from both the Computer Clubhouse and the 8-week workshop. It was a paper and computer code activity that introduced participants to programming in Python. First, participants were asked to complete paper-based Mad Lib type questions (Price & Stern, 1974). Second, they were given instructions for changing the computer code to include their Mad Lib answers. Third, the participants ran the code, producing a Graphical User Interface (GUI) that incorporated titles and images from their Mad Lib. The resulting GUI resembled a website for a movie, with the participants' written answers as the title and names of the lead actors, and using their chosen images.

Formative Findings

This broad range of research activities did not happen in a linear fashion. Rather, the various stages frequently overlapped, informed each other, and created an iterative research process. The findings reflect this, in that most findings are reinforced by other qualitative data. In this section, I will review the findings from formative work and tie them to the design implications that shaped Glitch. While the findings may be repetitive, it is through repetition and nuanced information from multiple perspectives that we can have confidence in qualitative data.

Observations

The console game play preferences of the participants seemed to align with the systems designers' intentions; participants did not try to alter the game play in any way. We noted that participants chose to play together on the console systems even when other consoles were available. More surprising was their choice to often watch each other play *Fusion Fall*, rather than playing with each other from different desktops. Because the game is an online multiplayer game, participants had the option to play with their friends in the virtual world of *Fusion Fall* from their own desktop. However, the participants often chose to watch over another student's shoulder and talk, rather than sit across from each other and view the game from their own monitors.

We observed loud, humorous, and continuous talk during game play as participants commented on the way other players looked, progressed, and performed in the game, and frequently made connections between their online play and their real world appearance or athletic performance. This talk was ongoing and often was coupled with bragging. The students referred to this as "trash talk" and "smack talk." It was similar to the banter that one would find in friendly, casual, physical games.

All of the participants were acquainted with the game *Madden NFL*. They chose to compete in one-off games rather than developing a team. This may have been due to the single session of observation, but in our interviews, participants noted that pulling out memory cards when playing sports games is a common practice. Participants felt that it was "fairer" that way, as others could not cheat by developing a character's attributes. The talk was often about the real-life football players and teams represented in the game. Participants went to great lengths to talk about how it was just like "real" football, and rarely noted how the video game play was different than a physical game of football.

Fusion Fall was the first massive multiplayer game that the participants had played. They did not immediately understand how to "level up" or the more complex elements of the game economy. After the first session, however, they seemed to understand how the game was organized, and began advancing rapidly. They had little interest in exploring the rich world of Cartoon Network references and characters, and rarely mentioned the characters except during the startup, when short video clips were shown. They did know, and seemed to like, many of the cartoon characters. Their primary concern was with advancing faster than the other participants. When one participant had advanced much further than the others, due to extra time playing, the competitive nature of and interest in the game fell off.

Survey

In the survey, students provided demographic data, as well as information about their current interests, access to computers, future goals and gaming habits. The survey results supported the literature data in that sports games and first person shooters were generally the most popular with this group.

Interviews

The interviews highlighted a number of ways in which the participants' presentation of self was reflected in their game play practices. While students did not talk about awareness of gendered or racial identity, the emphasis on physical skill, competition, athleticism and sportsmanship, the movies and music they referenced, and the characters they chose to play in video games indicated that normative gender and racial identities were important in their self-presentations. Findings from the interviews focused on the way in which games fit into their lives, outlined how technology and computation impacted their experiences with digital games, and explored the role of socializing in gaming.

Performance of Multiple Selves through Gaming

In all 13 interviews, students expressed feelings of confidence and skillfulness with games. Some of them associated their game play with personal traits such as creativity.

As Darnel[5] explained, "I have the creative side, the challenge side, and I have the mature side, which gives me the advantage." It was apparent that being competitive against others and against the game itself was of value to the students. Jamal expressed this by bragging about his skillfulness compared to other players. "If a friend come over, and like say you just playing…I wan to put my friend inside [the game] and beat him." Most of the students talked about their competitive nature with pride. They felt that being competitive reflected well on them as a person who likes a challenge and is not afraid of difficult things. As Devan described, "I am a competitive person. I like to play against somebody …If I am playing against somebody, I am a competitive person…I like to win, so I like to play other folks then."

More than half of the students commented that games allowed them to express feelings or actions they couldn't express in real life, or pointed out the way in which games are different than reality. Some commented that playing games such as *Grand Theft Auto* allowed them to act out without any real world repercussions. Some enjoyed interacting with characters, such as football players, who they would never get to meet or play in real life. The common theme among participants was an escape from reality. As Antwan explained, "I like playing games because you can steal cars, shoot stuff, and blow stuff up. You can't do that in the real world. In games, it is nice you don't have any consequences."

In this same vein, a few students talked about the way in which games provided a way to express anger. Interestingly, none of the students reflected on shooter or fighting games as a way to virtually express anger. While they played these games, they always

[5] Participants' names have been changed to protect their identities. I selected names which convey something of the original religious, ancestral or ethic heritage of the participant, but which are not identifiable as the same person.

talked about them with a bit of humor, understanding that the absurdity of games like *Fight Night* and *Grand Theft Auto* was part of the fun of playing them. When talking about expressing real feelings—in this case, anger—Jamal referred to *Madden NFL*: "It's fun, and it's a way to get away from…. from stress in stuff. Like in Madden, you hit somebody real hard and it's like…ooh, I got him. Hit him just real."

Our interviews support earlier findings (DiSalvo et al., 2008) that young African American men treat virtual sports and real sports similarly. Sekayi expressed that games were an additional way to play sports: "I go outside, me and my brother, we play football. Then everybody is just playing football. And then, I just like, when I go into the house I get that urge and then I just want to play more football…so I just pop in a sports game." Darnel believed that real-world football knowledge helps one's game play in video football games: "You got to know how to play football, and you got to know everything about Madden in order to succeed."

Just as in sports, the students put a high value on gaming sportsmanship. The use of modifications, cheats, and strategy guides was rare in general, and limited almost exclusively to non-sports games. As Sekayi explained, concerning his use of cheats and modifications, "Yeah, in other games like adventure games, I use cheat codes like extra health, infinity health, all the moves...but most sports games I haven't seen any Easter eggs, or cheat codes."

Some students chose not to use cheats in any game. Xavier explained this choice as a reflection of his character and gaming skills: "I don't use cheat codes anymore. I found out that cheat codes are just really cheap. I mean I want to beat the game, and I don't want to be a cheater."

In sports games, the definition of cheating was extended; any sort of modification to the game was considered cheating. When we asked Charles about using cheats in his favorite game, *NBA Live*, he was embarrassed to admit to switching sides when playing alone if his team was far behind. Charles said, "The cheat, it says like options, then I go to that, and then you can switch sides. That is pretty much what I do." Sekayi commented that the standard for playing sports games was to remove all memory cards so that no player had more experienced characters.

Technology, Computation and Gaming

Most of the students played online games, and many had high-speed Internet access. We found that most did not use computers with Internet access, however, and rather had Internet access through their cable television provider to enable online play on console game systems like Xbox and PlayStation 2. Only three participants had access at home to a personal computer that had an Internet connection. One student had access to a networked computer at his grandmother's home, where he spent time frequently, and one participant had a computer with no Internet access. Even those three with computers and Internet access had limited access to the computers. As Charles explained, "My mom has the AOL, and she has to put the Internet cord into it. I only use the internet cord for Xbox."

We asked about technical problems and probed students about learning computing skills from gaming or setting up gaming systems. The students did not report any other personal experiences with technical issues or learning.

Social Experience with Games

Social play was important, not in connecting with strangers online, but with known associates in the room. Many students played games exclusively with family members. Students provided many examples of playing with male friends, brothers, male cousins, uncles, and fathers, but only one student mentioned playing with a female, his "auntie." Darnel expressed that games were a way to bridge age gaps with family members: "I got friends and family and stuff that play games and we have competitions…Even my dad still plays games. I play games with my dad, my older cousin, he is what, like twenty-five or something."

A few students commented on social pressure to play *Madden NFL*. They indicated that it was not a favorite game, but they played and practiced to keep up with their friends. Xavier mentioned that he had started playing *Madden NFL* after his friends had mastered it; "I play sports games, mostly *Madden*, because I have to, with friends."

Over half of the students said that they preferred to play alone at times. The deciding factor in playing alone was the type of game. Action and adventure games were solitary pursuits, while sports games were social. However, those that played action and adventure games online with other people still considered this playing "alone." As Antwan explained, "When you play on the computer [online] you don't get any good feedback. When you play with your friends [in the room], you get little smart comments from your friends and stuff."

Dion expressed similar discontent with online play; "I play differently than people around me [online]. I am a team player, I think everyone online, they leave people and don't make sure everyone gets their experience [points in the game]." Xavier was one of the few students who played online regularly. Even he had a number of reservations about playing online, because of unfair play and poor attitudes among other players. As Xavier mentioned, "Fighting games, sometimes I like to play by myself, because people online, they talk a lot of trash."

Design Research Process and Outcomes

In this section I will outline the findings from the cultural probes and the participatory design research activities. These research activities were often sparked by findings in the formative work that suggested further exploration. Through the process and outcomes of the design research I developed an open dialogue with participants. This dialogue resulted in a number of reflections on cultural values that encouraged incorporating legitimate work and pay as part of the learning environment, and helped us create an appealing brand for young African American males to identify with. In this section, I will review the process and outcomes from the design research and tie them to the design principles that shaped Glitch.

Cultural Probes

The use of cultural probes helped to establish trust and dialogue between the researchers and the participants. We found that participants rarely talked about race or gender, but the choices they made about how they presented themselves and what characters they identified with had strong connections to idealized African American masculinity and African American celebrities.

Canary Environmental Tour

During the Canary Environmental Tour, participants demonstrated pride in the their neighborhood but expressed dismay over the gentrification that was changing the neighborhood. A number of new homes were built recently in the neighborhood. These new homes had displaced apartments and homes previously occupied by their friends and families. In addition, they pointed out several homes that developers could not sell. These homes had broken windows, which the students understood to mean that people were doing drugs in the abandoned buildings. It frustrated them that the drug dealers and users now had better homes than they did.

The participants spent most of their tour time showing me the park and playground across the street from their school. It was a favorite hangout and they liked that all types of kids from the neighborhood would go there. While we were walking around, I noticed that the few white residents out walking their dogs or jogging would cross the street before sharing the sidewalk with the five teens and me. I am not sure of the motivation for crossing the street and it was difficult to determine if the participants noticed this behavior. Regardless, the experience made me aware that racially-motivated fear (Russell, K.K. & Russell-Brown, K. 1998) was a factor that could hamper a learning environment for young African American men, and we needed to mitigate this restriction as much as possible.

Make A Game Activity

Most participants reacted enthusiastically to the project and seemed to truly enjoy one-on-one time with the researchers, which they spent explaining their games and the reasons behind their choices. Some students were very hesitant to show their work to the group, even in friend groups, and played down the effort they had put in. Students commonly chose to develop current popular games with a culturally significant content, such as HBCU (Historically Black Colleges and Universities) Football based on the game play of Madden. Two of the more complex games were about following an athlete from middle school through the professional level (see Figure 3.1).

Figure 3.1.

Sample CD Covers for the Make-A-Game Activity

Figure 3.1. In the Make-A-Game Activitiy participants created CD jewel cases for their ideal game.

This exercise gave us an opportunity to recognize which games the students liked and what they hoped to see in the future. Most chose to populate their games with African American characters. In only a few cases were white or Asian characters used, and all of those were shooter games. Participants expressed interest in the development process, and were surprised that the construction of each game took so many steps and so many people. Participants tended to focus on one area of the project, such as the visual appeal of the game case, the narrative, a small change in the game play of a popular game, or the construction of a game that would have market appeal, particularly within the African American community.

Participatory Design

The participatory design activities directly influenced implications for what would motivate participants to engage in learning, the look and feel of the project, and the way in which we approached teaching computer science.

Media Literacy

This project culminated in a mockup of an advertisement that featured a dirty basement room with the tag line, "If you do not like to live in your mom's basement, DO YOUR HOMEWORK!!!!!!" (see Figure 3.2). In all of the advertising concepts, a focus on future economic independence was the primary concern. Other learning motivations such as creativity, learning for the sake of learning, and living up to family expectations were not mentioned in discussions.

Figure 3.2.

Final Advertisement for the Media Literacy Activity

Figure 3.2. In the Media Literacy activity, participants collaborated to make an advertisement to encourage kids to stay in school and do their homework.

<u>Logo Design</u>

The names and logos first suggested, such as Glitch and A.I.M., were directly related to testing work and had masculine overtones, (see Figure 3.3). The word "glitch" regularly came up when we described what bug reports were. The participants did not initially understand what we meant by a "bug." After a brief explanation, participants frequently responded with, "Oh, you mean glitches."

Figure 3.3.

Logo Ideas from Participants

Figure 3.3. Participants came up with a variety of ideas during the co-design process of creating a brand for a game testing program.

The participants liked the idea that they were making something real to be used in the game testing program. In some ways, the findings of this rather simple and obvious activity had a great deal of resonance, since I describe how the program got its name and look when new researchers come into the program. This brand is used in all of our collateral materials (see Figure 3.4) and the co-design of the brand established with the undergraduate researchers and staff that Glitch is designed *with* participants, not *for* them.

Figure 3.4.

The Glitch Handbook

Figure 3.4. The look and feel of all of our collateral materials was the outcome of co-design with participants.

Mad Lib Programming

For most participants the Mad Lib activity was the first time they had worked with a text-based programming language. I had anticipated that the participants might have personal interest in unique and funny Mad Lib GUIs. However, the participants remained serious about the activity, and used it as an opportunity to explore the programming language, rather than to play around with the GUI. They seemed fascinated that programming was this easy. They later talked about the ease they had with programming as an indication that it was something they had talent for. (see Figure 3.5)

Figure 3.5

Mad Lib Programming GUI

Figure 3.5. In the Mad Lib programming activity, participants filled out a mad lib sheet, then entered their answers into Python code, which produced a GUI that simulated a movie website.

Game Testing Pilot Workshops

The formative and design research we conducted presented us with a set of principles that had us reflect on authentic reasons to break open games without violating values of sportsmanship. These principles will be discussed in more depth in the discussion, but they did lead us to the final stages of the design research, which was the development of game testing pilot workshops. Game testing offers a way for these young men to compete with each other through bug finding, and also provides real job training in technology fields. It is work that is highly social and communicative, and it provides cultural capital with their family and peers as it impacts the development of real games.

Pilot Workshop 1

The middle school and high school student participants were excited to work on games and find out about a job in which they could be paid to play video games. However, the middle school students found it difficult to work on bug finding when they were engaged with a video game. While they still expressed positive sentiments about the idea of game testing, their excitement for the project was lower after the workshop. The high school students showed a greater ability to concentrate and focus on the work of learning to find bugs. They found the competitive nature of the regression testing exciting and performed past our expectations. For them the idea of being paid to work at a computer was also a reason that game testing was considered a "good" job.

Both groups found the programming challenge interesting and easy. The response of the high-school participants was enthusiastic. When asked what he learned, one high school student, Devon, responded:

> I learned that I might take interest in that career. You know because there are a lot of interesting things that came about during that time. With the language, I really want to learn how to read stuff like…[computer programs], to understand what it means not just letters and objects in a square, but to understand.

Even from a one-day workshop, multiple students began to make exactly the leap hoped for: seeing video games as computation, developing an interest in how they are constructed, and aspiring to learn about computing technology.

Pilot Workshop 2

The initial workshop supported the idea of a game testing program and helped identify high school students as the target audience. The second, longer program was initiated in autumn of 2008 with 15-year-old high school students. Initially, the workshops were held at Morehouse College. On the first night, 8 participants attended and were enthusiastic about the program. Participants were provided with access to an early beta release of Cartoon Networks' *Fusion Fall* game. We asked the participants to become familiar with *Fusion Fall* for the next week's testing work (see Figure 3.6).

Figure 3.6.

Participant Testing Cartoon Network's Game Fusion Fall

Figure 3.6. Participants tested an early beta version of Cartoon Network's MMORP game Fusion Fall one evening a week for eight weeks.

Over the course of the next few weeks, the numbers dropped to 4 students. The transportation to Morehouse was difficult for the participants and the community groups that had agreed to transport them were overcommitted and inconsistent. I moved the program to a nearby Boys and Girls Club where the four students could continue to attend regularly. In week six, one of the four participants was suspended from school, and the Boys and Girls Club policy would no longer allow him to attend any sessions in their facility.

I had hoped to train students to become game testers and to eventually develop them and the program into a sustainable quality assurance team, generating revenue that would help offset the cost of educational outreach. The attempt at a gradual start with 15-year-old participants who were not paid did not facilitate this growth and may have set a precedent by which the participants did not take their work seriously. Because of this, I sought to establish a more authentic program, where participants would be paid from the beginning. I also found that, with little feedback from Cartoon Network, the participants did not feel that their input contributed to the final game. This seemed to be critical to the students taking the *work* seriously and taking pride in the time and effort they put into testing. To emphasize that the participants' work was taken seriously, I needed to design ongoing, daily interactions, similar to a work environment. While the program was not successful in providing a comprehensive outreach to students, it provided vital information that shaped the training, curriculum, logistics, and incentive program for the final project, the Glitch Game Testers.

Principles for Design

These finding highlighted some of the design implications that resulted from asking Research Question 1: *How do African American males' play practices encourage or discourage computer science learning opportunities with digital games?* However, the studies went beyond applying what we learned about gaming technology practices. The design research also provided background on cultural values and learning that influenced the design principles that were used in the development of Glitch. These broader principles emerged from our work with young African American males, but they can be applied to developing designs for learning interventions that leverage technology for other groups.

- *Emulate successful practices* – Understanding how other groups leverage technology for learning, and why that results in effective learning, can inform designs to emulate these practices. For example, background work on CS majors' digital game play practices indicated that hacking, modifying and cheating at games were practices that encouraged players to look at the underlying computation of games by breaking them open and using them in ways not intended by the designers.
- *Respect culture* – Seek to understand cultural differences in play practices and prioritize cultural values. For example, workshops on hacking games might have been a more direct route to encourage young African American men to act like their white and Asian American peers who were leveraging digital game play practices into computing interest. However, the cultural value on sportsmanship that was carried over to digital games meant we needed to find a way to have

them legitimately look at the computation behind the digital games – to see games as something they had agency over.

- *Affordances in technology practices* – Find opportunities for learning interventions in students' current play practices. For example, the competitive nature demonstrated in our observations encouraged us to build competition into all aspects of the program
- *Affordances in cultural values* – Find opportunities to support learning through the cultural value of games. For example, the emphasis on finding a way to support oneself, to get out of poverty, encouraged us to look more closely at creating a work program that was less about education or fun, and more about serious work that would be respected by the family and friends of the participants.

The implications of these studies led us to develop the Glitch Game Tester project, which will be described in Chapter 4. The Glitch Game Testers, as a product of these principles, became the environment to study their influence on the non-learner and to help answer Research Question 2: *What are the design principles to leverage technology for learning with those engaged in active non-learning*?

Summary

This formative and design research took place over two years. It was not a linear study with one finding leading to the next exploration. Instead, it was an immersive experience that I had with youth in Atlanta. This involvement with the community, balanced by input from literature, collaborators, and mentors, helped define what the design principles were. Based upon those design principles, I began asking the questions that lead to the design of the Glitch Game Testers. Because of this, the formative and design findings shaped the design questions. For example, rather than asking, “How can I make young African American males interested in computing?” I began asking, “How can I make authentic work about computing accessible to young African American males?” The extensive formative and design work I conducted provided an understanding of cultural values that shaped these questions.

CHAPTER 4

GLITCH: DESIGN PRODUCT AND RESEARCH ENVIRONMENT

The Glitch Game Testers program that resulted from the formative and design research became the environment for further research, an arena we used to study the effectiveness of the design principles and to study learning motivation theory. In this section I will describe the Glitch Game Testers, tying design choices to design implications and the background research laid out in the previous chapters to support the development of a game testing work and education program. This will contextualize the studies within the Glitch Game Testing environment and provide background on the participants in Glitch from 2009 – 2010.

Game Testing Designed as Learning Environment

Glitch was developed through formative work that documented that the heavy use of video games by young African American males failed to correlate with the accepted notion that "hardcore" video game players often become interested computer science. Early work explored the way in which young African American men tended to play games differently from the young men who turned their gaming into an interest in computer science (DiSalvo & Bruckman, 2009). I found that young African American men tended to play games similarly to the way in which they played sports, accepting rules as unchangeable and valuing sportsmanship and competition. Computer science majors told us about their interest in hacking and modifying game mechanics, writing strategy guides, and being a part of small game communities. It seemed that these practices, rather than the actual game play, encouraged players' agency with the technology and allowed them to see computers as tools and as a possible career interest area. In contrast, young African American men perceived hacking, modifying games, or using strategy guides as a sign of weakness in one's skills, and possibly of weakness as a person (DiSalvo & Bruckman, 2010). This finding challenged me to ascertain a way to allow these young men to gain agency with the technology without violating their values.

Game testing was an obvious choice for allowing the participants to look inside digital games, to see games as computation over which they could have agency. Additionally, game testing provided a number of opportunities to meet the design requirements discovered in our formative design work. For example, we found that young African American males tend to place a strong value on being paid for their work and making an impact on real world products. They valued effort towards these practical applications rather than learning or creating for general self-improvement or curiosity. Because game testing is a legitimate job, one that the testers felt was impressive to their friends and family, we compensated them for their time and created a real world work environment rather than a learning environment, which gave them only what they felt was fake work.

