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Designing Games, Designing Roles: A Study of Youth Agency in an Urban Informal Education Program

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Abstract

Collaboration (GDMC), an informal education program in 3D computer modeling and 2D interactive game design serving primarily African American youth aged 7 to 19 years in the Washington, D.C. metro area, transformed from a program designed and taught by adults to one designed and taught by youth. In Year 1, 8% of youth participants held a leadership role; by Year 4, 30% of youth participants did. Moreover, the nature of these roles transformed, with youth increasingly taking on responsibilities formerly held by adults. In this qualitative study, the authors describe and seek to understand this role shifting. Through the extensive collection and analysis of field observations over 4 years, the authors describe qualitative shifts in the agency involved in these roles—moving from a conception of youth as student to assistant to youth as designer and implementer of instruction. The authors analyze changes in youth agency that accompanied their implementation of the *studio mentorship model* where classrooms were transformed from traditional teacher-led classes to studios with a 1:3 ratio of peer mentors to students. The authors describe how, following this shift, youth initiated new instructional roles leading to the creation of a mentor-instructor pipeline. The authors pose the GDMC program as an example

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to discuss how culturally relevant computing practice emerges from a programmatic goal of viewing youth as assets and actively seeking ways to support youth's initiatives and agency in digital technology education. The authors argue for the value of this asset building in technology education as a way to encourage youth from traditionally underserved groups to become technology leaders and innovators.

Keywords
digital technology, culturally relevant pedagogy, informal education, media arts education, games and learning, mentoring

Informal educational programs are not fixed entities, with fixed properties that can be deemed culturally relevant (or not). Relevance is an elusive, shifting target depending on many factors, such as who is in the program, why they are there, the communities in which it is embedded, and the moment we are in history and in each participant's life. Drawing on a qualitative study of how our informal education program, Game Design Through Mentoring and Collaboration (GDMC), evolved over 4 years, we describe the cyclical design research process that helped us adapt the program to become increasingly responsive to, and designed and led by, the youth participants. Though we did not begin the program following an explicit approach to culturally relevant pedagogy, we argue that our design research process led to a program that was more reflective of and responsive to the individual and cultural backgrounds of the participants. In particular, we focus on how the GDMC reflected the asset-building dimension of culturally relevant pedagogy (Hilliard, 2003; Lee, 2007). That is, how we adopted a consistent student-centered stance toward using our research to discern the knowledge, background, and skills of the youth participants and increasingly find ways to provide outlets for youth to use their knowledge as assets in the program design and implementation. We describe a process where cultural relevance emerged when we supported participants to become increasingly responsible for designing their own and their peers' education.

GDMC is in an urban setting, serves a population of primarily African American youth, and one of our key goals is to provide experiences for youth that increase their interest, skills, and self-efficacy with technology and to help them envision potential futures in science, technology, engineering or math (STEM) fields. That African American young adults in the United States are not entering or persisting in STEM fields to the same degree as their White or Asian counterparts is a well-documented context to our work (see, for instance, U.S. Department of Education, 2008; U.S. Department of Labor, 2010). Game playing, which has been increasingly lauded by many researchers for its role in learning (e.g., Federation of American Scientists, 2006; Gee, 2007; Shaffer, Halverson, Squire, & Gee, 2005) and which some researchers pose as a route to entering technology fields (Hayes, 2007; Williams, 2006), may be a potential avenue to support African American youth's entry into technology fields. African American youth (ages 8-18) play video games an average of nearly 1.5 hours per day, roughly 1.34 times the amount spent by White youth (Rideout, Foehr, & Roberts, 2010). Yet, according to a recent study by the U.S. Department of Labor, African Americans are the least likely ethnic group to enter technology fields (U.S. Department of Labor, 2010). In our view, while game play may be an initial step for youth to become interested in technology, it alone is not a strong enough conduit for African American youth to enter technology fields and become technological innovators. We hope that learning to design games, using professional-level tools in a culturally responsive community of learners, will be.