The Context of Glitch

The high school participants in Glitch worked full-time in the summer and part-time in the school year as game testers, doing quality assurance work on pre-release digital games for industry clients. These testers also participated in computer science workshops and classes that were contextualized using digital media and other interests of the testers. Other elements were part Glitch, included gaining experience working on a college campus and a competitive point system. Glitch Game Testers launched in the summer of 2009 (DiSalvo et al., 2010) and ran through the summer of 2011. Due to changes in the program in 2011, when the Georgia Tech College of Computing took over management of the program, I have chosen to include only data from 2009 – 2010.

Schedule and Pay

During the summer, the testers worked from 10:00 AM to 5:00 PM, Monday – Friday for 8 weeks. During the school year testers worked from 9:00 AM to 5:00 PM on most Saturdays. During our first summer, 2009, we paid the testers a $500 stipend every two weeks for their work. When we moved to the fall schedule, participants would occasionally miss Saturdays due to other school-related commitments. To make payment more equitable, the pay schedule was changed to an hourly rate of $8.00. A typical summer day consisted of testing from 10:00 AM to noon, lunch, a CS workshop after lunch, and then more testing until 5:00 PM. The weekly activities varied, but the majority of the time was spent on testing or tasks related to testing (see Figure 4.1).

Figure 4.1

Sample of Weekly Activities in Glitch

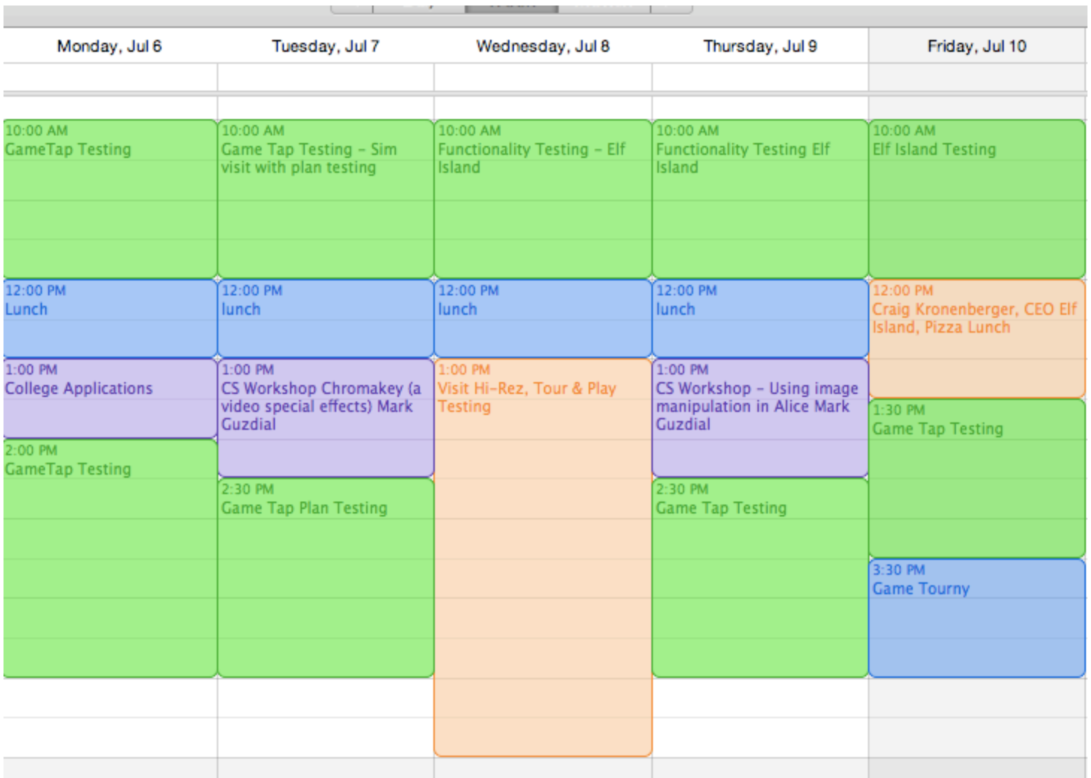


Figure 4.1. In this weekly schedule from 2009, the green indicates game testing, blue indicates free time or fun activities, purple indicates learning activities, and orange indicates tours and visitors.

On Monday mornings there would frequently be quality assurance training and review, where we would look at new concepts or review bug reports and look at what was being done correctly or incorrectly. On Fridays there were pizza lunches with computer scientist speakers, and we held a game tournament late Friday afternoon. There were other activities, such as tours of colleges or game companies and visitors from the game companies, who would conduct specific training or help with technical issues.

Recruitment and Consent

Participants were recruited to become part of the Glitch program through an email flyer with a one-page application, which we sent to local youth leaders, teachers and community members in predominantly African American communities and schools. Of the approximately 200 applications received in the first two weeks after the email was sent, we selected 15 - 18 students to interview each summer, and 5 to interview for fall of 2009. Selections were made based upon the date the application was received. To qualify for an interview, applicants were required to be between 16 and 18 years of age and still in high school.

In all cases, the first 20 applicants that met these criteria were African American males. For the summer of 2009 program, 15 applicants that met the criteria were invited to interview at Georgia Tech. All agreed to interview, but only 14 showed up for the interview. After the interview, participants were selected based upon punctuality and passion for and experience with playing video games. To make the final selection, priority was given to those who qualified for free or reduced lunch and were rising juniors. Thirteen were selected to participate. One dropped out just before the program began because of other obligations. In the fall of 2009, only 3 of 5 invited applicants agreed an interview, and all three were invited to participate. For the 2010 summer program, the first 18 applicants were invited to interview. Of these 18 applicants, 15 agreed to be interviewed, 14 attended the interview, and 10 were accepted. This requirement to attend the interview helped us determine which applicants would be able to get to and from Georgia Tech for a full-time job.

All data for this study was collected between June 1, 2009 and July 23, 2010 with 25 participants. All participants and their parents were informed of the human subject protocol, and assent from minor participants and consent from adults and adult guardians was obtained and annually reviewed and renewed.

Participants

From the beginning of the Glitch program in June of 2009 to the end of the school year program in May of 2011, we had 25 total participants. Of the 12 participants who started in 2009, all but 2 participants chose to return that fall or the following summer. We brought on an additional 3 participants in the fall of 2009 and 10 new participants in the summer of 2010. In the fall of 2010 our numbers dropped to 14 due to graduating seniors leaving the program, 3 leaving for the school year, and 1 participant who was asked to leave the program due to poor attendance (see Table 4.1).

Table 4.1

Glitch Program Activities from 2009 to 2011

Phase	Name	Description	Participants
IV	Glitch Game Testers: Summer 2009	8 week, full-time job for High school students, testing games for clients and attending CS workshops.	12
V	Glitch: School 2009-2010	Continuing game testing and CS workshops on Saturdays.	9 returning 3 new
VI	Glitch: Summer 2010	2nd summer, 8-week, QA testing, CS workshops and new Advanced Placement Computer Science class.	13 returning 10 new
VII	Glitch: School 2010-2011	Continuing with students most Saturdays and APCS classes.	14 returning
Note: There were 25 unique participants in Glitch.			

All participants were surveyed about demographic information including their race and ethnic identification, age, and eligibility for free or reduced lunch at school. We also conducted a survey about their households and family educational history. Finally, we asked each of the students the name of their school so that we could better understand their options for future CS classes.

Demographics

All participants self-identified as African American males, and two also self-identified as Latino. The participants ranged in age from 15 – 18 years of age, with an average age of 17. Of the 25 participants, 19 qualified for free or reduced lunch.

Family

Of the 24 participants who answered questions about their families, 7 lived in households with both a mother and father present, 14 lived with one parent (12 with their mothers and 2 with their fathers) and, 3 had neither a mother nor a father present. The household conditions for these 24 participants, when contrasted to the conditions for most American children between the ages of 12 and 17, showed a greater percentage of Glitch participants living in single parent homes or homes with neither parent present (U.S. Census Bureau 2011).. Most participants had family members who had attended some college. Two had one immediate family member with a PhD, while one had no family members who had completed high school.

Schools

We analyzed the course offerings of the high schools the Glitch Games Testers attended in order to understand what educational options are available to them. To perform this analysis, we looked at Georgia's Computer Science Career Pathway, a four-course sequence that fosters computational agency, the idea that students are co-creators of computational tools rather than simply users of pre-made tools. Table 4.2 shows that even though students were interested in taking more and more advanced computing, the courses simply were not available in their schools (Mcklin, Engelman, DiSalvo, & Bruckman, 2010).

Table 4.2.

Course Offerings in Schools with Glitch Participants

Course	Number of Schools Offering
Computing in the Modern World	5 of 8
Beginning Programming	1 of 8
Intermediate Programming	0 of 8
Advanced Placement Computer Science	0 of 8

Location

Testing occurred in the Glitch Lab on the third floor of the College of Computing Building (CCB). This floor of the CCB was abandoned in 2009, when we first started using it. With the help of the College of Computing staff and undergraduate researchers we moved furniture, cleaned and renovated one room. We also swept the halls, cleaned the bathrooms, and replaced ceiling tiles, so that while all the other rooms on the floor were in disrepair, the testers only encountered clean, professional-looking spaces.

Transportation

The prototype workshops demonstrated that transportation was an important issue and that holding the program on the Morehouse campus, which was the original intent, would not work because of limited public transportation. Instead, the program was held on the Georgia Tech campus, and an expectation was set, as it would be in any other job, that testers were responsible for their own transportation and would not be paid if they didn't show up. Most testers took public transportation to work at Glitch, while a few commuted with family members on weekdays and got rides on the weekends. One participant rode his motorcycle and on occasion others would drive.

Game Testing

Formative work demonstrated that computer scientists' early play practices of hacking, modifying and cheating with digital games had seeded their interest in computing. In contrast the young African American males we talked with emphasized a strong scense of sportsmanship, which seemed to limit their hacking, modifying and cheating of games. I sought a way to emulate the practices with games that seeded an interest in computing while respecting culture African American males. Game testing became a line of inquiry because it seemed both to satisfy the practice of breaking open the games and respect the culture of sportsmanship.

Game testing is a form of software quality assurance (QA) work. To insure that the program was authentic, I participated in a weeklong QA training at Electric Arts Tiburon, and used their protocol and training materials as the basis of an industry-standard game testing program. In Glitch, testers would receive early versions of games from our clients, then look for instances where the code broke down and did not perform as expected. These errors can be significant in that they cause the whole system to crash, or they can be very small, such as when a button does not respond as expected or a word is spelled incorrectly. There are a number of types of testing including planned testing, which is systematic testing of specific functionalities; play testing, in which a tester reports on the balance and playability of the game; and regression testing, in which a tester checks previously-reported bugs to see if they have been fixed correctly. When an error in the code is found, testers write up a bug report using online bug tracking software. This report includes a detailed step-by-step description of how to reproduce the bug. Developers then look at these reports and respond to them by fixing the bug or asking questions about the bug report.

Computer Science Learning

While breaking open the games was one method for increasing an interest in CS, on most days dedicated time was set aside for learning about computers and computer science. The reason for including a directed CS component was to increase the opportunities for learning. This was designed into the program, because I anticipated these young men would start to look at games differently and this would possibly seed an interest in learning CS. However, without access to learning CS, it was unlikely that seed would sprout.

The introductory CS workshops were built upon existing curriculum and there was evidence supporting using this curriculum could be successful in teaching non-CS majors basic computing concepts. The development of the CS learning components is ongoing and has been a secondary study of the Glitch program. During their first year in Glitch, participants took part in CS workshops based on the media computation approach (Guzdial, 2003) using Alice, a drag and drop programming language (Cooper, Dann, & Pausch, 2000), and Jython. Initially I had no plan for CS workshops for the participants' second year in the program. However, because of the participants' requests, we offered a chance to take an Advanced Placement Computer Science (APCS) course to prepare them for the Advanced Placement exam. All of the participants voluntarily chose to take this class rather than taking the workshop again or working for that hour each day. Finally, both first- and second-year students built computers.

<u>First Year Workshops</u>

While a study of the CS curriculum has not been a primary component of this work, there have been reflections and iterative design work on the curriculum for the first year workshops. In 2009 these workshops were taught by Dr. Kenneth Perry, Chair of the Computer Science Department at Morehouse College, and Dr. Mark Guzdial, Professor in the College of Computing at Georgia Tech. In the second year, African American male undergraduate CS majors from Morehouse college taught the curriculum that Dr. Perry and Dr. Guzdial developed.

The approach we took for the curriculum drew from media computation, as developed by Dr. Guzdial (Forte & Guzdial, 2004), in that we tried to create projects that used media the participants were knowledgeable about and interested in. In the first four weeks, Alice programming activities were used to introduce fundamental concepts of software design and programming. These workshops used project-based activities that emphasized the software development process. In the last four weeks, Python (specifically, Jython with media extensions) was used to introduce textual programming in the context of media manipulation. These Jython programming activities allowed students to integrate media they created in Jython into their Alice projects.

At the end of the first 8-week summer program in 2009, participants were asked to complete a questionnaire to collect self-reported data on their learning experiences over the course of the program. The questionnaire contained 25 items asking students to rate their level of agreement or disagreement with their ability to perform actions specific to their learning. Students rated their agreement or disagreement along a 4-pt scale ranging from strongly disagree to strongly agree with no midpoint. They did, however, have the option to rate the item as not applicable. Of the 12 participants in the program, 11 were present to take the questionnaire. The qualitative data from our post interviews, which is described later in this chapter, was included in analysis of participant responses.

Building Computers and Other Activities

During the school year Glitch met only on Saturdays. Attendance during the school year was not consistent due to conflicts with participants' school and extra-curricular activities. This inconsistency, and the long break during the week, made it difficult to follow a longer-term CS programming curriculum. In response, undergraduate researchers developed computer building and one-day activities to teach CS and to help prepare participants for work and college. These one-day included workshops on web development and graphic design, job applications and resume writing, and choosing and applying to college. The majority of these Saturday sessions were spent building computers for the Glitch program. Building these computers allowed the incorporation of learning about computer hardware (participants determined the specification needed for the computers, found the parts that would meet these specifications and built the computers from scratch) and authentic work (high-performance computers were required in order to run the games). The program was started using surplus machines from Georgia Tech and Morehouse, and these machines were not powerful enough to run the games being tested. Second, one of the computers was the final prize in an ongoing *Glitch Points* competition for the outstanding tester and CS student. The *Glitch Points* will be explained in more detail in the Competition section.

Advanced Placement Computer Science Class

During the school year, the cohort of participants who had completed the first summer asked to be taught Java programming because it was a programming language that real developers used. We asked if they were interested in learning Java and preparing for the Advanced Placement Computer Science test, which would be given in May of the next year. They all expressed an interest. Based upon the work of Guzdial and Erickson (2005), undergraduate researchers developed a course to help participants prepare for the Advanced Placement Computer Science test. This was the most formal class structure we had in Glitch. The undergraduates who taught these classes were all African American males and taught the class using examples and project topics they felt would correspond with participants' interest. For example, they used basketball players, teams, and positions to teach about object-oriented programming.

Competition

Formative work indicated that competition was important to young African American males when gaming, and in their everyday lives. Because of this, I designed competitive elements into the Glitch program. During workshops and classes, mentors and teachers used competition and rewards to motivate the participants. The types of rewards and prizes varied. Sometimes participants were awarded candy as a prize, or rewarded intangibles, such as being voted as having the "best" presentation, or with points in the overall Glitch Points Competition.

Glitch Points were awarded during all aspects of the program. In the CS workshops a participant might earn 10 points by producing what his peers considered the best program or 1 point for asking or answering a question. The points were also accumulated through game testing. For example, 1 point was awarded for each unique bug and a predetermined number of points were awarded for creating, managing or participating in a functionality test depending on the difficulty. On occasion points were awarded if a participant helped out with other tasks, such as unpacking equipment or running errands on campus.

An ongoing tally of the points was posted on a white board in the room, and keeping track of points became a very important part of each day for the participants. When updates were made to the point board, everyone stopped what they were doing and started bragging, making excuses or trash talking each other based upon the outcome. The points were added up each week to determine a winner. In the summer the weekly winner received a video game or a gift certificate. At the end of the summer and the school year, the winner won a computer built by the participants.

The point system was designed into the program based upon our formative work that showed competition was an important part of gaming for young African American males. This observation and designing for it became a critical piece for motivating work and learning in Glitch and will be addressed in more depth in Chapter 7.

CHAPTER 5

METHODS: EVALUATION AND FACE SAVING STUDIES

Data collection and analysis was done with assistance from the Findings Group Ltd., an independent educational evaluation group, hired to conduct an evaluation of the program as a requirement of the National Science Foundation grant that funded Glitch. There were two objectives in designing and developing methods. First, we sought to conduct assessment on confidence and interest in computing to evaluate if the program was successful in increasing the likelihood of participation in computing. Second, after observing success in the program, I sought to understand why Glitch was successful in motivating young African American males to learn computing. Further details will be given on the surveys used to assess learning and interest and on the qualitative methods used to analyze Glitch, which included observations, interviews and focus groups.

Surveys

Online surveys were used to meet several needs. First, with the assistance of the Findings Group, Inc.[6], two surveys were administered. These included an existing survey on interest in computing and a modified survey to gauge intent to persist in education and computing. Second, the undergraduate researchers who taught our CS workshops used surveys on self-reported learning to monitor the effectiveness of workshop and to modify them according to the results. Third, I developed a survey to measure face saving tactics used by Glitch participants. In this section I will explain each of these tools. The surveys

[6] The Findings Group, Ltd. is the independent firm hired to evaluate the work done with funds from NSF.

were used primarily for evaluation and to help us understand the effectiveness of Glitch. The face saving surveys assisted in answering how, not if, Glitch was effective.

Interest in Computing

We used a survey instrument developed by Yardi (2008) to measure participants' interest in computing. This survey was based upon two validated instruments that measure computer attitudes, self-efficacy, and outcome expectancy. Additional questions were included in the survey to measure career interest, Internet self-efficacy and outcome expectancy. The first of the two validated surveys used was the Computer Attitude Questionnaire (CAQ), which was designed to measure attitudes and disposition towards computers and was shown to have "very good" internal consistency [Christensen and Knezek 2000, 2001]. This version of the CAQ used three of the eight possible subscales: Computer Importance, Computer Enjoyment, and Creative Tendencies (Cronbach's Alpha r = 0.80, 0.80, 0.87, respectively). The second validated instrument we used was the Microcomputer Beliefs Inventory (MBI), which assessed the participants' self-efficacy and outcome expectancy beliefs toward computers (Enochs & Ellis 1993; Riggs & Enochs, 1993). Item analysis, scale reliability assessment, and factor analysis of scale integrity were previously conducted and both scales performed with "good" reliability (Cronbach's Alpha r = 0.80, 0.85, respectively) (Riggs and Enochs, 1993). The surveys used a 5-point scale (where 1=Strongly Disagree, 3 = Not Sure, 5 = Strongly Agree). In the first year, 2009, we administered this survey as a pre (N = 12) and post (N = 12) measure at the beginning and end of the 8-week summer program. For some questions, participants' post surveys reported lower self-efficacy. We suspected that students were overconfident about their computing abilities pre-Glitch, and after participating in the 8-

week program discovered the breadth and depth of computing knowledge that was available, and gave more conservative estimates of their confidence and knowledge. In response to this, we modified the survey in 2010 and delivered it as a retrospective survey to participants (N = 21), which allowed us to ask the participants to evaluate how they changed in their attitudes, self-efficacy and outcome expectancy (Appendix C).

Intent to Persist

The intent to persist survey was based upon validated measures developed by Toker and Ackerman (2011) to assess vocational interest in STEM fields. Participants were asked to rate the truth of statements regarding intention to persist with education, STEM interest, and interest in computing on a 6 point scale, with 1 being Very Untrue of Me and 6 being Very True of Me (N = 22). This survey included 12 items based on Wyer's (2003) framework of short-term, mid-level, and long-term commitments. We modified the survey slightly to include 6 additional questions that followed the same framework, but which were specific to computer science (Appendix D). In 2009 the survey was given as a pre and post measure. In 2010, we gave the survey only at the end of the 8-week summer program and added retrospective questions to gauge more exact reflections on changes in participants' intent to persist in education, technology and computing.

Self-Reported CS Learning

Participants were asked to rate their agreement or disagreement with statements reflecting their level of knowledge of topics related to the Alice programming environment (N = 6) and the Advanced Placement Computer Science (AP CS) course (N = 14). The ratings consisted of a 4-point scale, with 1 being Strongly Disagree and 4

Strongly Agree. The Alice programming questions were administered the week after the lesson that corresponded with those questions so that the undergraduates teaching the workshops could monitor and modify the lessons based upon the students' self-reporting of their learning. Because this was the first set of lessons on AP CS, measures were not developed before the summer, and the self-reporting survey was used as an evaluation tool at the end of the summer.

Face Saving Surveys

Every other week between June 1, 2010 and July 23, 2010, participants were asked to complete four surveys that asked about hypothetical justifications they might use for: participation in computer science activities, working on a college campus, game testing, and working full-time (N=23, response rate of 92.39%). These surveys were developed from similar hypothetical survey and interview questions used to measure face saving (Bond & Lee, 1981; Juvonen, 2000). For example the participants were asked how different individuals in their life would respond to justifications for putting extra time in on their computer science projects (see Figure 5.1).