Theoretical Background

In this article, we describe a shift where the GDMC program moved from being designed and taught by high school technology teachers, to one where youth participants took on all design and instructional roles. It is through the agency that the youth demonstrated in this evolution—the shifts they made in the roles they took on, and in the design of new roles for themselves—that we believe individual and cultural relevance within the program emerges. Other studies of informal urban education programs describe similar situations where youth create and embody leadership roles as they participate in the community (e.g., Calabrese Barton & Tan, 2010; Ching & Kafai, 2008; Heath, 2004; Kafai, Peppler, & Chapman, 2009). Calabrese Barton and Tan (2010) focus on how these roles often involve imaginative, hybrid practices as marginalized youth create "expert" identities that are socially and culturally situated. Brice Heath (2004) argues for viewing these creation and adoption of roles that youth take on, as routes to envision and make visible their competence and as central to their learning and development. This may be particularly true for students from traditionally underserved groups, whose competence may be rendered less visible by typical evaluations (see, for example, Aronson & Steele, 2005, for an extensive literature on the effects of stereotype threat on evaluations of academic achievement). In our study, we seek to understand the processes by which youth make their competence visible and come to envision and adopt new leadership roles—and we conceptualize this link between agency and role shifting to be key to culturally responsive digital pedagogy.

While the particulars of approaches differ, a common core of culturally responsive pedagogy is that students' cultural backgrounds are actively viewed as central to the learning process (e.g., Gay, 2000, 2002; Howard, 2003; Lee, 2007). The application of culturally relevant pedagogy to the digital sphere involves *reflection* on how culture is reflected in and shapes the technosocial abilities, contexts, and experiences of youth and envisioning ways to recognize diverse digital experiences as *assets* to be built upon (Scott, Clark, Hayes, Mruczek, & Sheridan, 2010). The culturally relevant computing approach is central to our design research process and program implementation. We use research to reflect on and understand the youth in our program and to identify potential assets in their interests, actions, and backgrounds to build upon. The implementation of the *studio mentorship model* and the mentor-instructor pipeline we describe in this article illustrate this process of reflection and asset building.

We frame asset building in this case as efforts to support the expression of youth's agency. While the construct of "agency" is embedded in historical debates about the nature of free will and a structure–agency divide that is beyond the scope of this article, researchers in a sociocultural tradition in learning sciences often use the construct as to describe the inventive ways youth recreate practices, roles, and identities to transform sociopolitical constraints of participating in local disciplinary worlds (Barton & Tan, 2009, 2010; Holland, Lachicotte, Skinner, & Cain, 2001; Nasir & Hand, 2008). While a number of authors document examples of youth's inventiveness in expressing agency despite constraining environments (Barton & Tan, 2009, 2010), our focus is on investigating how the GDMC program's practices support (or fail to) youth's ability to create and express agency. Agency is at the center of our approach to culturally relevant computing education. When youth have opportunities to design with technology, to become mentors that develop new strategies to teach technology to their peers, and to introduce new technologies and instructional approaches they become designers of their education. Through attentiveness to opportunities to support students in expressing greater agency and autonomy in a program, the program becomes increasingly culturally relevant as it embodies the perspectives of those who become increasingly designers of it.

This emphasis on agency is also shown in our transition to a studio model. Studio environments, where students work on open-ended product creation, encourage youth to engage in a cyclical process where they envision possibilities, use materials and tools to enact them, and observe and reflect on how they work (Hetland, Winner, Veenema, & Sheridan, 2007; Sheridan, 2011). Halverson (2011) describes how this cyclical process in digital arts creates increasingly sophisticated representations and awareness of ideas. Brice Heath (2001) identifies a parallel when students engage in a more open-ended studio environment on their work they also approach their roles in the environment with greater openness, engaging in what she terms "imaginative actuality" as they make collaborative plans. In this study, we describe a similar pattern where both students' digital products and their conceptions of their roles in the program became more imaginative and complex.

To understand these processes, we draw on the research that we used to understand and design the GDMC program. We focus in particular on our implementation of the *studio mentorship model*, an instructional approach where more advanced peer mentors collaborate with novice students on studio projects with technology, informed by studies on traditional visual art studios (Hetland et al., 2007) and digital media arts (Halverson, 2011; Peppler, 2010). We describe how while we initially conceived of the student mentors as a route to make the instruction more open ended and studio based, this also led to unexpected situations where youth initiated new projects and created leadership roles for themselves. Our analysis in this article is guided by the following research questions:

Research Question 1 (RQ1): How do urban youth see and enact their roles in the GDMC program, and how does this change over time?
Research Question 2 (RQ1): What program changes are associated with greater expressions of agency for youth?