Figure 5.1

Sample Question from Face Saving Survey

When people ask you, "Why are you working so hard on your Glitch computer science project?" You tell them, "Because, I want to get extra points for the weekly competition." What would the following people think of that answer:

	Good Reason 1	2	3	4	**Bad Reason** 5	**Doesn't apply to me** 6
Your mother	❒	❒	❒	❒	❒	❒
Your father	❒	❒	❒	❒	❒	❒
Your grandmother	❒	❒	❒	❒	❒	❒
Your grandfather	❒	❒	❒	❒	❒	❒
Your favorite aunt	❒	❒	❒	❒	❒	❒
Your favorite uncle	❒	❒	❒	❒	❒	❒
Your sister	❒	❒	❒	❒	❒	❒
Your brother	❒	❒	❒	❒	❒	❒
Your best male friend	❒	❒	❒	❒	❒	❒
Your best female friend	❒	❒	❒	❒	❒	❒
Other friends	❒	❒	❒	❒	❒	❒
Popular kids at school	❒	❒	❒	❒	❒	❒
A "geeky" friend	❒	❒	❒	❒	❒	❒
A co-worker	❒	❒	❒	❒	❒	❒
A favorite teacher	❒	❒	❒	❒	❒	❒
A coach or activity leader	❒	❒	❒	❒	❒	❒

Figure 5.1. Questions in the face saving surveys asked participants to rate how 16 people in their lives would respond to hypothetical justifications for different aspects of Glitch.

Participants gave us their perceptions of what 16 people in their life would think are good or bad justifications. The people on the survey included the participant’s mother, father, grandmother, grandfather, favorite aunt, favorite uncle, sister(s), brother(s), best male friend, best female friend, other friends, popular kids at school, geeky friend, co-worker, favorite teacher, and coach or activity leader. The responses were used to gauge what the participants perceived would be a desired presentation of self in front of these people. The average appropriateness of the justification was rated on a semantic differential scale, with 1 being perceived as a good reason and 5 being perceived a bad reason, with an option that the question doesn't apply (i.e. this person is not present in their life). We used the surveys to understand what variations might exist in terms of what participants perceived as an appropriate presentation of self in front of different people in their lives.

Interviews

As part of the larger analysis of Glitch, the researchers conducted interviews with Glitch participants. The interviews were conducted as pre-, mid-, and post-interviews with participants (Appendix E). Twelve participants from cohort one (Summer 2009), and thirteen participants from cohort two (Summer 2010) were interviewed. Pre-interviews were conducted during the first week of the 8-week summer program, mid and post interviews were conducted in the last week of the summer program. Mid-interviews were with participants who would be returning in the fall and post-interviews were conducted with participants who would be leaving the program at the end of the summer. These were conducted during the last week of their second summer program. At all three points in time (pre, mid, and post), the participants were asked to describe their interest and experience in computing, their plans for taking more computing courses in high school, examples of computing tasks that they helped others with and on which they sought help, computing tasks they would like to know how to do, their thoughts on working for a gaming company, and future education and career plans. During the mid and post interviews, participants were also asked to describe their role within Glitch, whether they felt their work made a difference to the game, and what they were most proud of during the summer program.

Tom Mcklin of the Finding Group and I conducted these audio-recorded interviews. The recordings were transcribed by a third person not involved in facilitating the interviews. A fourth researcher (also from the Findings Group) coded the transcripts for themes that were developed to evaluate Glitch (see Appendix F). In a separate analysis, the transcripts were analyzed for occurrences or explanations of face saving tactics in justification of Glitch. These were coded using the face saving codebook (see Table 5.1)

Face Saving Focus Groups

For each face saving survey, four different participants were selected to be part of a focus group. I led these focus groups. Because I had a daily working relationship with the participants and frequently mentored them regarding work, school and future plans, the participants were comfortable in discussions with me. In the focus groups we first reviewed the survey question, and then I asked for more open-ended responses to the way they presented their participation in Glitch to people in their lives. The groups were selected to balance new and returning participants; each groups consisted of two participants who had a year of seniority in the program and two participants who started in June of 2010. Beyond this condition, groups were randomly selected and assigned to a focus group without regard to the topic.

Focus groups met 1 – 3 hours after participants completed the survey and asked open-ended questions about what responses the participants would most likely give to different people in their lives. The researcher used the surveys as a topic starter and asked why one response would be more acceptable than another. Focus groups were audio-recorded and took between 29 and 41 minutes. The focus group leader then transcribed the audio recordings, imported the transcribed documents into a qualitative analysis software program, and coded for recurring themes. The coding took place in four steps. First, two researchers independently reviewed all of the transcripts and identified codes, looking for patterns and themes that were both anticipated and emergent. Second, the researchers compared independently-derived themes, discussed each theme, and agreed upon a final set of themes and patterns for the codebook (see Table 5.1).

Table 5.1

Codebook for Face Saving Study

Gaining experience	Competition	Authentic contribution or work	Personal interest	Engaging w/ teasing & bragging	Conversations to avoid
Day-to day work practices	Winning prizes	Earning money	Games	Working on "real" games	Computer Science
Growing up/ becoming a man	Being the best	Video games	Film & animation	Being "paid to play"	Learning
Learning CS		Work is valued		Working at Georgia Tech	
Life at college				Blasé or negative to appear more mature	
Note: Some focus group themes were anticipated while others were unexpected.					

In the third pass of coding, the two researchers independently coded all transcripts for themes and patterns and coded as *Adult* or *Peer*, depending on the intended audience of the justification. The fourth step brought the researchers together again to review each code of the transcript. When disagreements in coding had occurred, we reviewed the text, discussed the coding, and agreed upon the most appropriate codes.

In this study, the use of focus groups had both advantages and disadvantages. For example, individuals' answers may have been constructed to fit group consensus, and therefore unique perspectives may not have been expressed. However, group consensus may be more reflective of face saving tactics because face saving tactics are based upon the expectations of social groups. To mediate the weakness of group consensus, we conducted multiple sessions with different participants to eliminate anomalies of one particular session or group.

Observations

Formal observations were collected over the course of approximately 800 hours. Two researchers made daily notes on a two-column form: observations and reflections. In addition, researchers conducted weekly interviews with two to three of the other research team members who were assigned to managing the day-to-day quality assurance operations and to teaching the CS workshops and classes. We found that while these team members did not have time to note observations during the week, the weekly interview provided an opportunity to reflect upon the program and participants in great detail. These interviews were audio-recorded and transcribed. The observation forms and team interviews were then captured as short scenarios (usually 500 characters or less) that were organized by a team of four researchers who participated in the daily activities around Glitch. The scenarios were assigned to four categories, according to group consensus, which were then used in organizing the face saving survey questions: computer science, full-time work, experience on a college campus, and work in the game industry. Some scenarios were assigned to multiple categories.

Follow Up with Graduates

Of the 25 participants, 16 have graduated from high school. The remaining 9 are on track to graduate on time. Through the use of social networks, email follow ups and conversations with parents, I have followed up with all of the participants regarding their school and career choices in the year after graduating from high school. Participants reported whether they were attending school, working, or in the military, and then provided details on their choices, such as the school and major or the specialized military program in which they are involved, and their college plans after their service. When available, we have reported whether participants have made changes in the first year after graduation; for example, one student did not attend his first choice college due to financial issues and was unemployed and out of school during the fall. In the spring semester, he started attending a vocational school for computer programming, and in the summer he entered the Army in the hopes that this would help him pay for college. This participant is reported as pursuing further education and training in the military.

CHAPTER 6

FINDINGS ON COMPUTING AND FACE SAVING

The findings presented in this chapter are derived from surveys, focus groups, interview data and observation. Surveys and interviews on interest in computing, confidence with computing, and intent to persist with computing education or careers has been organized by immediate, short-term and long-term impact, along with details on the post-secondary education outcomes. This organization provides a linear perspective on the connection that participants made with computing through Glitch. I then provide a more detailed analysis of the first year of CS workshops, which supported our formative findings that participants' valued learning about authentic work, and initiated further studies into learning motivation. These additional studies explored ways of navigating motivations to not-learn using face saving tactics, and included surveys and focus groups. When applicable I have incorporated data from interviews and observations to help illuminate issues of face saving in Glitch.

Interest, Confidence and Intent with Computing

Overall surveys, interviews, and post-secondary educational choices indicate an increased interest in and confidence with computing, and an intent to persist in CS. These findings were observed in three stages: first, in the immediate time frame (during the Glitch program); second, in participants' short-term plans for high school course selection; and third, in their long-term intentions to engage in computer science education and computing careers. Immediate intentions were demonstrated in increased confidence with computing skills and self-reporting on CS learning in the first year workshop. This self–reporting also yielded data on what types of CS approaches would be most appealing for this group. Short-term intentions were demonstrated by participants' plans to take computer science classes in high school, as well as intentions to take the APCS exam. Long-term intent was indicated in pre and post reflections on higher education in general and on computer science education more specifically. Finally, the most compelling evidence of interest in computing, confidence with computing, and intent to persist in computing comes from the participants' educational choices after high school.

Immediate Impact: Interest and Confidence in Computing

Increased interest and confidence in computing was demonstrated in pre and post surveys and in interviews. Regarding different levels of confidence and interest in specific programming languages, studies completed at the end of the first year included self-evaluations that demonstrated confidence with both drag-and-drop and text-based programming. In interviews, participants indicated that they have a preference for learning with programming activities that they considered more authentic.

On pre/post surveys, there were statistically significant gains and small to medium effect sizes in participants' interest in computer programming (p=0.008); in their interest in information technology (p=0.013); and in their interest in computer engineering (p=0.013). There were similar results in student confidence. On a survey in which 20 of the 25 participants responded, three participants indicated feeling that they knew less about computing than the other Glitch participants. Most indicated they knew about the same as or a little more than the other students. In particular, participants demonstrated increased confidence on "I know how to use the computer" (p=0.005) and on the negatively-worded "I get a sinking feeling when I think of trying to use a computer" (p=0.046). Participants' responses to these items indicate that they have gained computing confidence (see Table 6.1).

Table 6.1

Glitch Participants' Confidence in Computing (n=21)

Statement	Time	Mean[†]	A	Wilcoxon
1. I know how to use the computer.	Before	4.43	0.690[c]	0.005**
	After	4.81		
2. I am not very good at using a computer.	Before	2.19	0.532[a]	0.610
	After	2.29		
3. Even when I try hard, I do not use the computer as well as others do.	Before	1.90	0.502[a]	1.000
	After	1.95		
4. I think I generally use the computer poorly.	Before	1.86	0.517[a]	0.157
	After	1.67		
5. I understand what a computer can do well enough to use it correctly.	Before	4.10	0.590[b]	0.102
	After	4.29		
6. I get a sinking feeling when I think of trying to use a computer.	Before	1.71	0.544[a]	0.046*
	After	1.57		

Note. Vargha & Delaney's A is a non-parametric measure of effect size. An *A* value of 0.50 indicates no difference between group means; an *A* of 0.56 equates to a small effect size (d=0.20), an *A* of 0.64 equates to a medium effect size (d=0.50), and an *A* of 0.71 is equivalent to a large effect size (d = 0.80). Effect size ranges are denoted with the letters a-d to indicate the range within which the effect size statistic falls.

[a] none to a small effect; [b] small to medium effect; [c] medium to large effect; [d] large effect

[†]Scale ranges from 1 (Strongly Disagree) to 5 (Strongly Agree) with "I'm not sure" as the midpoint.

*Statistically significant (p<0.05)

**Statistically significant (p<0.01)

In interviews participants told us about their increased interest in computing. Levon, who told us he performs very poorly in school generally, said, “I am highly interested in computing. Actually, I’m so interested that when I take my classes, it’s more of an only option thing for me, because I don’t really study anything else that much.” After his first summer in Glitch, Steve told us he was more interested in computing; “I would like to know how to be better at programming. This summer I’ve learned a little about programming. It’s interesting, I would like to learn more about that.” After Steve’s second summer, and after taking the APCS prep class, he knew that he wanted to be a CS major, and the way he talked about digital games began to reflect the fact that he had moved from a consumer to a producer of technology. Steve told us, “Like, for example, if you have a cake, you don’t think about how the cake is made unless you’re a chef or something. I am starting to do that with video games. Like now I see what it takes to make the video game instead of just the video game as a whole.”

Short Term Impact: High School CS Course-Taking Plans

In evaluating the short-term impact Glitch had on students’ interest in, confidence with, and intent to persist with computing, we looked at the students’ plans for taking CS classes in high school and their test-taking patterns with the AP CS test. Both of these measures provide perspective on the barriers against encouraging lower income young African American males to pursue computing.

High School CS Classes

Overwhelmingly, all participants plan to graduate high school, and the Glitch program appears to have had a significant effect on participants’ intentions to take computing classes “next semester” ($p = 0.01$) and “as many classes as possible in computing every semester" until they graduate (p=0.19). Even though Glitch participants were interested in taking advanced computing courses, the courses were not available in their schools. Glitch participants attended 8 different schools, and only one of them offered beginning programming. None offered intermediate programming or AP CS. Goode, Estrella, and Margolis (2006) report that schools with higher populations of minority students and high percentages of students on free/reduced lunch tend to offer vocational, rather than academic, computing coursework. This lack of computing courses correlates highly with socio-economic status. In fact, a Pearson's correlation shows a -0.67 relationship between the percentage of economically disadvantaged students in schools and the percentage of students scoring 3 or higher on any AP exam (Mcklin et al., 2010). Most of the Glitch Testers fall into the economically disadvantaged category. Instead of computing pathway courses, Glitch participants' schools offer courses with a greater focus on developing IT skills, with little exploration of computational agency. The two most highly-offered courses are Computer Applications and Business Essentials. Glitch was the primary source of programming experience for all but one participant, who took a college level program course after his first summer in Glitch.

Advanced Placement Computer Science

Of the students who participated in the APCS prep course during the summer of 2010, only one pursued the course and took the test in May. Originally, 14 participants took the summer course, but only 6 participants were present during the entire summer course and the school year portion in which they continued to review material (the other

8 participants had graduated[7] or left the program for the school year). During the summer the participants were able to cover a great deal of material, but during the school year, with just weekly class and some large breaks or missed classes, participants had a hard time keeping up. In the spring semester the undergraduate instructors felt that only four of them were prepared enough to take the test and felt confident that only two would get a passing grade. Of the five who decided to not take the test, there were several reasons given. One was taking the AP Calculus exam that week as well and wanted to concentrate on that rather than the AP CS test. Three did not feel prepared to take the test and told us so, although one of these participants, from our instructors' perspective, was likely to pass the test. All but the one student who attended the test site school said that logistics was part of the reason; the test was offered at 8:00 a.m. at a different school than they attended, on a school day, and none of them wanted to wake up that early to take public transportation there and miss school.

These were all reasonable and compelling reasons to not take the test, which I tried to mitigate. First, the cost of taking the test was covered by the Glitch program. Second, I offered to drive to their homes, pick them up, and drive them to the test site. Third, I offered to write an explanatory note to their schools. Fourth, I emphasized that no one had expectations for their test results except to understand what they had learned from the prep course. These offers did not change anyone's desire to take the test.

The barriers to taking additional CS courses in high school and taking the AP CS exam hampered the participants' ability to follow through with short-term impacts from Glitch. Inside of the Glitch program participants were eager to learn, but pushing that

[7] The six participants who had graduated told us the wanted to be part of the AP CS prep because they it would prepare them for their introductory CS classes in college.

interest outside of the boundaries of Glitch proved to be more difficult.

Long Term Impact - Intent to Persist in Higher Education and CS

While participants were not able to pursue CS interest in their high schools, surveys and interviews suggested that they intended to pursue CS in their future careers. Table 6.2 shows participants reported significant differences in their pre and post intentions to graduate from college with a computing-related degree (p=0.026) and in their intentions to attend graduate school in a computing related field (p=0.028).

Table 6.2

Glitch Participants' Intention to Persist in Computer Science (n=22)

Statement	Time	Mean†	A	Wilcoxon
1. I plan to apply to college.	Before	5.86	0.478	0.317
	After	5.82		
2. I plan on graduating from college.	Before	5.86	0.457	0.157
	After	5.77		
3. I plan on graduating from college with a computing-related degree.	Before	4.05	0.648[c]	0.026*
	After	4.55		
4. I would like to go to graduate school after college.	Before	4.41	0.571[b]	0.096
	After	4.68		
5. I would like to go to graduate school after college for a computing-related degree.	Before	3.59	0.653[c]	0.028*
	After	4.14		

Note. Vargha & Delaney's A is a non-parametric measure of effect size. An *A* value of 0.50 indicates no difference between group means; an *A* of 0.56 equates to a small effect size (d=0.20), an *A* of 0.64 equates to a medium effect size (d=0.50), and an *A* of 0.71 is equivalent to a large effect size (d = 0.80). Effect size ranges are denoted with the letters a-d to indicate the range within which the effect size statistic falls.
[a] none to a small effect; [b] small to medium effect; [c] medium to large effect; [d] large effect

†Scale ranges from 1 (Very Untrue of Me to 6 (Very True of Me).
*Statistically significant (p<0.05)

These findings indicate that the Glitch program is having an impact on their intent to study computing in both college and graduate school (Mcklin et al., 2010).

Participants were also asked about their career aspirations (see Table 6.3).

Table 6.3

Glitch Participants' Interest in Pursuing a Computing Career (n=22)

Statement	Time	Mean†	A	Wilcoxon
1. I am planning on working in a technology-related field.	Before	4.86	0.589[b]	0.02*
	After	5.18		
2. I can see myself working as a computer scientist or programmer in the future.	Before	4.23	0.582[b]	0.07
	After	4.68		
3. I am planning to find a job as a computer scientist or computer programmer.	Before	3.77	0.624[b]	0.01*
	After	4.36		
4. I am planning on earning a living as a computer scientist or programmer.	Before	3.55	0.640[c]	0.004**
	After	4.27		
5. I am planning to devote my career to an area related to computer science.	Before	3.77	0.582[b]	0.026*
	After	4.27		

Note. Vargha & Delaney's A is a non-parametric measure of effect size. An *A* value of 0.50 indicates no difference between group means; an *A* of 0.56 equates to a small effect size (d=0.20), an *A* of 0.64 equates to a medium effect size (d=0.50), and an *A* of 0.71 is equivalent to a large effect size (d = 0.80). Effect size ranges are denoted with the letters a-d to indicate the range within which the effect size statistic falls.
[a] none to a small effect; [b] small to medium effect; [c] medium to large effect; [d] large effect
†Scale ranges from 1 (Very Untrue of Me to 6 (Very True of Me).
*Statistically significant (p<0.05)
**Statistically significant (p<0.01)

Again, there are significant changes from pre to post in their "plans to work in a technology-related field" (p=0.02); "plans to find a job as a computer scientist or computer programmer" (p=0.01); "plans to earn a living as a computer scientist or programmer" (p=0.004); and "plans to devote my career to an area related to computer science" (p=0.026). As with their intentions to continue their education in computing, the participants expressed a growing interest in pursuing computing as a career.

The changes in intention to pursue computing were also reflected in the post interviews. Some of these changes were quite dramatic, such as Reggie's new career goals:

> I wanted to get into criminal justices but now I am starting to like programming so I think I am going to get into programming…It is just interesting. There is always something to learn, always something new you have to do. It would never get boring. It isn't like you do the same thing over and over. – Reggie.

Others were subtler, such as Franco, who in the pre-interview talked about becoming a pilot as his career goal. He now saw the opportunity to combine CS with his love of aeronautics. Franco told us, "I will probably go into Computer Science and use it in [the] aeronautics field."

Some students expressed an interest in computing because they wanted to make games.

> My interest in computing involves me designing, or, really, I just want to… know everything. Like, I want to be able to do everything. I want to create 3-D models, create environments, know how to do all the programming, understand all the programming, do the visual components. And my goal is to create video games. - Dre

Most participants talked about applying computing to other fields, such as Franco's desire to combine CS with aeronautics. Others expressed a passion for computer science more generally, such as Daniel, who said at the end of his second summer in Glitch, "I want to take computing to the highest point, I guess. Go into research and development, that's where the money is. Coming up with new ideas of how certain things could work, then implementing them and trying to make code that does things that haven't been done before."

The survey data and interviews are evidence that these young men intend to pursue computing for their careers. The interviews also indicate that the participants were interested in CS not because it was only an opportunity to make money, but also because it was an interesting set of problems and an opportunity to make new things across a variety of applications.

Educational Outcomes

As of May 2011, sixteen participants have graduated, and remaining participants are still enrolled in high schools. Fourteen of the graduates are pursuing post-secondary education. Of those students, twelve are in computing-related fields (eight in computer science, two in computer engineering, and three in digital media) (see Table 6.4).

Table 6.4

Glitch Participants Educational Status One Year After Leaving Program

Participant	Graduate / Grade Fall 2011	Institution	Type of institution	Major / Area of study
1	May-10	Georgia Tech	4-year	Computer Science
2	May-10	Morehouse	4-year	Computer Engineering
3	May-10	Atlanta Metro	2-year	Computer Science
4	May-10	SCAD	4-year	Digital Media
5	May-10	Art Institute	2-year	Digital Media
6	May-10	Kennesaw State	4-year	Education
7	May-10	DeVry / Army	2-year / Military	Digital Media / Computing
8	Dec-10	None		
9	May-11	GA Southern	4-year	Computer Science
10	May-11	GA Southern	4-year	Computer Science
11	May-11	Arizona State	4-year	Computer Engineering
12	May-11	Georgia State	4-year	Computer Science
13	May-11	Air Force	Military	Computer Science
14	May-11	Savannah State	4-year	Marine Biology
15	May-11	DeVry	2-year	Computer Science
16	May-11	None		
17	Senior	High school		
18	Senior	High school		

Table 6.4 Continued

19	Senior	High school		
20	Senior	High school		
21	Senior	High school		
22	Senior	High school		
23	Senior	High school		
24	Senior	High school		
25	Senior	High school		

Only three participants expressed an interest in a computing-related major during their intake interview. Of the nine participants who are currently seniors in high school, all indicated that they plan to apply to and graduate from college. Six of these young men have said in interviews or mentioned in day-to-day activities that computing is a likely college major.

Across all of the data it is clear that most participants now have intent to persist in computing. However, there are still real barriers to their success outside of the Glitch environment that these young men may not be equipped to handle. The first indication of this was when participants did not want to take the AP CS test. After entering college some of the participants have not made good grades as easily as they thought they would with their prior experience. One participant did not attend school at first because of finances, then went to a technical school, then dropped out to enter the military. Finally, some participants chose to go to two-year institutions that were easy to get into and finance. However, these schools frequently underperform in helping place students in jobs or four-year colleges, and they also frequently overcharge. This leaves students with high debt and few career opportunities (Lansing, P. & Olsen, D. S. 2011). While the findings are compelling that over time interest in computing, confidence with computing, and intent to persist in computing all increased, long-term effects may be tempered with the reality of the barriers that young lower-income African American males face.

Response to CS Workshop

While increased interest, confidence and intent to persist in CS were marked by these measures; surveys and interviews provided additional information about how different types of approaches were effective in teaching different CS concepts. Participants self-reported their ability to perform simple tasks with each of the programming tools used in the first year program course. This provided an opportunity to compare and contrast their reflections on using a drag-and-drop programming language (Alice) and a text base programming language (Jython) in teaching introductory CS concepts.

Self-Reporting on Confidence with Alice and Jython

Regarding Alice, the students were most confident in their ability to do simple manipulations within the program, such as creating a scene with objects from the Alice gallery, making a character move across the screen, and adding 3D text to a scene (100% of students either agreed or strongly agreed). The participants were less confident in their ability to "Keep score and declare a winner using if/else control structures, custom functions, and parameters." (see Table 6.5)

Table 6.5.

Participants' Self-Reported Confidence in Performing Tasks in Alice

	Disagree Strongly (1)	Disagree (2)	Agree (3)	Agree Strongly (4)
1. Create a scene with objects from the Alice gallery.	0%	0%	36%	64%
2. Make a character move across the screen	0%	0%	18%	82%
3. Add 3D text to a scene.	0%	0%	40%	60%
4. Keep score and declare a winner using if/else control structures, custom functions, parameters	9%	18%	36%	36%

Note: not all sum to 100% due to rounding

Regarding basic knowledge of computer science, the students were most confident in their ability to explain to someone else: "A computer program", "A computer", "The relationship between a class and an object", "A method", and "Why it is important to create my own methods" (100% either agree or strongly agree). The students were least confident in their ability to explain an algorithm, top-down design, and step-wise refinement (disagreement = 18%, 18%, and 27%, respectively) (see Table 6.6).

Table 6.6..

Participants Self-Reported Knowledge of Computer Science

I can explain the following to someone else:	Disagree Strongly (1)	Disagree (2)	Agree (3)	Agree Strongly (4)
1. A computer program.	0%	0%	73%	27%
2. A computer.	0%	0%	73%	27%
3. An algorithm.	0%	18%	55%	27%
4. Top-down design.	0%	18%	55%	27%
5. Stepwise refinement.	0%	27%	55%	18%
6. The relationship between a class and an object.	0%	0%	55%	45%
7. A method.	0%	0%	40%	60%
8. Why it is important to create my own methods.	0%	0%	64%	36%

The students were also provided with instruction on manipulating sounds and images using a media computation approach, and expressed high confidence in their ability to "create simple color filters for JES (Jython Environment for Students), to change the color on pictures", and "recognize when someone is correctly describing how images and sounds are stored in a computer" (100% either agree or strongly agree). Students were only slightly less confident in their ability to "describe the algorithms used for important image manipulations (like negation, grayscale, and chromakey)" and "describe how to use Alice to generate images for manipulation in JES" (91% either agree or strongly agree).

Reflections on Program Languages

Throughout the interviews, participants talked about their experience with Alice and Jython. When asked what they know about computing, what they learned in the CS workshops, or what they were most proud of, most participants volunteered that they preferred one programming language to the other. Three participants indicated that they preferred their experience with Alice. Six participants indicated that they preferred Jython. Three participants did not indicate a preference for one over another (see Figure 6.1). When students mentioned a preference, the interviewers followed up with additional questions regarding their preference. Interviewers did not seek to have students choose between the two programs, and only when participants began the comparison did the interviewer directly address issues around programming language.

Figure 6.1

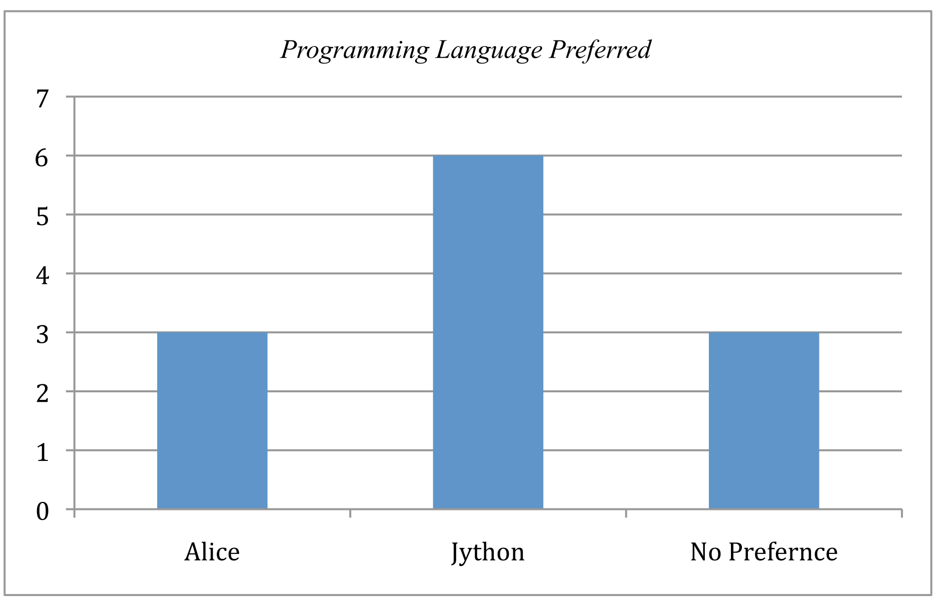


Figure 6.1. Programming language preferred by the Glitch participants after 8 weeks.

Visual Interface

The visual interface and low barrier to entry to Alice prompted three participants to indicate that they preferred working with Alice. Jacob noted that the Alice interface made it more enjoyable: "I just enjoy Alice more because it's so visual, and it's right there." Carl echoed several participants in noting that Alice seemed easier; "I liked Alice more because it was simpler and it was quick."

When asked why they felt Alice was easier or more enjoyable, participants mentioned that the visual nature of Alice allowed them to understand what was happening in the program over text-based Jython coding. They indicated that debugging and knowing "when it worked" was easier in the Alice environment. Jacob and Anthony preferred Alice because it was visually appealing, and it helped them understand what was happening with the program because of its visual nature.

> Jython is not exactly as clear just because you can't see it, you have to think about what is actually happening inside the computer…I don't like to read code that much, I just like to write the code and look that it came out correctly. With Alice, you can really see that it came out correctly. – Jacob
>
> I think, because you can see the 3D models and everything that you are making, and you can see what you need to fix and the methods in the world. – Anthony
>
> I was amazed by Alice, I didn't know it was going to be so easy, I thought I was going to have to type a million codes just to make them walk, but you can just drag and make your own methods and you own properties, change the colors, and you can drag pictures from Jython into the Alice world. - Max

Participants who reported a preference for programming in Alice over Jython were more likely to be interested in visual and media design (see Figure 5.2). However, when asked how they would apply what they learned, they gave direct examples of how the computational media approach of Jython gave them a better understanding of media concepts. Jacob had an interest in music and music technology and was well versed in software designed for mixing music. Jacob told us, "He [Dr. Guzdial][8] introduced a lot of new concepts that I really liked, you remember the graph he showed when he increased the frequency…I would like to use it one day." Despite his reported preference for Alice, Jython seemed to provide him with more insights into how sounds are represented in computational language.

Carl, who preferred Alice, talked directly about Jython, rather than Alice, assisting him with computing concepts concerning visual media. Carl said, "I thought at first, a designer has to go pixel by pixel to design a program, but then we used Jython, and I realized it was easier than I thought it would be."

Big Concepts

In contrast, many of the participants who stated that they preferred working with Jython reported learning gains for bigger concepts with Alice. For example, Isaiah said he preferred Jython, yet his use of Alice allowed him to gain insights into some higher-level thinking about computer science. Isaiah said, "[I] like the top-down design, we are able to break down the bigger problems into smaller problems and then even smaller problems so it's a simpler way to file through. I think you could probably apply top-down design to anything in life."

---

[8] Dr. Mark Guzdial, Professor in the College of Computing, developed and taught the Jython portion of the CS workshops based upon his media computation approach to in CS education (Forte & Guzdial, 2004).

The Alice curriculum was focused on larger computer science concepts. Participants mentioned concepts such as top-down design, statements, variables, parameters, recursion methods, class properties and methods as concepts they learned and were excited by when using Alice. “I can create ‘if/do/together’ statements, I can create variables and parameters like really well now. I can do recursion methods. I love that,” said Jacob. And Luis told us, “Alice, I just started using that, like the cycle of development of the game. Like when Dr. Perry[9] came in he was talking about top-down design, I learned a lot.”

Authentic Programming Experience

All of the participants who preferred Jython mentioned that it was a more authentic programming experience. Carver noted that Alice was too easy when he told us, “I mean, to make a character move [in Alice], I feel like a six year old could do that…With JES, that takes time and you have to put a lot of work into it and type all the stuff out.” When asked what accomplishment he was the most proud of, Chappelle said, “Jython, because when I first started it was ridiculously hard, I didn’t understand any of it, I felt like I was at school… but I finally got it.” While Chappelle talked about how difficult Jython was, he also felt real pride in working with the textual programming language. Everett made a distinction between Alice being time consuming, and Jython being challenging when he remarked, “Alice is just really time consuming. If you mess up, sometimes, you have to go all the back and change what you did.” In contrast, Everett indicates that Jython is challenging, but in a good way; “So like in Jython, when you have

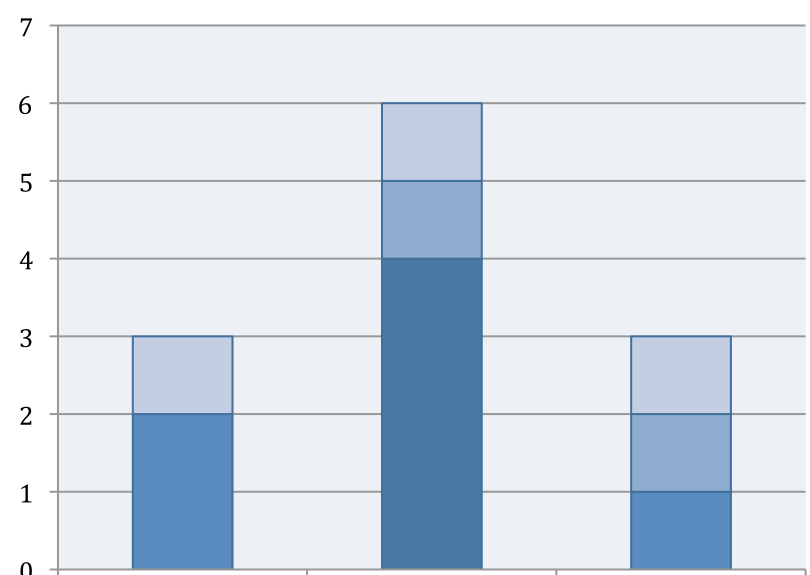
[9] Dr. Kenneth Perry, Chair of the Computer Science Department of Morehouse College developed and taught the Alice portion of the CS workshops in year one, 2009.

the code on the top half[10], you have to type in, like increase max, or increase blue or something. And then you have to load program, click explore, picture, all of that. It is pretty confusing, but I like being confused."

Others felt that Jython was more authentic because it was closer to "real" coding. The four participants who expressed a strong interest in programming as a career expressed a preference for Jython. (see Figure 6.2)

Figure 6.2

Interest in CS Career in Relation to Preferred Programming Language



	Alice	Jython	No Preference
No CS Interest	1	1	1
IT		1	1
Media and Design	2		1
Programming		4	

Figure 6.2. Participants' CS career interest in relation to their programming language preference.

[10] Students programmed in Python using the JES IDE, which is designed to look like DrJava or DrScheme, formats in which the editor window sits on top of an interpreter pane.

This preference may be based on a perception that textual coding is more authentic programming. Elijah specifically addresses how it is more like game development to him; "It [Jython] made me feel like I am closer to making a game, like I'm closer to the way that EA makes a game…it made me feel like I was close to my dream, like closer to what I want to do in life."

Ownership and Authorship

Participants expressed a sense of ownership over the projects they created using Jython and Alice. As Elijah mentioned, "Jython lets you start from scratch." Frank told us that the visual appeal gave him a sense of power with his code; "It's kind of cool how you put in the code, and then you preview it, and it's kind of cool, you got like power in your hands. You get to do anything."

The idea that Alice preset much of the programming was not appealing to a number of participants. As Carver told us, "I think Alice is more like, not childish, but more like beginner...Alice is just moving a leg or making him walk however many meters or jumping so high, nothing real complex…everything is set for you instead of you setting everything."

In contrast, the complexity and the idea of being "real coders" made some participants express a greater authorship with their Jython experience. Elijah said, "I like everything [about Jython], like the way it make you go through the computer and tell the computer what you really want it to do. I think that's what makes me really like it. I think I am more of a coder than Alice because Alice is putting in commands, like you are dragging and dropping, but Jython makes you put in whole commands."

Participants had been exposed to the practice of computer science in a number of ways over the course of their first year, and concluded that they wanted to use a language that they heard professionals and students talk about more frequently than Jython. This preference for a more authentic-feeling programming language prompted a number of participants to ask for a more advanced class that used a "real" programming language, such as Java. In response, the Advanced Placement Computer Science prep class was added in the summer of 2010. However, we continued to use both Alice an Jython in our introductory workshop, because of the affordances in teaching basic concepts with Alice and the way that the visual language of Alice was an entry point to computing for some participants.

Face Saving

Analysis of the findings regarding face saving practices in Glitch include data from surveys and focus groups designed to elicit responses concerning the way in which face saving was used to justify participation in Glitch. Also included are findings from interviews and observations that help illuminate or support these findings. These are organized by the four themes of the surveys and focus groups:

- Participating in computer science
- Participating in higher education
- Participating in the game industry
- Participating in full-time work

In surveys and focus groups, a pattern of correlation between ratings occurred. This pattern defined four groups of people in the participants' lives, and showed similar responses to justifications for participating in different aspects of Glitch.

- *Adult family*, including parents, grandparents, and favorite aunt or uncle;
- *Adult other*, which included a favorite teacher and coach or activity leader;
- *Peer family,* which included brothers and sisters;
- *Peer other,* which included best male and female friend, other friends, popular kids at school, a "geeky" friend, and co-workers.

There were some exceptions to these patterns, which will be discussed in more detail. There were also broader themes related to face saving that occurred throughout the focus groups and were reinforced by interviews, as well as by other survey instruments, which will also be addressed.

Participating in Computer Science.

In surveys, participants were asked to rate what people would think about three different answers to the hypothetical question, "Why are you working so hard on your Glitch computer science project?" Participants rated two options, "I want to learn about technology" and "I want mine to be the best," as a 1 or 2 on a 5 point scale, with 1 as *Good Reason* and 5 as *Bad Reason*. Only "popular kids at school" were perceived to judge these justifications more negatively, but were perceived as being more accepting of competition as a justification (Figure 6.3).

Figure 6.3

Face Saving Survey Responses to Computer Science Justifications

When people ask you, "Why are you working so hard on your Glitch computer science project?" You tell them:

		How would the following people rate that answer?	Because, I want to learn about technology.	Because, I want mine to be the best.	Because, I want to get extrapoints for the weekly competiton.
Family	Adult	Your mother (N=22, SDs=.213, .658, 1.27)	1.05	1.36	1.73
Family	Adult	Your father (N=18, SD =.471, .841, 1.1)	1.11	1.47	1.89
Family	Adult	Your grandmother (N=19, SDs=.501, .657, 1.098)	1.16	1.3	1.83
Family	Adult	Your grandfather (N=19, SDs=.535, .587, 1.182)	1.21	1.35	1.89
Family	Adult	Your favorite aunt (N=19, SDs=.459, .887, .961)	1.11	1.45	1.58
Family	Adult	Your favorite uncle (N=18, SDs=.523, .669, 1.056)	1.2	1.38	1.94
Family	Peers	Your sister(s) (N=18, SDs=.698, .902, 1.249)	1.39	1.58	1.94
Family	Peers	Your brother(s) (N=19, SDs=.692, .988, 1.074)	1.42	1.85	1.72
Non-Family	Peers	Your best male friend (N=21, SDs=.75, .68, 1.134)	1.48	1.48	1.79
Non-Family	Peers	Your best female friend (N=21, SDs=.87, .959, 1.113)	1.43	1.59	2
Non-Family	Peers	Other friends (N=21, SDs=1.091, .964, 1.146)	1.9	1.86	2.45
Non-Family	Peers	Popular kids at school (N=21, SDs=1.16, 1.203, 1.406)	2.38	2.05	2.27
Non-Family	Peers	A "geeky" friend (N=21, SDs=.539, .966, 1.378)	1.24	1.67	2.23
Non-Family	Peers	A co-worker (N=22, SDS=.703, 1.006, 1.221)	1.27	1.82	1.59
Non-Family	Adult	A favorite teacher (N=22, SDs=.501, 1.086, 1.453)	1.18	1.68	2.27
Non-Family	Adult	A coach or activity leader (N=22. SDs=1.049, 1.143, 1.436)	1.64	1.55	2.41

Figure 6.3. This heat map illustrates average participant ratings of justifications for participation in computer science activities on a scale of 1 – 5, with 1 (white) as a good justification and 5 (blue) as a bad justification.

When asked in the focus groups how people would react to the justification that the student wanted to win a competition or be the best, participants indicated that people would respond positively. Eddie said, "I would tell them that I want the best one. And I'd brag around, tell them that I enjoy it."

In the survey, participants rated learning about computer science as a good response for why they were doing computer science work. In contrast, in the focus groups, participants responded that they would only tell their mother/female guardian and their computer teacher that learning was the reason for their participation. Anthony said, when asked how he would tell his friends about putting in extra time for his computer science project, "They wouldn't care about either one; the learning aspect and they wouldn't care about the points. I mean they are not in it, so why would they care?"

Indeed, participants repeatedly told us that they tried not to talk about the CS aspect of the program with anyone but their closest friends or perhaps a technology teacher. When participants were asked why they did not talk with their family about CS, they indicated that it would open up unwanted conversations. Daniel said, "I have a talkative family. And, um, sometimes I really just don't want to deal with it and I just tell them 'It pays.'" Anthony supported that idea, "Yeah, my family doesn't know what CS is. I would have to explain it to them." and Kadeem added "No, they'd want me to explain it to them." Arnold provided us with another explanation in a post-interview, that it might complicate his relationship if he knew more than his father, "It's like so crazy because I'm like, 'Wow. Like he's really technology-illiterate.' So, maybe I can teach him a few things, but not too much because I don't want to get in trouble." Arnold was expressing what a number of participants had hinted at, they didn't want to complicate their relationships by demonstrating how much more they knew about computing than the people around them.

While participants chose not to talk about CS learning among friends and family in the conversations we observed, participants told us in interviews that learning about CS was important to them and was an important factor in their future. When asked about their interest in computers, most of the participants responded with enthusiastic responses about what else they would like to learn or how important computing is to them. For example, Daniel said, "I want to take computing to the highest point, I guess. Go into research and development things. That's where the money is, I guess. (Laughter) Coming up with new ideas of how certain things could work. Then implementing them and trying to make code that does things that haven't been done before."

When asked “What accomplishment are you most proud of from the summer?” participants frequently talked about CS learning. Michael said this about programming: “I learned how to use Net Beans and Java. At first, I didn’t know it was a real program until they showed us Net Beans, so I was kind of psyched about that. Then, when we used it I learned how to make methods and classes. I really got into it. I’m still trying to learn more about it.” Arnold, who was afraid to talk to his dad about CS, told us he was most proud of what he learned in general about computers; “I learned a lot about computers. Like my knowledge is so…compared to my knowledge before, I’m really on top of a mountain right now looking down.”

In our daily observations we also saw enthusiasm for learning computing, and participants frequently asked for help with debugging programming problems or understanding a new concept. We also observed that when one of the participants started asking questions, particularly a participant who was more senior and respected by his peers, all of the participants felt more at ease to geek out by asking questions and tinkering with the program.

Participants told us that they talked with few people about what they were learning, perhaps only their closest friend or a teacher who had an interest in technology. In an interview, Michael told us that he started getting mentorship from a teacher because she saw him on campus. “We were talking, and she said she saw me up here one day, and I told her everything I did up here, and she said, ‘That’s good, just stick with it.’”

In the focus groups two themes emerged as reasons participants would give to their best friends or co-workers for working on their computer science projects. First, they were likely to say that they have a strong interest in technology, and to talk with close friends and teachers about how they had taken “special” computer courses. Steven told us he would only tell a close friend that he was putting in extra time, “because I am interested in the field and it deals with some of my hobbies, too.” Second, the tediousness of game testing made the computer science classes more appealing. As a result, participants might say to their co-workers and closest friends that they were putting in extra time on their computer programming projects to avoid spending time testing.

However, these excuses were used only with very select peer groups. For other people in their lives, participants acknowledged in the surveys that learning CS would be perceived as good reason for their time and efforts in Glitch, but they would be unlikely to talk about CS with most people. While the interest in computing was very clear, and they felt comfortable talking about CS among a select group of peers, in general the participants avoided talking about CS and their interest in CS. The reasons for this tendency are multi-layered, but are all part of their presentation of self as someone who is not focused on computing or education.

Participating in Higher Education

In the survey, participants rated the way in which people in their lives would respond to four hypothetical responses regarding their college campus experience. The hypothetical question was: “What is good about working on the Georgia Tech campus?” Two reasons were rated between 1 – 2 for all audiences other than the popular kids: 1) “I like getting experience/getting comfortable on a college campus,” and 2) “The students who work with us tell us about classes, homework, campus, etc.” Participants felt popular kids would be less accepting of this reason (see Figure 6.4).

Figure 6.4

Face Saving Survey Responses to Higher Education Justifications

When people ask you "What is good about working on Georgia Tech campus?"
You tell them:

		How would the following people rate that answer?	I like getting experience/ getting comfortable on a college campus.	The students who work with us tell us about classes, homework, campus, etc.	I like meeting the ladies.	Nothing, it is just a job.
Family	Adult	Your mother (N=21, SDs=.78, .746, 1.174, 1.322)	1.32	1.43	3.95	3.95
Family	Adult	Your father (N=18, SDs=.838, .784, 1.53, 1.372)	1.42	1.44	2.89	3.67
Family	Adult	Your gandmother (N=20, SDs=.805, .68, 1.153, 1.356)	1.38	1.48	3.86	3.95
Family	Adult	Your grandfather (N=17, SDs=.608, .697, 1.224, 1.345)	1.39	1.53	2.95	3.94
Family	Adult	Your favorite aunt (N=19, SDs=.902, .754, 1.218, 1.273)	1.42	1.6	3.3	3.79
Family	Adult	Your favorite uncle (N=20, SDs=.74, .676, 1.289, 1.226)	1.38	1.43	2.52	3.65
Family	Peers	Your sister(s) (N=17, SDs=.768, 1.219, 1.238, 1.536)	1.42	1.88	3.25	3.12
Family	Peers	Your brother(s) (N=20, SDs=.68, .928, .945, 1.334)	1.48	1.81	1.45	3.1
Non-Family	Peers	Your best male friend (N=20, SDs=.676, .734, 1.185, 1.694)	1.43	1.59	1.5	2.85
Non-Family	Peers	Your best female friend (N=21, SDs=.8, .78, 1.468, 1.446)	1.55	1.68	2.82	3.24
Non-Family	Peers	Other friends (N=20, SDs=.796, .92, 1.323, 1.508)	1.67	1.95	2.32	2.8
Non-Family	Peers	Popular kids at school (N=21, SDs=.894, 1.037, 1.818, 1.278)	1.68	2.14	1.59	2.67
Non-Family	Peers	A "geeky" friend (N=20, SDs=.658, .8, 1.359, 1.455)	1.36	1.55	2.32	3.7
Non-Family	Peers	A co-worker (N=22, SDs=.964, .928, 1.214, 1.511)	1.74	1.81	1.74	3.23
Non-Family	Adult	A favorite teacher (N=21, SDs=.631, .656, 1.211, 1.342)	1.27	1.39	3.68	4
Non-Family	Adult	A coach or activity leader (N=22, SDs=.647, .73, 1.435, 1.343)	1.35	1.52	3.17	3.77

Figure 6.4. This heat map illustrates average participant ratings of justifications for participation in college campus activities on a scale of 1 – 5, with 1 (white) indicating a good justification and 5 (blue) indicating a bad justification.

When asked to rate how people would respond to "Nothing, it is just a job," most participants indicated that adults would think this was a less acceptable excuse (average ratings between 3.5– 4). A similar pattern was found with the reason "I like meeting the ladies." During the course of the program, "meeting the ladies" was a reason they often gave for eating lunch outside or asking to run errands on campus. Because of this tendency, "meeting the ladies" was included as an item in the survey. Participants indicated that they felt adults and female peers would think this was a poor reason. However, they anticipated that male peers would think this was a good reason.

In the focus groups, when asked how they would explain why they liked working on campus, participants indicated that learning life skills or networking for the sake of enhancing future opportunities were highly acceptable to most adults. However, peers were less likely to be given these excuses. Instead, participants suggested that socializing on campus, including sexual bragging about meeting older and more diverse women, was the more likely reason they would give a peer for why they like working on campus. As Rodrick mentioned, "To the kid at school I would say it's fun, better than what you're doing. I would say it is a good experience to my Gran." And Arnold explained why the women on campus were of special interest to their peers; "Oh I might say it to a homeboy. Because they're used to one type of high school girl, but there are girls from all over the country, all over the world at college. In a way it might influence them to want to go to college, so they could meet new people other than those they've been around their whole life."

An unanticipated finding was that the association with Georgia Tech held significant social status. Participants perceived that Georgia Tech held prestige for most of the people they interacted with, and they were associated with that prestige because they worked on campus. In the following short interaction, the participants explain why Georgia Tech is an important part of the program to mention.

Jayden – I would say I work on Georgia Tech campus. Testing video games and clients bring us video game.

Interviewer - Why would you mention Georgia Tech?

Rodrick – Cause it grabs their attention fast cause it is a college campus.

Arnold – It's not even that. It is just that the name Georgia Tech is well known as one of the best engineering school in the country. And that is an achievement to actually be in the presence of that setting.

In interviews, participants talked about the influence of being on a college campus as something they valued; "I got to see more of a college atmosphere, and talk to people in college, and find out more just about schools in general, and more about what I wanted to do in the future" (Isaiah). However, the participants were more likely to talk about specific people they encountered as influential rather than being on or associated with the Georgia Tech Campus. For example, when asked what they remembered about other activities besides game testing, Terell mentioned that he was surprised that a visiting faculty member[11] was funny, "The guest speakers, one of them, I think he was the Dean of Tech or something like that. He's very smart, and he was just teaching us things. He was funny, too." The undergraduate researchers who taught the CS workshops also had a strong influence; **"**The undergrads who teach us say we're learning what they are

[11] Charles Isbell, College of Computing Associate Dean for Academic Affairs

supposed to learn in college right now, classes that they actually took. So, I might have a little advantage, even though Corey and Marcus[12], they teach a different way than the professors might teach" (Levon).

The survey and focus groups indicated that participants presented different aspects of working on a college campus to different people. The interviews demonstrated that the interactions with individuals associated with the institution had a strong influence on participants. However, these influences were not presented as part of their campus experience.

Participating in the Game Industry

In the survey, participants rated how people in their lives would respond to two hypothetical responses regarding why they are in a game testing program. The survey asked the hypothetical question, "Why are you a Glitch Game Tester?" The hypothetical responses were: "I love games" and "I want to learn how to make games." Although both reasons rated as good reasons for most audiences (average ratings between 1.38 and 2.1), participants rated geeky friends and co-workers as having slightly higher average approvals of 1.29 and 1.11, respectively. In contrast, the popular kids were perceived as finding both reasons less acceptable than would other groups, 2.48 for "I love games" and 2.2 for "I want to learn about making games." (see Figure 6.5)

[12] Corey Stewart and Markus Austin, former Georgia Tech Computer Science majors who helped manage and teach CS workshops in Glitch.

Figure 6.5

Face Saving Survey Responses to Game Industry Work Justifications

When people ask you" Why are you a Glitch Game Tester?"
You tell them:

		How would the following people rate that answer?	I love games.	I want to learn about making games.
Family	Adult Family	Your mother (N=21, SDs=.973, .489)	1.38	1.15
Family	Adult Family	Your father (N=17, SDs=1.124, 1.124)	1.47	1.53
Family	Adult Family	Your gandmother (N=19, SDs=1.116, 1.124)	1.63	1.43
Family	Adult Family	Your grandfather (N=19, SDs=1.357, 1.095)	1.79	1.6
Family	Adult Family	Your favorite aunt (N=21, SDs=1.078, .865)	1.52	1.62
Family	Adult Family	Your favorite uncle (N=21, SDs=1.110, .870)	1.62	1.57
Family	Peers	Your sister(s) (N=18, SDs=1.006, .684)	1.78	1.37
Family	Peers	Your brother(s) (N=20, SDs=.945, .550)	1.55	1.25
Non-Family	Peers	Your best male friend (N=20, SDs=1.146, .814)	1.55	1.48
Non-Family	Peers	Your best female friend (N = 20, SDs=.894, 1.03)	1.8	1.81
Non-Family	Peers	Other friends (N=21, SDs=1.062, .796)	2.14	1.67
Non-Family	Peers	Popular kids at school (N=21, SDs=.784, 1.240)	2.48	2.2
Non-Family	Peers	A "geeky" friend (N=21, SDs=.784, .301)	1.29	1.1
Non-Family	Peers	A co-worker (N=19, SDs=.315, .561)	1.11	1.29
Non-Family	Adult	A favorite teacher (N=21, SDs=1.290, .740)	1.81	1.38
Non-Family	Adult	A coach or activity leader (N=20, SDs=1.210, 1.031)	2.1	1.7

Figure 6.5. This heat map illustrates the average participant ratings of justifications for game industry work on a scale of 1 – 5, with 1 (white) as a good justification and 5 (blue) as a bad justification.

In focus groups, participants told us that, to their peers, they emphasized that games were cool, that they were “paid to play,” and that they were making authentic contributions to real games. In one exchange, the participants enthusiastically talked about how they could brag about their job.

> **Interviewer** –Let’s say you’re going back to school this fall, while talking to your friends someone asks you what was it like working full time this summer, what would you tell them?

Dre - The first thing that I would say is yeah I just play games for money. I would just try to tease them. First I probably ask them "What you do this summer?" Then they ask me what I did. And I just say (leaning back in his chair) "Ohh, I didn't do too much I just played games for money, nothing new, same old same old."

Terell – And they be like, "oh, that's cool. What games did you play?"

Dre – And you're like, "Ahhh….details, details we don't want to get into that." (everyone laughs)[13]

Interviewer - Do you all do that, put that teaser out there?

Dre – Oh yeah, "We play games for money."

Xavier - You know last year, we did that Cartoon Network game. I'll be like, "You've seen that commercial, I helped on that."

Participants told us about talking with adults about how good their job was, but focused more on the idea that the game industry could offer future employment rather than it just being cool. In contrast, the participants spoke in interviews about how tedious and difficult the work was. As Xavier told us, "I thought it would be fun, to have a good time, testing good games, not just messing around. Now that I'm doing it, it's very repetitive, and it takes a long time, and then you have to write up a Glitch the right way, you can't just make a shortcut to it." Participants told us how proud they were of their work, that they had an impact on the final product. As Isaiah told us, "Every game has stuff that when you're playing it just makes you real mad. Some stuff just pisses you off to the point of you just don't want to play that game anymore. I feel like I found a few of

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[13] Participants often complained about the games they tested because they did not in general consider them fun or cool.

those [bugs]. So, I feel like that will keep somebody from quitting the game for forever." What is notable about this is that the tediousness of testing games and the pride they felt in making a difference in the product was not something they talked about with friends and family. Instead, they would brag about being paid to play.

Participating in Full-time Work

In our survey, we asked participants to rate what people would think about four different reasons for the hypothetical question: "What is it like working full-time this summer?" Participants perceived that for adults and siblings the justifications "Now I know what it is like to be a man and work full-time" and "I am learning about how to act at work" were acceptable (averages between 1 and 2). Participants perceived that non-family peers would rate these excuses between 1.94 and 2.5; just better than "It makes me see why I don't want to do a lame job when I grow up," which averaged 2.94 and 3.11. Participants perceived that adults would rate this answer even lower, from 3.27 – 3.63. The answer, "It sucks" was rated poorly for all people (averages between 3.84 – 4.65). (see Figure 6.6)

Figure 6.6

Face Saving Survey Responses to Full-time Work Justifications

When people ask you "What is like working full-time this summer?"
You tell them:

How would the following people rate that answer?			Now I know what it is like to be a man and work full-time.	I am learning how to act at work.	It makes me see why I don't want t do a lame job when I grow up.	It sucks.
Family	Adult	Your mother (N=18, SDs=.97, 1.183, 1.543, 1.149)	1.67	1.89	3.5	4.56
		Your father (N=14, SDs=.852, .893, 1.534, 1.242)	1.43	1.79	3.27	4.4
		Your gandmother (N=17, SDs=1.033, 1.197, 1.417, .786)	1.76	1.94	3.59	4.65
		Your grandfather (N=15, SDs=1.082, .915, 1.404, .828)	1.8	1.87	3.4	4.6
		Your favorite aunt (N=16, SDs=1.025, 1.123, 1.506, .874)	1.88	1.94	3.5	4.53
		Your favorite uncle (N=18, SDs=1.043, 1.015, 1.495, 1.179)	1.83	1.82	3.33	4.28
		Your sister(s) (N=15, SDs=.862, 1.068, 1.617, 1.359)	1.8	1.85	3	4
		Your brother(s) (N=17, SDs=.951, 1.144, 1.452, 1.118)	1.82	2.06	3.12	4
Non-Family	Peers	Your best male friend (N=18, SDs=.998, 1.243, 1.495, 1.433)	1.94	2.11	3	3.95
		Your best female friend (N=18, SDs=.937, 1.224, 1.571, 1.463)	1.94	2.05	3	3.84
		Other friends (N=19, SDs=1.084, 1.197, 1.534, 1.425)	2.21	2.11	3	3.84
		Popular kids at school (N=18, SDs=1.249, 1.257, 1.434, 1.37)	2.5	2.37	2.94	3.89
		A "geeky" friend (N=17, SDs=1.118, 1.295, 1.451, .97)	2	2.17	3.11	4.33
		A co-worker (N=18, SDs=1.056, 1.079, 1.514, 1.487)	2.06	1.95	3.06	3.89
	Adult	A favorite teacher (N=19, SDs=1.068, 1.119, 1.305, 1.124)	1.84	1.84	3.58	4.47
		A coach or activity leader (N=19, SDs=1.049, 1.119, 1.3, 1.149)	1.89	1.84	3.63	4.44

Figure 6.6. This heat map illustrates the average participant ratings of justifications for full-time work on a scale of 1 – 5, with 1 (white) as a good justification and 5 (blue) as a bad justification.

In focus groups the participants were asked what response they would give to parents about their experience working full-time. Many expressed that working full-time was difficult and game testing was tedious, but they would be unlikely to tell their parents or guardians a negative-sounding response. They were more likely to emphasize the responsibility of working full-time to their adult family members. As Steve told us, working fulltime is tied to manhood and growing up; "They told me when I first got the job, 'Yeah, Steve is being a man now, he is making his own money.'" And Levon said that talking about a job makes him seem more grown up, "My folks look at me as more of an asset. Yeah, to have a job, and they are like, (in deep voice) 'Oh, responsibility.' They look at you as more mature. You got more responsibility."

While it did not rate highly in the survey, participants talked in the focus groups about using the justification, "It sucked," as well as emphasizing negative aspects or difficulties of the job, in order to make themselves appear world-weary and mature. With an attitude of bravado Dre told us, "They be like, 'Yep, that is what you get, that is what you do to get paid.' " and Xavier said, "I would say…'You know it was boring, but you know at the end of the day I deal with it.' " When asked what other responses they would give to less close peers they emphasized that they had fun and got to hang out with people their age who became friends. Jayden told us that he would mention to peers at school, "I had a good experience with friends," and Levon mentioned that he would add a chance to brag about getting paid; "I would say that I like it, which I do, and that I have fun and then I might just push it in there, oh it also pays good and it has good hours."

Participants also said that to adults and distant family members they would likely tell them that it was difficult, because that is part of what being grown up is and "life is hard." They also indicated that to distant adult family members and friends the idea of working full-time and being paid good wages was of significant social value. Keandre told us, "Yeah, I just probably tell them the same thing I tell a friend. 'Yeah, it is a job.'" There was a subsection of non-family member adults, primarily teachers, to whom they indicated they would give different responses. Dre told us his response to a computer teacher would be, "Oh, I went to work, I also got paid and learned some AP CS."

While the face that they put on working full-time was frequently about the weight of the responsibly and simply being more "grown up," in interviews the participants told us a different story about working full-time. For all of the participants, this was their first full-time job, and for many it was the first time they were responsible for getting themselves to and from work. In many ways, the logistics of waking up on time, getting to work, managing their own lunch and budgeting for all of these things were the experiences they most valued. As Arnold mentioned, "It is just the experience. Like you learn a lot of things. I didn't know how to ride the bus, so I had to learn. It is just things like that that you can't survive without learning." And Isaiah told us about how financial independence changed his relationship with his mother. "I make money. I don't have to rely on anybody else for what I want or need. So, I don't have to hear my mom give me a lecture about why I shouldn't get this or why she's not paying for it."

Holding down a good job was a very acceptable excuse for participating in Glitch. This was about making money, doing cool work (game testing), and being mature and responsible. While the reality was that the job was frequently difficult and tedious and the responsibility was something they were learning, the face participants put on their experience was of a mature young adult who, because of special skills or talent, held down a difficult but very desirable job.

Broader Observations and Findings – Becoming a Grown Up

While the surveys and focus groups were organized around participation in computer science, working on campus, game testing, and full-time work, themes overlapped among all of the focus group discussions regarding maturity. It was apparent that working, earning money, and being responsible in a way that was considered "grown up" was the primary set of excuses that the participants used to explain what they liked or gained from Glitch to adults.

Participants found it difficult to test games all day, miss out on summer fun, and wake up early every weekday. This was something that they talked about with close friends and siblings, and these were perceived as acceptable topics because they had "adult" things to complain about. When asked what he told people at school, Eddie said that he made sure people knew that the job was difficult: "I tell everybody, you sit there and play the same game for 8 hours straight sometimes. It is not that fun. (Shaking head, laughing, and emphasizing) It is not that fun. But then I tell them there are days we get a new game and we play 'em. But other than that it's a real job and it's not fun." Xavier tells friends that it was hard, but with a glint of humor, "I'd say it wasn't easy. It was very tiring. I had to go see the chiropractor a couple of times. (laughing)"

Participants also told us that they tell peers how being on a college campus was different than high school and provided them with life skills that they did not get in high school. Rodrick said, "I say it's not high school…You have to be more responsible. You have to buy your own food, get your own transportation, buy your own supplies, and get your own place. It ain't like your parent or grandmother going to help with all that."

This access to an adult life experiences were of real value to the participants because the recognized they needed these experiences to teach them life skills. They were also of value because of the social prestige they brought. Participants' comments suggest they felt that working on a college campus made them appear more like college students, more mature, sophisticated and with more opportunities than their peers.

Summary

The immediate, short-term, and long-term measures of interest and intent to persist with computing indicate that the participants are on track to pursue computing as a career. The post-secondary educational choices further support these findings. The participants' responses to specific languages, Alice and Jython, support formative findings that text-based languages provide authenticity, which is important to motivation. This value on learning authentic CS tools may be an example of participants' desire to present their experience with Glitch as real work experience rather than an educational outreach program. This ties in to finding from the face saving study, which shows that an interest in computing or learning is not what the participants tell their friends and family about Glitch. In the next chapter I will discuss the differences between justifications for participation and real interest in learning, and explore the relevant broader implications for African American males and the learning sciences.

CHAPTER 7

DISCUSSION

Findings from the design, implementation and evaluation of Glitch contribute to answering the three research questions:

RQ 1. *How do young African American males play practices impact their interest in computer science?*

RQ 2. *What are the design principles to leverage technology for learning with those engaged in active non-learning?*

RQ 3. *How does face saving help navigate cultural conflict with learning?*

In this discussion I will address each of these questions in relation to the findings and discussion from the formative work and reflections from the post-interviews on how digital game play practice changed after Glitch. In the process of answering RQ 1, I developed design principles that were used to design and implement the Glitch Game Testers program. The evaluation and study of Glitch informs RQ2. The evaluations of Glitch suggest a successful intervention to leverage technology and interest in computing among a group that is frequently disengaged with learning. This success became a context to systematically study how face saving was used to navigate around cultural pressure to appear disengaged from learning, and contributed to RQ3.

RQ1: Cultural Values, Play Practices and Learning

The initial observation that African American males played digital games frequently but did not leverage that into an interest in computing proved to be an important jumping-off point for the formative work. This formative work contributed to Research Question 1: *How do African American males' play practices encourage or discourage computer science learning opportunities with digital games?* These formative findings are supported by participants' reflections on how their perception of digital games has changed through their participation in Glitch.

Sportsmanship vs Gaming the System

Background and formative work on masculine constructs in African American and geek culture mapped directly to the play practices of both groups. African American males' play practices focused on physical skills, sports and sportsmanship with little agency over the digital game. This kind of play therefore did not result in an interest in computing. In contrast, formative study of CS majors' play practices indicated their early play practices included hacking, modifying, and cheating with digital games. These practices seeded interest in computing by encouraging them to break open the games and see the computation beneath it. This maps to constructs of masculinity in geek culture such as demonstrating agency with computation by hacking, modifying, and cheating digital games, led to an interest in computers. This suggest that the cultural values that African American males bring to their game play that encourages sportsmanship and emphasis on sport, discourages CS learning opportunities with digital games.

Other Play Practices

Other play practices of young African American males emerged that might encourage using games for learning CS. First, a strong value on competition in African American males' gaming corresponds to computer scientist practices in gaming and in the CS classroom. This suggests that elements of the competitive CS environment might hold opportunities to leverage CS learning with African American males. Second, play practices frequently included older family members, which suggest that digital games hold cultural capital beyond peers. This cultural capital can provide a motivation for pursing interest in making games to family and peers.

Reflection on Technology Practices After Glitch

In interviews, Glitch participants said that game testing encouraged them to look under the hood of digital games and to begin to explore what they found as computation. Chappelle said, "I learned certain things in Glitch, if I go home and play a football game. I used to just try to play the game, win the game, now I just take my time and mess around with the game..." This description highlights the change that many of the young men where making. They no longer just consumed digital games, but rather became part of the community of practice that produced games. Because of this they saw the parts—computation, artwork, game design, etc.—that go into making the whole.

While I initially was specifically looking at digital game play practices, analysis of other cultural values and their interaction with technology practices proved to be useful. For example, other factors tied to exposure to software quality assurance work contributed to our successful outcomes with Glitch. Participants joined Glitch believing that game testing would be the most enjoyable job they could every have. By the end of their first summer they told us that game testing was difficult and tedious work. This had a two-fold effect on increasing interest in CS learning. First, participants were eager to attend CS workshops because they were more interesting and engaging than testing. Second, participants recognized that game testing (the dream job that did not require a college degree) was not a job they would value as a careers, and that to do what they valued, making a greater contribution developing digital games, they would need additional education in CS or digital media.

RQ2: Design Principles for Motivating Non-Learners

Initial observations were correct in that cultural values shaped how technology was used, and therefore influenced the affordances for learning with technology. However, other cultural values seemed to also hold a significant place in creating a CS learning environment. Research Question 2 asked, “What are the design principles to leverage technology for learning with those engaged in active non-learning?” In response I outlined four principles that balance cultural values and technological affordances:

- Emulate Successful Practices – Move beyond the idea that just using a technology will lead to learning, and foster understanding of *how* other groups leverage technology for learning, and *why* that results in effective learning. This instruction can inform designs to emulate these practices.
- Respect Culture – Place a priority on the cultural values of the group targeted. Even when the cultural values seem to be in opposition to learning goals they must be given priority because a non-learner will not reject their own culture for the sake of learning.
- Affordances in Technology Practices – Seek to understand the targeted group’s technology practices so that, if affordances for learning exist, they can be incorporated into the design of learning interventions.
- Affordances in Cultural Values – Find opportunities to support cultural values associated with technologies and leverage those for learning.

The evaluation and outcomes from Glitch indicate that these design principles were effective in creating a learning environment that leveraged technology for learning. The number of participants who went on to post-secondary education is remarkable, particularly for a demographic that frequently rejects learning. That so many of the participants in Glitch chose to major in computer science is even more remarkable considering the low rates of engagement that young African American males have with producing computation. It is important to note that these design principles balance cultural values and technology affordances. An example of the balance between the cultural values and technical affordances can be seen in the introductory CS workshop's use of two different programming tools.

Reflecting on Cultural Values in CS Learning Tools in Glitch

Even among this rather homogeneous group of young men, different CS tools appealed to different participants and enabled different learning. When looking at the tools we used to teach the introductory CS workshops, cultural values seemed to play a role, which prompted us to ask which language—a game-like and visually compelling tools such as Alice, or an authentic practice tools such as Jython—would be better in Glitch. Not surprisingly, interest in visual media was an aspect of Alice that some participants found appealing. The enthusiasm for Jython's text-based programming and appreciation of its "authenticity" was even greater than we anticipated. The preference for one tool over the other was not tied to self-assessment of learning gains. Those who preferred Alice over Jython, or vice versa, had no more confidence in their abilities across tasks for both languages.

Beyond participants' reported preference for one language over another, patterns emerged in attaining learning goals. Alice was more likely to help the participants in Glitch understand broader CS concepts such as object-oriented programming methods. However, in the questionnaire, participants expressed a high degree of confidence in understanding basic operations of Alice and in explaining what programming is, but less confidence in explaining to someone else more complex ideas such as functions, algorithms, and step-wise refinement.

In contrast, Jython, taught in a computational media context (Guzdial, 2003), seemed to serve as a vehicle for understanding computing concepts in application rather than abstraction. For example, in responses to the questionnaire, students were not confident that they could explain an algorithm as taught to them through Alice, but they did express confidence that they could describe more concrete examples of algorithms used with Jython.

The design principles also supported consideration of cultural values that, upon reflection, did not appear to be of value to the young men in the program, but were of value as a justification or "face" they could put on actions that would normally be considered culturally inappropriate, such as engaging in learning CS.

RQ 3: Saving Face While Geeking Out

Studies conducted in the Glitch learning environment contributed to answering Research Question 3: *How does face saving help navigate cultural conflict with learning?* We have seen a number of measures that demonstrate that participants increased their interest in computing. This could also be observed in the everyday interactions at Glitch. These guys are friends, they like and respect each other, and they talk about programming, hacking or game design with each other without worrying too much about being thought of as a geek. However, they didn't start out that way. They started in Glitch presenting very different faces to their peers. In our first computer science workshops, they kicked back in their chairs and only answered questions when candy or points were offered as a reward. These external motivators seemed to be the only thing moving them to learn or to demonstrate their learning.

As I asked why these external motivators worked, it became clear that their willingness to participate in learning was not motivated by pieces of candy; the candy was only an excuse for trying hard. I felt that a desire to learn, a natural curiosity, was in each of these young men, but they could not act upon it because it was in direct contrast with their presentation of self. When they could protect their presentation of self, or save face, by using the candy or competition as an excuse, they eagerly participated. As they spent more time in Glitch, some of the face saving fell away when they were at Glitch. However, they maintained many of these face saving tactics with their family and friends.

Avoidance: Not Talking about Computer Science Learning

In the surveys and focus groups, participants let us know that their peers, particularly those who were not close friends, did not care about what they might or might not be learning in their computer science workshops, and they would be unlikely to ever mention it. They also told us that they actively avoid talking about learning computer science with their family. They were afraid that their adult family members would become too enthusiastic or they would know too little, and explaining to novices was not enjoyable. With peers, the choice to actively not talk about what they were learning was tied to both the topic, computer science, and to learning in general. For some, being good at computing was not an identity they wanted, and for others, caring about learning was not an identity they wanted. With adult family members, the topic of computer science was the primary obstacle to talking, because computing is not something that their parents or guardians know about and participants felt fearful of broaching the subject with them. The participants suggested that they feared their parents would want everything explained and this would be a nuisance. Some also expressed a fear of making their parents feel or look less knowledgeable about a topic.

Manhood: The Good and the Bad

Participants told us they would offer negative explanations to peers and adults (but not their parents or guardians) about the day-to-day grind of working full-time or the tediousness of quality assurance work. This was a way to emphasize the responsibility they had taken on. This identification with being more adult was also expressed to their parents in more explicit ways when their parents remarked that they were becoming "men" or taking on adult responsibilities. Some of this was also about having their own money, taking the bus to work each day, and being on their own in the city rather than just in their neighborhood.

Being Cool: Positive Associations

The complaints about working could be seen as an aspect of cool pose (Majors, R. & Billson, J.M. 1993). I also saw more positive cool pose associated with Glitch. Because Glitch provided a job that the participants felt was impressive, they often bragged about it with their peers. They told us about teasing their friends with their cool job, leaning back and bragging about being paid to play games. The participants also talked, however, about how game testing was not fun. The recognized that sitting in front of computer in a darkened room every summer day, playing a small section of a game they did not like over and over again, was not something that their friends would admire. So they downplayed the negative aspects of the job, presented a different image of Glitch and game testing to their friends and peers.

The Face Saving Surprise

Although I did not set out to design for face saving, our extensive formative research encouraged us to design in ways that ended up supporting face saving tactics. For example, we created a Glitch point system awarding weekly games and a computer at the end of the summer for top point earners. We did this because we thought that being competitive was motivating. What we observed was that being competitive was used as an excuse for learning efforts even when it was apparent that they were enthusiastic about learning for its own sake. This observation encouraged us to look at the other face saving tactics in order to understand how our design process encouraged them.

We found that our design of the program as a paid job was motivating for reasons other than the money it provided. Work experience and making money was the excuse they presented to their peers and adults for participating. Only to their closest friends, ones who share an interest in computing, or to their favorite teacher would they present learning as a motivation.

The formative work in Chapter 3 outlined the design research activities that emphasized participatory design and purposefully created a value system in Glitch that would match that of our participants. However, the fact that many of these elements, such as the pragmatic need for a paying job, were used as justifications for participating in learning surprised us. Other elements were powerful excuses for participating, motivations that we did not design, but which instead occurred naturally. Students were primarily tied to the location. The program was originally to be held at Morehouse College, because the all-male African American school would provide additional everyday role models for the participants. However, the pilot project demonstrated that the lack of public transportation and control over the space made Morehouse difficult. Georgia Tech had a room for our exclusive use and was located closer to major hubs of public transportation. Participants felt that being on the Georgia Tech campus offered a number of advantages. Primarily it gave them prestige in front of their friends and family because Georgia Tech is considered the top institution in their communities. Its national reputation for engineering and sports makes it exclusive, and because of its public status, it seems attainable for them. They enjoyed telling people that they worked at Georgia Tech and seeing their reaction.

Participants also enjoyed talking about college life, particularly bragging about meeting college women. Although we observed them talking to very few young women, talking about girls was a consistent topic. These types of presentation of self—being smooth with the ladies, and being tied to an exclusive institution—fit with different identities these young men created for themselves. By contextualizing Glitch in these ways, they could come in each day and learn programming without becoming a geek.

Summary

This line of research began with the idea that games can be leveraged for sparking an interest in CS. This was proved correct. Young African American males were eager to have jobs that paid them to play games. There are subtleties in the details, however, that go far beyond that initial motivation. By framing our understanding of motivation around active non-learning we were able to uncover the face saving tactics that the young men used to negotiate between maintaining cultural identities and identifying with learning and computer science. By presenting their computer science experiences as a part of holding down a cool job, trying to win a competition, or the next step beyond game testing, these young men were able to enjoy learning without threatening their self-beliefs or identity.

The concept of face saving can be used as both a lens for understanding what happened in Glitch and also as a design tool for circumventing motivations to not-learn. Using face saving to understand how Glitch was successful for African American males provides specific lessons that can be applied to future learning interventions for this group. Broader applications of face saving concepts can be used to help design interventions for other groups who are frequent non-learners, or in designing learning environments for topic areas, such as CS, that are resistant to self-belief changes due to cultural conflicts.

CHAPTER 8

CONCLUSION AND FUTURE WORK

The research presented in this dissertation provides insight into the question: *How do different cultural values and technology practices impact participation in the production of computation?* These insights move towards answering this question, by way of a mixed-methods approach that draws on design research, qualitative methods, and learning science and technology. In this chapter I will address three ways in which these methods have contributed to answering this central question.

- First, by looking at technology practices with digital games, I found that cultural values impacted how the user interacted with the underlying computation of the games and the potential for the technology to inspire computational production.
- Second, by looking at young African American males (a unique audience), I found implications for future technology interventions with this audience to increase their agency with technology.
- Third, the study of the Glitch program contributes to theory on learning motivation through the construct of the non-learner and the systematic study of face saving as a method to navigate around motivation to not learn. This method may have particular implications for computer science.

Each of these contributions also suggests future directions for research that have implications for human-centered computing, computer science education, and the learning sciences.

Implications of Cultural Values on Computational Production

The work in this document explores how cultural values play a role in technology use, and in turn impact participation in the production of computation. Specifically, cultural values are addressed in the context of digital game play practices. While there is a growing body of research that has looked at women's and girls' use of games, and a few studies of race and gaming, this is the first study that looks at the intersection of race and gender in gaming play practices, and on the impact of race and gender on interest in computing. This is of value, because the race and gender of young people is a strong indicator of their level of participation in computation, from consuming computation to producing computation. It also is of value to address the challenges in African American male education because African American males are the group that are most likely to lie near the consuming end of the computational participation spectrum, and they are the group facing the greatest challenges in our current educational system.

Context of Games as Technology

To begin to answer the broader questions of how culture impacts our technology use and engagement with the production of computation, I chose to look at one technology, digital games, and one group defined by race and gender, young African American males. Digital games are one of the few computational mediums that have been researched through a cultural lens, particularly looking at gender and gaming. By looking at young African American males' practices with this technology, we can begin to see how cultural values that are shaped by more than gender impact choices with technology and engagement in computation.

Previous work that explored race and ethnicity and gaming has informed my research by demonstrating the current state of the representation of race in games. Young white male characters have a wide range of different attributes, while black male characters are primarily athletes in sports titles and gang members in first person shooters. This previous work supports findings that race and ethnicity impact game selection and time spent gaming. Research that looked at gender and gaming found that girls' play practices are different than boys', suggesting a cultural influence on how people engage with technology. Gender and gaming studies have focused almost exclusively on women and girls, however, little research has considered the intersection of race and gender in digital game use.

The formative work I conducted looked at the play practices of young African American males and CS majors. The differences in the play practices of these two groups mapped to the cultural norms for masculinity in African American and geek cultures. This observation has broader applications, in that the technical practices of different groups demonstrate not only differences in content choices or time spent playing but also the way in which culture impacts an individual's interaction with the computation of digital gaming. Implications for studies in human-centered computing suggest that these methods of understanding cultural values have an impact on interaction with computation that could be applied to any technology. With a lens of cultural values, we can see how computation is appropriated, and perhaps design better computational interactions that are more inclusive for the diversity of our population.

Intersection of Gender and Race

The broader applications for this type of analysis can be explored through the concept of the computational participation spectrum, which I developed and put forth in Chapter 1. This computation production spectrum helps to explain patterns of use among groups, based upon race and gender. For groups such as African American males, their use of technology tends to the consuming end of the spectrum, such as using digital games or mobile phones. Very little of their use lies on the production end of the spectrum, neither producing new computation nor producing content with computational tools. Other opportunities can be explored based upon where groups may lay on this spectrum. For example, young Africa American women are frequent producers of content with computation, such as blogs or social network interaction. Can this pattern of use be leveraged into computational production? The intersection of gender and race offers a way to find these patterns in technology practices and design new engagements and learning opportunities for human-centered computing and computer science education.

Implications for African American Male Learning

While this analysis can be applied to groups from various backgrounds and identities, young African American males are a group that offers unique challenges. Young African American males tend to be on the consumer end of the spectrum, be underrepresented in computing, and have low performance in school, all of which are likely factors in their high rates of under-education, unemployment, incarceration, and death. By using design research methods, including extensive participatory and co-design with young African American males, this research contributes to methods for designing learning environments for young African American males to help them navigate conflicting motivations, allowing them to both adapt a cool pose and work on interesting geeky problems.

One way that the participants in Glitch navigated these conflicting motivations is by using acceptable justifications for their participation in Glitch. The participants stated in interviews, focus group sand surveys that work and pay were primary justifications for participation in Glitch. They also indicated that the real reasons for their participation also included a desire to learn about computing or to be a part of a community, both things they might express to their closest friends. However, justification of work and pay, particularly working at a cool job like game testing, was a way for them to navigate the motivations to not learn that sometimes limit the motivation of young African American males in educational settings. I suggest that authentic work and pay is an effective method for engaging young African American men in learning opportunities.

The use of weekly talks from computer scientists was more impactful than we anticipated. Our speakers represented a different image of computing and technology workers. Of the 13 speakers we had from 2009 – 2010, 8 are African American male faculty or technology workers, 3 are White American females, one is a White and Indian-American female, and one is a White American male. Their personal stories about overcoming issues around race and poverty, and their demonstrations of a passion for learning or gaming, provided new narratives for our participants to explore and imagine themselves in. This functioned similarly to storytelling as understood in critical race theory (Ladson-Billings & Tate IV, 1995), and provided a way for the participants to see challenges they might face as computer scientists, as well as to understand the spectrum of narratives beyond the stereotype of geeky males.

Through observations, interviews, and surveys, there was evidence that the participants' self-theories changed, and that this shift had a positive impact on increasing motivation to learn. However, I did not set out to explicitly change these self-theories, nor did I collect data to establish baselines. For future learning interventions with African American males, I suggest specifically designing self-theory interventions and using established self-theory measurement tools as a means of assessment. The use of established interventions for changing self-beliefs, coupled with design research for establishing the correct context for these interventions, holds promise for powerful change in the motivation of non-learners.

Implications for Learning Motivation

This research offers two concepts that provide future opportunities for research in learning sciences. First is the construct of the non-learner, which can be used as a lens for studying groups that are disenfranchised from the educational system, and as a method for understanding intercultural conflict between students' values, learning goals, and belief systems. Second, the application of face saving theories contributes to designing learning environments for non-learners.

Non-Learning

The construct of the non-learner provides a new lens for understanding motivation in the learning sciences. This construct is the synthesis of many other theories that look at students' rejection of learning. Dweck's (2000) self-theories provided the background for understanding why stereotype threat (Steele, Spencer, & Aronson, 2002) impacted young African American males' motivation to learn. Other theories based upon cultural issues offer a lens on how cultural values and loyalties impact learning motivation. In Kohl's observations and analysis, we find an initial introduction to the active non-learner. However, Kohl's work is based upon his observations over the course of a productive career in education, not a study of learning motivation. This work moves beyond Kohl by examining all of these theories closely, synthesizing them and then using this synthesis, the construct of non-learners, as a lens for studying Glitch. What is important about the non-learner is that their choices to not learn are based upon valid values. Rather than changing their values, we need to assist students in navigating around the intercultural conflicts between their values and learning goals and their beliefs about the educational system. In these ways, the construct of the non-learner becomes a lens for studying groups that are difficult to reach.

Face Saving

In communication theory, intercultural confrontation is often answered with face saving tactics (Ting-Toomey & Kurogi, 1998). By designing CS learning interventions that held value to family and friends of the participants – allowing them to *save face* - participants could develop interest in CS and an identity as a computer scientist. Participants presented the face of a responsible son to their family, someone who had a good job working with computers at Georgia Tech. In contrast, participants told their friends they were paid-to-play. While we did not initially design for face saving, we did design for cultural values based upon ethnographic and design research methods. We were working from a definition of cultural values as the resulting strategies of action used by an individual developed from experiences, stories, rituals and world views that individual has been exposed to. So rather than focusing on the identity of the individual, we looked at his family and community as primary drivers of his presentation of self. In designing Glitch, there emerged conflicts between cultural values and computer science learning goals. This conflict is central to overcoming the motivation to not-learn. Face saving offered a way to negotiate the conflict. Participants maintain their cultural values through face saving while still having the opportunity to participate in learning.

Face saving tactics occurred in Glitch without an explicit goal to create these tactics. In Glitch, we see that face saving can serve both as a lens for understanding how active not learning can be negotiated for specific groups and as a design tool for creating self-belief interventions. In future research I hope to utilize the design research methods that address face saving in formative work more actively, which will allow me to more effectively incorporate face saving into my research.

There is no way to design for all of the cultural values that non-learners have. Kohl might address that problem by training teachers so they can negotiate those value differences. However, this can be difficult because of institutional, financial, and philosophical challenges. Designing for face saving may help place the power in the hands of learners, offering them different presentations of self, allowing them to negotiate their own identity, community, and learning choices.

Future Work

While Glitch can be considered a successful outreach program in increasing interest in computing, there were many questions that were left unanswered. Some of these questions are fundamental to the motivation of Glitch and other computing outreach programs. Now that computer use in the US is becoming ubiquitous, what does that mean for broadening participation in computing? Other questions were tied more specifically to the type of intervention that Glitch is. When looking at successful research interventions or products, how can we evaluate what makes them successful and pinpoint generalizable findings and methods for reproducing successes?

Participation with Computation

In the introduction of this document, I used the concept of the computational participation spectrum to frame discussions around how race and gender are correlated to engagement with computation, from consuming to producing. This frame ties directly to recent conversations around computational thinking (Wing, 2006) and broadening participation in computing (Glibert, 2006). The computational participation spectrum framework, while hopefully adequate as a rhetorical device, encourages additional questions. How can we define computational production? What places along this spectrum do users engage in computational thinking? And finally, in relation to this spectrum, what are we trying to achieve with outreach programs that use computation? Is digital literacy as a consumer adequate? Do we need a type of computational fluency to be fully engaged with the computational world?

Applying Messiness of the Real World to Design

Much of the success of Glitch may be attributed to formative work that considered cultural values and technology practices. However, the ways in which I was able to connect from the formative work to concrete design choices is difficult to define and to teach others. Questions remain about the practicality of replicating this type of culturally situated work. What is the nature of the process between formative and design research outcomes and designing interventions? How does thinking about designing for one group, such as African American males, provide us with a new lens for problems that may apply to others? And more generally, to what extent does Glitch speak to particulars of a situated environment versus generalizable, broader truths?

Finding Causes of Success

When doing learning sciences or Human-Centered Computing (HCC) research sometimes a failure can provide more insight than a success. When exploring something that fails, it is often easy to pinpoint exact moments where the intervention or the system breaks down, and then to identify why. In Glitch, many factors supported its success. How do we tease them apart and what is their relative importance? To help answer this question, future work may focus on refining methods for working with successful HCC interventions by building upon Design-based Research (Barab, S. & Squire, K., 2004) methods to incorporate methods from the design research field.

In future work I hope to address these questions by working with new groups, such as lower-income mothers or young Cajun men. I hope to use the computational participation spectrum to first, understand where groups are currently situated in relationship to technology use; second, to identify appropriate areas along the spectrum they would benefit from participating; and third, through these exercises to define what it mean to be producing or consuming computation. After formative work, I will seek to apply the design principles defined in Chapter 3 in new learning interventions or computational systems, with the goal to refine and expand upon them. Glitch demonstrated that use of design provided insights, but we need unpack the use of design methods in the field of learning sciences. Analysis of future research programs that use design methods, as they are developed, may advance the vocabulary of, methods for, and conversations about design as it is integrated into the learning sciences. These conversations should also consider how to unpack successful intervention or systems to better identify what works and what does not.

APPENDIX A

PROTOTYPE WORKSHOP SURVEY

A paper survey with the following questions was given to participants before the prototype workshops began.

- What is your age?
- What is your ethnic or racial identity?
- What school do you attend?
- What grade are you in?
- What is your favorite subject?
- What is your least favorite subject?
- What do you plan on doing after high school? (going to work, college, trade school)
- What are your future career plans?
- What after school activities do you do?
- What is your favorite video game?
- What is your favorite platform for video games? (Xbox, PSP, computer, moble phone, etc.)
- How many hours per week do you usually play video games?

APPENDIX B

FORMATIVE STUDY SEMI-STRUCTURED INTERVIEW QUESTIONS

Digital Games (Pre-Interview Only)

- Favorite video game
- Favorite platform for video games
- Hours per week playing video games
- How important is communities or socializing around games
    - Preferences for playing alone or with group
        - Playing with Family
        - Playing with friends
        - Goals when playing alone versus with group
    - Participation in online play
    - Exchanging cheats, strategies or other information about games
- Most important thing about playing games
- Best thing about playing games

Interest in Computation

- What is your experience with computers?
- Are you planning on taking computer classes or technology track at school?

Computer Literacy

- What do you know about computers?
- What are some computer tasks you know how to do?
- What computer task do you provide/seek help with?

Post Interview Only

- Before signing up for the workshop did you think about working for a game company?
- What did you learn during the workshop?
- What would you change about the workshop?
- Will you think about games differently now?
- Will you think about computers differently now?

APPENDIX C

INTEREST IN COMPUTING SURVEY

APPENDIX C: INTEREST IN COMPUTING SURVEY

1. Please provide the following information:

1. Glitch Alias:

2. Grade that I will enter in the fall:

- Freshman
- Sophomore
- Junior
- Senior

3. Age:

4. What high school do you attend?

5. What is your grade point average (GPA)?

2.

1. What do you plan on doing right after high school?

- Ministry
- Military
- College
- Working
- Trade School
- Volunteer Work

Other (please specify)

3.

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APPENDIX C: INTEREST IN COMPUTING SURVEY

1. Where are you thinking about going to school?

2. What do you want to study or major in?

4. COMPUTER QUESTIONS:

Directions: Choose whether you Strongly Disagree, Disagree, are Not Sure, Agree, or Strongly Agree with each question. Choose one answer per question. If you do not understand a question, just do the best you can. There are no wrong answers!

APPENDIX C: INTEREST IN COMPUTING SURVEY

1. How strongly do you agree with the following statements:

	Strongly Disagree	Disagree	I'm not sure	Agree	Strongly Agree
Before Glitch, I knew how to use the computer.					
Now, I know how to use the computer.					
Before Glitch, I was always finding better ways to use the computer					
Now, I am always finding better ways to use the computer.					
Before Glitch I though that if I got better using computers, it would help me do better in school.					
Now, I think that if I got better using computers, it would help me do better in school.					
Before Glitch, I was not very good at using a computer.					
Now, I am not very good at using a computer.					
Before Glitch I thought, when other students' attitude toward math improves, it is often due to their having learned how to use the computer.					
Now I think, when other students' attitude toward math improves, it is often due to their having learned how to use the computer.					
Before Glitch I thought, even when I try hard, I do not use the computer as well as others do.					
Now I think, even when I try hard, I do not use the computer as well as others do.					
Before Glitch I thought, I generally use the computer poorly.					
Now I think, I generally use the computer poorly.					
Before Glitch I thought, learning how to use the computer well would help me in my classes.					
Now I think, learning how to use the computer well would help me in my classes.					
Before Glitch, I understood what a computer can do well enough to use it correctly.					
Now, I understand what a computer can do well enough to use it correctly.					
Before Glitch, my success in school was related to how well I could use a computer.					
Now, my success in school is related to how well I can use a computer.					
Before Glitch, I knew how to use a computer as well as most students.					
Now, I know how to use a computer as well as most students.					
Before Glitch I thought, learning how to use a computer could help me.					
Now I think, learning how to use a computer could help me.					
Before Glitch, I found it difficult to use a computer.					

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APPENDIX C: INTEREST IN COMPUTING SURVEY

Now, I find it difficult to use a computer.	○	○	○	○	○
Before Glitch, I thought learning to use a computer would not help my future.	○	○	○	○	○
Now I think, learning to use a computer will not help my future.	○	○	○	○	○
Before Glitch I thought, it is not worth my time to use a computer.	○	○	○	○	○
Now I think, it is not worth my time to use a computer.	○	○	○	○	○
Before Glitch, I thought I would probably never use a computer once I leave school.	○	○	○	○	○
Now I think, I will probably never use a computer once I leave school.	○	○	○	○	○
Before Glitch, given the choice, I would not let the teacher grade me on using the computer.	○	○	○	○	○
Now, given the choice, I would not let the teacher grade me on using the computer.	○	○	○	○	○
Before Glitch I thought, it is really not necessary to use a computer.	○	○	○	○	○
Now I think, it is really not necessary to use a computer.	○	○	○	○	○
Before Glitch when I had an assignment which involves a computer, I was usually at a loss as to how to do it.	○	○	○	○	○
Now when I have and assignment which involves a computer, I am usually at a loss as to how to do it.	○	○	○	○	○
Before Glitch I thought, computers can be helpful.	○	○	○	○	○
Now I think, computers can be helpful	○	○	○	○	○
Before Glitch I thought, I might someday make more money if I learn to use a computer.	○	○	○	○	○
Now I think, I might someday make more money if I learn to use a computer.	○	○	○	○	○
Before Glitch, I felt comfortable when I used the computer.	○	○	○	○	○
Now, I feel comfortable when I use a computer.	○	○	○	○	○
Before Glitch I thought, most good jobs do not require computer skills.	○	○	○	○	○
Now I think, most good jobs do not require computer skills.	○	○	○	○	○
Before Glitch I did not know how to use the computer well.	○	○	○	○	○
Now I do not know how to use the computer well.	○	○	○	○	○
Before Glitch, whenever I could, I avoid using computers.	○	○	○	○	○
Now, whenever I can, I avoid using computers.	○	○	○	○	○
Before Glitch I thought, success in school had nothing to do with being able to use the computer.	○	○	○	○	○
Now I think, success in school has nothing to do with being able to use the computer.	○	○	○	○	○
Before Glitch, I enjoyed doing things on a computer.	○	○	○	○	○
Now, I enjoy doing things on a computer.	○	○	○	○	○

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APPENDIX C: INTEREST IN COMPUTING SURVEY

5. More Computer Questions:

Directions: Choose whether you Strongly Disagree, Disagree, are Not Sure, Agree, or Strongly Agree with each question Choose one answer per question. If you do not understand a question, just do the best you can. There are no wrong answers!

1. Before Glitch how strongly DID you agree with the following statements and how strongly DO you agree with the following statements now:

	Strongly Disagree	Disagree	I'm not sure	Agree	Strongly Agree
Before Glitch - I am tired of using a computer.	○	○	○	○	○
Now - I am tired of using a computer.	○	○	○	○	○
Before Glitch - I will be able to get a good job if I learn how to use a computer.	○	○	○	○	○
Now - I will be able to get a good job if I learn how to use a computer	○	○	○	○	○
Before Glitch - I concentrate on a computer when I use one.	○	○	○	○	○
Now - I concentrate on a computer when I use one.	○	○	○	○	○
Before Glitch - I enjoy computer games very much.	○	○	○	○	○
Now - I enjoy computer games very much.	○	○	○	○	○
Before Glitch - I would work harder if I could use computers more often.	○	○	○	○	○
Now - I would work harder if I could use computers more often.	○	○	○	○	○
Before Glitch - I know that computers give me opportunities to learn many new things.	○	○	○	○	○
Now - I know that computers give me opportunities to learn many new things.	○	○	○	○	○
Before Glitch - I can learn many things when I use a computer.	○	○	○	○	○
Now - I can learn many things when I use a computer.	○	○	○	○	○
Before Glitch - I enjoy lessons on the computer.	○	○	○	○	○
Now - I enjoy lessons on the computer.	○	○	○	○	○
Before Glitch - I believe that the more often teachers use computers, the more I will enjoy school.	○	○	○	○	○
Now - I believe that the more often teachers use computers, the more I will enjoy school.	○	○	○	○	○
Before Glitch - I believe that it is very important for me to learn how to use a computer.	○	○	○	○	○
Now - I believe that it is very important for me to learn how to use a computer.	○	○	○	○	○
Before Glitch - I get a sinking feeling when I think of trying to use a computer.	○	○	○	○	○
Now - I get a sinking feeling when I think of trying to use a computer.	○	○	○	○	○

APPENDIX C: INTEREST IN COMPUTING SURVEY

Before Glitch - I think that it takes a long time to finish when I use a computer.	◯	◯	◯	◯	◯
Now - I think that it takes a long time to finish when I use a computer.	◯	◯	◯	◯	◯
Before Glitch - Working with a computer makes me nervous.	◯	◯	◯	◯	◯
Now - Working with a computer makes me nervous.	◯	◯	◯	◯	◯
Before Glitch - Using a computer is very frustrating.	◯	◯	◯	◯	◯
Now - Using a computer is very frustrating.	◯	◯	◯	◯	◯
Before Glitch - Computers do not scare me at all.	◯	◯	◯	◯	◯
Now - Computers do not scare me at all.	◯	◯	◯	◯	◯

6. General Questions:

Directions: Choose whether you Strongly Disagree, Disagree, are Not Sure, Agree, or Strongly Agree with each question Choose one answer per question. If you do not understand a question, just do the best you can. There are no wrong answers!

APPENDIX C: INTEREST IN COMPUTING SURVEY

1. Before Glitch How strongly DID you agree with the following statements and how strongly DO you agree with the following statements now:

	Strongly Disagree	Disagree	I'm not sure	Agree	Strongly Agree
Before Glitch - I examine unusual things.	○	○	○	○	○
Now - I examine unusual things.	○	○	○	○	○
Before Glitch - I find new things to play with or to study, without any help.	○	○	○	○	○
Now - I find new things to play with or to study, without any help.	○	○	○	○	○
Before Glitch - When I think of a new thing, I apply what I have learned before.	○	○	○	○	○
Now - When I think of a new thing, I apply what I have learned before.	○	○	○	○	○
Before Glitch - I tend to consider various ways of thinking.	○	○	○	○	○
Now - I tend to consider various ways of thinking.	○	○	○	○	○
Before Glitch - I create many unique things.	○	○	○	○	○
Now - I create many unique things.	○	○	○	○	○
Before Glitch - I do things by myself without depending upon others.	○	○	○	○	○
Now - I do things by myself without depending upon others.	○	○	○	○	○
Before Glitch - I find different kinds of materials when the ones I have do not work or are not enough.	○	○	○	○	○
Now - I find different kinds of materials when the ones I have do not work or are not enough.	○	○	○	○	○
Before Glitch - I examine unknown issues to try to understand them.	○	○	○	○	○
Now - I examine unknown issues to try to understand them.	○	○	○	○	○
Before Glitch - I make a plan before I start to solve a problem.	○	○	○	○	○
Now - I make a plan before I start to solve a problem.	○	○	○	○	○
Before Glitch - I invent games and play them with friends.	○	○	○	○	○
Now - I invent games and play them with friends.	○	○	○	○	○
Before Glitch - I invent new methods when one way does not work.	○	○	○	○	○
Now - I invent new methods when one way does not work.	○	○	○	○	○
Before Glitch - I choose my own way without imitating methods of others.	○	○	○	○	○
Now - I choose my own way without imitating methods of others.	○	○	○	○	○
Before Glitch - I tend to think about the future.	○	○	○	○	○
Now - I tend to think about the future.	○	○	○	○	○

7. Career Questions:

APPENDIX C: INTEREST IN COMPUTING SURVEY

We would like to know more about your career interests. In Part 1, tell us about the careers that you would like to have. In Part 2, tell us about the careers that you think you would be good at.

1. How strongly do you agree with the following statements:

	Strongly Disagree	Disagree	I'm not sure	Agree	Strongly Agree
I would like to be a Doctor.	○	○	○	○	○
I would like to be an Engineer.	○	○	○	○	○
I would like to be a Lawyer.	○	○	○	○	○
I would like to be an Entertainer.	○	○	○	○	○
I would like to work in Law Enforcement.	○	○	○	○	○
I would like to be a Computer Programmer.	○	○	○	○	○
I would like to be an Artist.	○	○	○	○	○
I would like to be a Professional Athlete.	○	○	○	○	○
I would like to be a Technology Designer.	○	○	○	○	○
I would like to be a Teacher.	○	○	○	○	○

2. How strongly do you agree with the following statements:

	Strongly Disagree	Disagree	I'm not sure	Agree	Strongly Agree
I think I would be a good Doctor.	○	○	○	○	○
I think I would be a good Engineer.	○	○	○	○	○
I think I would be a good Lawyer.	○	○	○	○	○
I think I would be a good Entertainer.	○	○	○	○	○
I think I would be good at Law Enforcement.	○	○	○	○	○
I think I would be a good Computer Programmer.	○	○	○	○	○
I think I would be a good Artist.	○	○	○	○	○
I think I would be a good Professional Athlete.	○	○	○	○	○
I think I would be a good Technology Designer.	○	○	○	○	○
I think I would be a good Teacher.	○	○	○	○	○

APPENDIX D

INTENT TO PERSIST IN COMPUTING SURVEY

APPENDIX D: INTENT TO PERSIST IN COMPUTING SURVEY

1. Welcome!

Your input in this survey will help us to determine what direction you are heading after highschool, and understand some of your goals for the future.

It will only take a few minutes to complete the survey. We greatly appreciate your time and input.

Remember: There are no wrong answers. This is a survey about YOU!

Please providing the following information:

Glitch Alias:

Age:

Grade:

2.

How well do the following statements describe you and/or your plans for the future?

Before the Glitch Summer Program:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me
I planned on graduating from high school.	○	○	○	○	○	○
In the next semester, I planned on taking a class on computing.	○	○	○	○	○	○
In the next semester, I planned on taking a class on math.	○	○	○	○	○	○
I planned on taking as many classes as possible in computing every semester until I graduate from high school.	○	○	○	○	○	○
I planned on taking math classes every semester until I graduate from high school.	○	○	○	○	○	○

Page 1

APPENDIX D: INTENT TO PERSIST IN COMPUTING SURVEY

Now that I have been in the Glitch program:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me
I plan on graduating from high school.	○	○	○	○	○	○
Next semester I plan on taking a class on computing.	○	○	○	○	○	○
Next semester I plan on taking a class on math.	○	○	○	○	○	○
I plan on taking as many classes as possible in computing every semester until I graduate from high school.	○	○	○	○	○	○
I plan on taking math classes every semester until I graduate from high school.	○	○	○	○	○	○

3.

How well do the following statements describe you and/or your plans for the future?

Before the Glitch Summer Program:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me
I planed to apply to college.	○	○	○	○	○	○
I planned on graduating from college.	○	○	○	○	○	○
I planned on graduating from college with a computing related degree.	○	○	○	○	○	○
I would have liked to go to graduate school after college.	○	○	○	○	○	○
I would have liked to go to graduate school after college for a computing related degree.	○	○	○	○	○	○

APPENDIX D: INTENT TO PERSIST IN COMPUTING SURVEY

Now:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me
I plan to apply to college.	○	○	○	○	○	○
I plan on graduating from college.	○	○	○	○	○	○
I plan on graduating from college with a computing related degree.	○	○	○	○	○	○
I would like to go to graduate school after college.	○	○	○	○	○	○
I would like to go to graduate school after college for a computing related degree.	○	○	○	○	○	○

4.

How well do the following statements describe you and/or your plans for the future?

Before the Glitch Summer Program:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me
I planned on working in a technology related field.	○	○	○	○	○	○
I could have seen myself working as a computer scientist or programmer in the future.	○	○	○	○	○	○
I planned to find a job as a computer scientist or computer programmer.	○	○	○	○	○	○
I planned on earning a living as a computer scientist or programmer.	○	○	○	○	○	○
I planned to devote my career to an area related to computer science.	○	○	○	○	○	○

APPENDIX D: INTENT TO PERSIST IN COMPUTING SURVEY

Now:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me
I am planning on working in a technology related field.	◯	◯	◯	◯	◯	◯
I can see myself working as a computer scientist or programmer in the future.	◯	◯	◯	◯	◯	◯
I am planning to find a job as a computer scientist or computer programmer.	◯	◯	◯	◯	◯	◯
I am planning on earning a living as a computer scientist or programmer.	◯	◯	◯	◯	◯	◯
I am planning to devote my career to an area related to computer science.	◯	◯	◯	◯	◯	◯

5.

How well do the following statements describe your interests?

Before the Glitch Summer Program:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me	I Don't Know
I was interested in computer programming.	◯	◯	◯	◯	◯	◯	◯
I was interested in information technology.	◯	◯	◯	◯	◯	◯	◯
I was interested in computer engineering.	◯	◯	◯	◯	◯	◯	◯
I was interested in math.	◯	◯	◯	◯	◯	◯	◯
I was interested in graphic design.	◯	◯	◯	◯	◯	◯	◯
I was interested in music programming.	◯	◯	◯	◯	◯	◯	◯
I was interested in web programming.	◯	◯	◯	◯	◯	◯	◯
I was interested in game design.	◯	◯	◯	◯	◯	◯	◯

APPENDIX D: INTENT TO PERSIST IN COMPUTING SURVEY

Now:

	Very Untrue of me	Untrue of me	Somewhat Untrue of me	Somewhat True of me	True of me	Very True of me	I Don't Know
I am interested in computer programming.	◯	◯	◯	◯	◯	◯	◯
I am interested in information technology.	◯	◯	◯	◯	◯	◯	◯
I am interested in computer engineering.	◯	◯	◯	◯	◯	◯	◯
I am interested in math.	◯	◯	◯	◯	◯	◯	◯
I am interested in graphic design.	◯	◯	◯	◯	◯	◯	◯
I am interested in music programming.	◯	◯	◯	◯	◯	◯	◯
I am interested in web programming.	◯	◯	◯	◯	◯	◯	◯
I am interested in game design.	◯	◯	◯	◯	◯	◯	◯

APPENDIX E

SEMI-STRUCTURED PRE AND POST GLITCH INTERVIEW QUESTION

Purpose: The purpose of this protocol is to answer evaluation question 2 which focuses on curriculum and instruction: How do participants react to the contextualized computing courses, the community of practice, and their games testing assignments?

Interest in Computation

- How interested are you in computing? (Or, describe your interest in computing)
- What is your experience with computers?
- Are you planning on taking computer classes or technology track at school?
    - What do you plan on taking?

Computer Literacy

- What do you know about computers?
- What are some computer tasks you know how to do? (examples?)
- What are some computer tasks you would like to know more about?
- What computer tasks do you provide help with? (to whom?)
- What computer tasks do you get help with? (from whom?)

Gaming

- Before signing up for the workshop did you think about working for a game company?
- What else do you think that you might do for a career after school?
- What does a (what ever it is they are interested in) do?
    - What is good about that job?
    - What are draw backs?
    - Describe someone who does that job?
- Describe the work that someone at a game company does.

Other Questions

- Describe your role within Glitch games testers.
- Do you think your actions will actually change the game? How so?
- What else do you do at Glitch, other than testing games? Please, tell me about that.
- Describe what you have learned from the CS workshops?
    - Were you able to apply it? How so?
- What accomplishments over the past 8 weeks are you most proud of?
- Is there anything that we haven't talked about that you believe is important to add?

APPENDIX F

CODEBOOK FOR PRE AND POST GLITCH INTERVIEWS

This codebook outlined qualitative coding categories used during qualitative data analysis.

Coding Category	Definition	Example
Computational Agency	Participants express that they are co-creators of games rather than consumers of computing products.	"I feel like I really know how the game works on the inside and that I'm helping to fix the game and make it better." (not a real comment)
Interest in computing	Descriptions of what participants are interested in being able to do in computing	"I have always played games and wondered how they put them together."
--Learn about computing	Descriptions of what participants want to learn about computing that they do not already know	"I kind of want to learn how to make a simple game on the computer. You would have to know how to program, maybe a little art to make the characters, that's pretty much it."
--Experience with computing	Experiences that participants have already had with computing	"I am in the robotics club at my school, and I am taking a few technology courses."
--Courses Taken	Names and descriptions of computing classes participants have already taken. These can be high school classes or classes taken through another program.	
Computer Literacy		
--Know about computers	Descriptions of what participants know how to do on a computer	
--Tasks (Known)	Descriptions of tasks that participants can do on the computer	"I pretty much use all of the Microsoft applications, surfing the web, I don't think I have learned how to make a

		webpage on a website. Yeah, I like to program too."
--Tasks (Want to know)	Explanations of tasks participants want to be able to do with a computer	
--Help others	Descriptions of tasks that participants help others with	
--Receive help	Descriptions of tasks that participants ask for help to accomplish	
Gaming		
--Thoughts on working in gaming	Descriptions of what participants think it would be like to work for a game company	
--What a gamer does	Descriptions of what the participants think a someone who works in a game company might do	
--Career	What participants might do for a career after school.	
----Career (likes)	What participants like about that career	
----Career (drawbacks)	What participants might NOT like about their chosen career	
----Career (person who does it)	Descriptions of someone the participants might know or imagine who does that job	

REFERENCES

AAUW. (2000). *Tech-Savvy: Educating Girls in the New Computer Age*. New York: American Association of University Women Education Foundation.

AKI Corporation. (2003). *Def Jam Vendetta*. On Def Jam. Tokyo: EA Sports BIG.

Andrews, G. R. (1996). 1995 CRA Taulbee Survey: New enrollment in Ph.D programs drops. *Computing Research News. http://archive.cra.org/statistics/survey/96/1995-1996_taulbee_survey.html, [date accessed 12/29/11].*

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology, 38*(2), 113-125.

Barber, J. T., & Tait, A. A. (2001). *The Information Society and the Black Community*. Westport, Conn.: Praeger Publishers.

Barker, L.J., Garvin-Doxas, K., & Jackson, M. (2002). Defensive climate in the computer science classroom. *Proceeding of the 33rd SIGCSE Technical Symposium on Computer Science Education* (Cincinnati, February 2002).

Barron, B. (2004). Learning Ecologies for Technologiecal Fluency: Gender and experience differences *Journal of Educational Computing Research, 31*(1), 1-36.

Barab, S. & Squire, K., (2004) Design-Based Research: Putting a Stake in the Ground. *The Journal of the Learning Sciences*, 13 (1), 1 – 14.

Bond, M., & Lee, P. (1981). Face saving in Chinese culture: A discussion and experimental study of Hong Kong students. *Social life and development in Hong Kong, 288*, 305.

Bureau of Labor Statistics, U. S. D. o. L. (2007a). The 30 Fastest-growing Occupations, 2006 - 2016, *http://www.bls.gov/news.release/ecopro.t06.htm, [date accessed: Feb 18, 2009]*.

Bureau of Labor Statistics, U. S. D. o. L. (2007b). Household Data Annual Averages: Employed persons by detailed occupation, sex, race and Hispanic or Latino ethnicity, *http://www.bls.gov/cps/cpsaat11.pdf [date accessed Feb. 18, 2009]*.

Cartoon Network. (2009). *Fusion Fall*. Atlanta: Turner Broadcasting.

Cassell, J., & Jenkins, H. (1998). *From Barbie to Mortal Kombat: Gender and Computer Games*. Cambridge, Massachusetts - London, England: MIT Press.

Children Now. (2001). *Fair play: Violence, gender and race in video games*. Berkeley, CA: Children NOW.

Intel Computer Clubhouse Clubhouse, (2011). Mission and Vision of the Intel Computer Clubhouse*, http://www.computerclubhouse.org/content/mission-and-vision, [date accessed 9/29/2011].*

DePass, A., & Chubin, D. (2009). *Understanding Interventions that Encourage Minorities to Pursue Research Careers*. Maryland: American Society for Cell Biology.

DiSalvo, B., & Bruckman, A. (2010). *Race and gender in play practices: young African American males*. *Proceedings of Foundation of Digital Games* (Monterey, CA, June 2010).

DiSalvo, B. J., & Bruckman, A. (2009). Questioning Video Games' Influence on CS Interest. *Proceedings of Foundation of Digital Games (Bahamas, April 2009)*.

DiSalvo, B. J., Crowley, K., & Norwood, R. (2008). Learning in Context: Digital Games and Young Black Men. *Games and Culture, 3*(2), 131.

DiSalvo, C., Nourbakhsh, I., Holstius, D., Akin, A., & Louw, M. (2008).The neighborhood networks project: A case study of critical engagement and creative expression through participatory design. *Proceedings of Participatory Design Conference* (Bloomington, October 2008)

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development*: Psychology Press

EASports. (2008a) *Madden NFL*. EA Tiberon, Orlando, FL

EASports. (2008b). *NBA Live*: EA Tiberon, Orlando, FL

Ebo, B. (1998). *Cyberghetto or cybertopia?: race, class, and gender on the Internet*: Westport: Greenwood Publishing Group.

Eglash, R. (2002). Race, Sex, and Nerds. *Social Text, 20*, 49-64.

Enochs, L.R.I. & Ellis, J. (1993). The development and partial validation of the microcomputer utilization in teaching efficacy beliefs instrument in a science setting. *School Science and Mathematics*, 93(5), 257–263.

Entertainment Software Association. (2008) Sales, Demographics and Usage Data: Essential facts about the computer and video game industry. *http://www.theesa.com/facts/pdfs/ESA_EF_2008.pdf, [Date Accessed, February 18, 2009]*.

Etzkowitz, H., Kemelgor, C., & Uzzi, B. (2000). *Athena unbound: The advancement of women in science and technology*. Cambridge: Cambridge University Press.

Everett, A. & Watkin, C. (2008). The Power of Play: The Portrayal and Performance of Race in Video Games, *The Ecology of Games: Connecting Youth, Games, and Learning*. Edited by Katie Salen. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge: The MIT Press, 2008.

Federal Interagency Forum on Child and Family Statistics (2011). *America's Children: Key National Indicators of Well-Being, 2011.* Washington, DC: U.S. Government Printing Office.

Flanagan, M. (2005). Troubling'Games for Girls': Notes from the Edge of Game Design. *Proceedings of Digital Games Research Association Conference,* (Vancouver, Canada, June 2005).

Forte, A., & Guzdial, M. (2004). Computers for communication, not calculation: media as a motivation and context for learning. *Proceedings of the 37th Annual Hawaii International Conference on System Sciences,* 96-105. Waikoloa, Hawaii, January 2004.

Freire, P. (1975). *Pedagogy of the Oppressed*: Penguin Education.

Ferguson, A. A. (2000). *Bad boys: Public schools in the making of Black masculinity*: Ann Arbor: University of Michigan Press.

Furnham, A., & Rajamanickam, R. (1992). The Protestant work ethic and just world beliefs in Great Britain and India. *International Journal of Psychology, 27*(6), 401-416.

Gaver, B., Dunne, T., & Pacenti, E. (1999). Design: cultural probes. *interactions, 6*(1), 21-29.

Gilbert, J. E. (2006). Making a Case for BPC. *COMPUTER, 39*(3), 83-86.

Goffman, E. (1955). On face-work: An analysis of ritual elements in social interaction. *Psychiatry, 18*(3), 213-231.

Goffman, E. (1956). *The Presentation of Self in Everyday Life*. New York: Doubleday.

Greenfield, P. M. (1996). Video Games as Cultural Artifacts. *Journal of Applied Developmental Psychology*, 15(1), 3-12.

Guzdial, M. (2003). A media computation course for non-majors. *SIGCSE Bulletin, 35*(3), 104-108.

Guzdial, M., & Ericson, B. (2005). *Introduction to Computing and Programming with Java: A Multimedia Approach*. Upper Saddle River: Prentice Hall.

Heeter, C., Egidio, R., Mishra, P., & Wolf, L. (2005). Do girls prefer games designed by girls. *Proceedings of Digital Games Research Association Conference (Vancouver, June 2005)*.

Higgin, T. (2008). Blackless Fantasy: The Disappearance of Race in Massively Multiplayer Online Role-Playing Games. *Games and Culture*, 4(1), 3-26.

Hoberman, J. M. (1997). *Darwin's Athletes: How Sport Has Damaged Black America and Preserved the Myth of Race*. New York: Houghton Mifflin.

Horrigan, J. (2009). *Home Broadband Adoption 2009*. Washington, D.C.: Pew Research Center.

Hughes, K. (2007). Design to promote girls' agency through educational games: The Click! Urban adventure. In Y. B. Kafai, C. Heeter, J. Denner & J. Sun (Eds.), *Beyond Barbie and Mortal Kombat*. Cambridge, MA: MIT Press.

Ito, M., & Bittani, M. (2008). *Final Report: Gaming*. Berkeley: University of California Berkeley.

Jackson, L. A., Zhao, Y., Kolenic Iii, A., Fitzgerald, H. E., Harold, R., & Von Eye, A. (2008). Race, Gender, and Information Technology Use: The New Digital Divide. *CyberPsychology & Behavior, 11*(4), 437-442.

Juvonen, J. (2000). The social functions of attributional face-saving tactics among early adolescents. *Educational Psychology Review, 12*(1), 15-32.

Kafai, Y., Cook, M., & Fields, D. (2010). "Blacks Deserve Bodies Too!" Design and Discussion about Diversity and Race in a Teen Virtual World. *Games and Culture, 5*(1), 43.

Kafai, Y. B. (2006). Playing and Making Games for Learning: Instructionist and Constructionist Perspectives for Game Studies. *Games and Culture, 1*(1), 36.

Kafai, Y. B., Heeter, C., Denner, J., & Sun, J. Y. (2008). *Beyond Barbie and Mortal Kombat: New Perspectives on Gender and Computer Games*. Cambridge: The MIT Press.

Kafai, Y. B., & Resnick, M. (1996). *Constructionism in Practice: Designing, Thinking, and Learning in a Digital World*. Mahwah: Lawrence Erlbaum Associates.

Katz, S., Aronis, J., Allbritton, D., Wilson, C., & Soffa, M. L. (2003). Gender and race in predicting achievement in computer science. *IEEE Technology and Society Magazine, 22*(3), 20-27.

Kelleher, C., & Pausch, R. (2007). Using storytelling to motivate programming.

Kohl, H. (1994). *I won't learn from you: And other thoughts on creative maladjustment*. New York: New Press.

Kolko, J., Strohm, C. Q. & Lonian, A. . (2003). *Hispanics and Blacks game more.* Boston: Forrester, Consumer Technographics North America.

Kutner, L., & Olson, C. (2008). *Grand theft childhood: the surprising truth about violent video games and what parents should know*. New York: Simon & Schuster.

Ladson-Billings, G., & Tate IV, W. (1995). Toward a critical race theory of education. *The Teachers College Record, 97*(1), 47-68.

Lansing, P., & Olsen, D. S. (2011). The (Subsidized) Business of Higher Education: An Ethical Analysis of the Federal Funding in For-profit Higher Education, *Mustang Journal of Accounting and Finance*: 1; 118-135

Lapchick, R., Ekiyor, B., & Ruiz, B. (2007). *The 2006 Racial and Gender Report Card: National Football League*: University of Central Florida, DeVos Sport Business Managment Program.

Le Dantec, C. A., & Edwards, W. K. (2008). Designs on dignity: perceptions of technology among the homeless.

Lee, J. M. J. T., & Ransom, T. (2011). *The Educational Experience of Young Men of Color: A review of Research, Pathways and Progress*. New York: The College Board Advocacy & Policy Center.

Leonard, D. (2003). "Live in Your World, Play in Ours": Race, Video Games, and Consuming the Other. *SIMILE: Studies In Media & Information Literacy Education, 3*(4), 1-9.

Leonard, D. (2009). Young, Black (& Brown) and Don't Give a Fuck: Virtual Gangstas in the Era of State Violence. *Cultural Studies <=> Critical Methodologies, 9*(2), 248.

Levy, S. (2001). *Hackers: Heroes of the Computer Revolution.* New York: Penguin Books.

Lewis, C. (2007). Attitudes and beliefs about computer science among students and faculty. *ACM SIGCSE Bulletin, 39*(2), 37-41.

Lewis, S., Simon, C., Uzzell, R., Horwitz, A., & Casserly, M. (2010). *A Call for Change: The social and educational factors contributing to the outcomes of black males in urban schools*. Washington, DC: The Council of the Great City Schools.

Majors, R., & Billson, J. M. (1993). *Cool pose: The dilemmas of Black manhood in America*: Touchstone.

Margolis, J. (2008). *Stuck in the Shallow End: Education, Race, and Computing*. Cambridge: The MIT Press.

Margolis, J., & Fisher, A. (2002). *Unlocking the Clubhouse: Women in Computing*. Cambridge: MIT Press.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*(2), 224.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370.

McClelland, D. C. (1985). How motives, skills, and values determine what people do. *American Psychologist, 40*(7), 812.

Mcklin, T., Engelman, S., DiSalvo, B., & Bruckman, A. (2010). *GLITCH Game Testers Evaluation Ongoing Report: Year Two (NSF Technical Report)*. Atlanta: The Findings Group.

Miller, P. B. (1998). The Anatomy of Scientific Racism: Racialist Responses to Black Athletic Achievement. *Journal of Sport History, 25*, 119-151.

Mincy, R. B. (2006). *Black Males Left Behind*. Washington, DC: Urban Institute Press.

Nakamura, L. (2009). Don't Hate the Player, Hate the Game: The Racialization of Labor in World of Warcraft. *Critical Studies in Media Communication, 26*(2), 128-144.

National Research Council. (2007). Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering. Washington, DC: National Academy Press.

Nelson, D. (2003). The Lily-White World of Academics in Computer Science. *The Journal of Blacks in Higher Education, 40*(3), 40.

Nieusma, D. (2004). Alternative Design Scholarship: Working Toward Appropriate Design. *Design Issues, 20*(3), 13-24.

North, R. (1997 - 2009). *Grand Theft Auto*. Edinburgh: Rockstar Games.

NSF (The National Science Foundation). (2007). Special Tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey, 1997–2006. Arlington: The National Science Foundation, Division of Science Resources Statistics.

NSF (The National Science Foundation). (2008a). Broadening Participation in Computing (BPC) Program Solicitation. Arlington: The National Science Foundation, Directorate for Computer & Information Science & Engineering.

NSF (The National Science Foundation). (2008b). CPATH: CISE Pathways to Revitalized Undergraduate Computing Education. *http://www.nsf.gov/pubs/2008/nsf08516/nsf08516.htm. [date accessed 04/14/2008].*

NSF (The National Science Foundation). (2009). Women, Minorities, and Persons with Disabilities in Science and Engineering: 2009, NSF 09-305. Arlington: The National Science Foundation, Division of Science Resources Statistics.

Ogbu, J. U. (1988). Origins of Human Competence: A Cultural-Ecological Perspective. *Child Development*, 52(2), 413-419.

Osborne, J. W. (1999). Unraveling underachievement among African American boys from an identification with academics perspective. *The Journal of Negro Education*, 68(4), 555-565.

Pascoe, C. J. (2007). *Dude, You're a Fag: Masculinity and Sexuality in High School*. Berkeley and Los Angeles: University of California Press.

Pearson, W. Jr. & Fechter, A. (1994) *Who Will Do Science? Edcuation the Next Generation*. Baltimore: Johns Hopkins University Press.

Price, R., & Stern, L. (1974). *The Original #1 Mad Libs*. Los Angeles: Price Stern Sloan.

Resnick, M., Maloney, J., Monroy-Hernandez, A., Rusk, N., Eastmond, E., Brennan, K., et al. (2009). Scratch: programming for all. *Communications of the ACM, 52*(11), 60-67.

Richardson, R. (2007). *Black Masculinity And the US South: From Uncle Tom to Gangsta*. Athens: University of Georgia Press.

Rideout, V., Roberts, D. F., & Foehr, U. G. (2005). *Generation M: Media in the Lives of 8-18 Year-olds*. Menlo Park: The Henry J. Kaiser Family Foundation.

Riegle Crumb, C., & King, B. (2010). Questioning a White Male Advantage in STEM: Examining Disparities in College Major by Gender and Race/Ethnicity. Educational Researcher, 39(9), 656-664.

Riggs, I. M. & Enochs, L. G. (1993). A microcomputer beliefs inventory for middle school students: Scale development and validation. *Journal of Research on Computing in Education*, 25, 383.

Russell, K. K., & Russell-Brown, K. (1998). *The color of crime: Racial hoaxes, white fear, black protectionism, police harassment, and other macroaggressions*: New York: NYU Press.

Schuler, D., & Namioka, A. (1993). *Participatory Design: Principles and Practices*: Mawhaw: Lawrence Erlbaum Associates.

Schulte, C., & Knobelsdorf, M. (2007). Attitudes towards Computer Science - Computing experiences as a starting point and barrier to Computer Science. Proceedings of the *Third International Workshop on Computing Education Research*. (Atlanta, GA, September 2007)

Simon, B., Hanks, B., Murphy, L., Fitzgerald, S., McCauley, R., Thomas, L., et al. (2008). Saying isn't necessarily believing: influencing self-theories in computing. Proceedings of the *Fourth International Workshop on Computing Education Research* (Sydney, Australia, September 2008)

Simon, B., Kinnunen, P., Porter, L. & Zazkis, D. (2010). Experience report: CS1 for majors with media computation. prceedings of the *Fifteenth Annual Conference* *on Innovation and Technology in Computer Science Education*, (Bilkent, Ankara, Turkey, June 2010)

Sloan, R.H. & Troy, P., (2008b) CS0.5: a better approach to Introductory computer science for majors. *ACM SIGCSE Bulletin.* 40: 1, 271-275.

Squire, K. (2002). Cultural framing of computer/video games. *Game studies, 2*(1), 1-7.

Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. *Advances in Experimental Social Psychology, 34*, 379-440.

Stoecker, R. (2005). *Research methods for community change: A project-based approach.* Thousdand Oaks: Sage.

Summet, J., Kumar, D., O'Hara, K., Walker, D., Ni, L., Blank, D., & Balch, T. (2009) Personalizing CS1 with Robots. *ACM SICSE Bulletin – SiGCSE'09*, 41:1, 433-437

Swidler, A. (1986). Culture in action: Symbols and strategies. *American Sociological Review, 51*(2), 273-286.

Tatum, B. D. (2003). *Why are all the black kids sitting together in the cafeteria?: And other conversations about race*. New York: Basic Books.

Taylor, T. L. (2011). *E-sports and the Professionalization of Computer Gaming*. Cambridge: MIT Press.

Tew, A.E., Fowler, C. & Guzdial, M. (2005). Tracking and innovation in introductory CS education from a research university to a two-year college. *ACM SIGCSE Bulletin, 37:1,* 416-420

Ting-Toomey, S., Gao, G., Trubisky, P., Yang, Z., Kim, H., Lin, S., et al. (1993). Culture, face maintenance, and styles of handling interpersonal conflict: A study in five cultures. *International Journal of Conflict Management, 2*(4), 275-296.

Ting-Toomey, S., & Kurogi, A. (1998). Facework competence in intercultural conflict: An updated face-negotiation theory. *International Journal of Intercultural Relations, 22*(2), 187-225.

Toker, Y., & Ackerman, P. L. (2011). Utilizing occupational complexity levels in vocational interest assessments: Assessing interests for STEM areas. *Journal of Vocational Behavior*. September 2011. In press. Corrected proof.

Traweek, S. (1992). *Beamtimes and lifetimes: The world of high energy physicists.* Cambridge: Harvard University Press.

Turkle, S. (1984). *The Second Self: Computers and the human spirit*. New York: Simon & Schuster, Inc.

US Census Bureau. (2007). *Annual Estimates of the Population by Sex, Race, and Hispanic Origin for the United States: April 1, 2000 to July 1, 2007.* Washington, DC*:* US Census Bureau, Population Division.

Van Eck, R. (2006). Using Games to Promote Girls' Positive Attitudes Toward Technology. *Journal of Online Education, 2*(3).

Vetter, B. (1994). The Next Generation of Scientist and Engineers. In W. Pearson Jr & A. Fechter (Eds.), *Who Will Do Science? Educating the Next Generation* (pp. 1-19). London and Baltimore: Johns Hopkins University Press.

Warschauer, M. (2004). *Technology and social inclusion: Rethinking the digital divide*. Cambridge: MIT Press.

Williams, D., Martins, N., Consalvo, M., & Ivory, J. (2009). The virtual census: Representations of gender, race and age in video games. *New Media & Society, 11*(5), 815-834.

Wing, J. (2006). Computational Thinking, *Communications of the ACM*, 49(3), 33 – 35.

Wyer, M. (2003). Intending to stay: Images of scientist, attitutes toward women, and gender as influences on persistence amoung sscience and engineering majors. *Journal of Women and Minorities in Science and Engineering, 9*(1), 1-16.

Yardi, S., Krolikowski, P., Marshall, T., & Bruckman, A. (2008). An HCI approach to computing in the real world. *Journal on Educational Resources in Computing, 8*(3), 9.

Yates, S., & Littleton, K. (2001). Understanding computer game cultures: A situated approach. *Virtual gender: Technology, consumption and identity*, 103-123.

Yeager, D. S., & Walton, G. M. (2011). Social-Psychological Interventions in Education: They're Not Magic. *Review of Educational Research, 81*(2), 267-301.

Zweben, S. (2005). 2004 Taulbee survey: Record Ph. D. production on the horizon; undergraduate enrollments continue in decline. *Computing Research News, 17*(3).

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