Method

The findings in this study draw from a larger mixed-methods design research study of the GDMC program (Design-Based Research Collective, 2003). In this article, we describe the aspects of the qualitative research we used to address this article's specific research questions on how participant roles shifted over time.

Program Description

The GDMC project was a partnership between George Mason University and a technology-oriented public urban high school supported by a National Science Foundation's Innovative Technology Experiences for Students and

Table 1. Demographic Background of Participants in the GDMC Program (n = 415) During the Academic Year.

	Year 1	Year 2	Year 3	Year 4
Number of participants[a]	139	110	100	66
Mean age[b]	13.1	12.7	14	14.25
% of male[b]	93	77	87	69
% of female[b]	7	23	13	31
% of African Americans[b]	80	94	87	94
% of Caucasians[b]	9.1	0	6	6.3
% of biracial/multiracial[b]	2.3	0	6	0
% reporting Other[b]	9	5.9	0	0

[a]Number of participants does not include summer sessions, but demographic patterns were roughly similar.
[b]Only participants with parental consent are included.

Teachers (ITEST) grant to the authors from 2007 to 2011 (Award Number: 0737667). Support was provided for 3 years followed by a no-cost extension in Year 4. Through instruction in computer 3D modeling, animation, and 2D interactive game design, the GDMC project sought to provide opportunities for year-round instruction in information technology (IT) for middle- and high-school students, primarily from traditionally underserved populations in Washington, D.C., and the metro area. A key goal of the project and the ITEST program is to create awareness of, and interest, self-efficacy, and skills in STEM subjects via technology, particularly for groups traditionally underrepresented in STEM fields. Over the course of 4 years on Saturdays and during the summer (Fall 2007 to Summer 2011) the GDMC program provided 480 instructional hours in 3D modeling, animation, and simulation using the professional-level software, Autodesk Maya, and in 2D interactive game programming using Alice, GameMaker, Scratch, and Flash. Classes were organized into fall, spring, and summer sessions.

Site and participants. Throughout the 4-year program, there were more than 400 registrants, with some participants attending multiple semesters or years. As illustrated in Table 1, the participants were primarily African American (n = 80, 94%) and male (n = 69, 93%), although an increase in female participation was seen in Years 2 and 4. Youth were in the age of 7 to 19 years, with a mean age of about 13.5 years.

While the majority of students were from the Washington, D.C., public school system, students represented more than 90 different schools (as well as home-schooled students) in the Washington, D.C., metro area. While it is beyond the scope of this article to discuss fully, we conducted surveys that indicated program consistently attracted students who, while diverse in socioeconomic status (SES) and academic preparation and achievement, demonstrated strong interest and self-efficacy in science, math, and technology (see Clark & Sheridan, 2010; Sheridan & Clark, 2010, for discussions of findings).

Data Collection

We regularly collected qualitative data to document and understand the program, inform implementation decisions, and study the implementation process and its effects. Research was conducted by members of the university research team and by an external evaluator. The bulk of our data come from observations conducted by 1 to 3 researchers at the majority of program sessions, resulting in more than 250 hr of field observation with accompanying field notes and summary memos. These observations focused on documenting how technologies were used; the content embedded in the project problems; the interactions between students, mentors, and instructors; and the context of the learning environment. Researchers also conducted informal interviews, documented meetings and workshops with mentors and instructors, and collected student work. We viewed this intensive and immersive ethnographic process as not primarily an evaluation of how the program was functioning but as a route to understanding participants and their experiences. Our external evaluator provided more of a snapshot view of the program. She designed and conducted surveys that documented the demographic backgrounds of the participants; created and administered a measure assessing students' awareness, attitude, and self-efficacy in STEM areas; and conducted field observations and informal interviews with students, parents, mentors, and instructors. Both the ongoing qualitative study and the external evaluation were integral to the ongoing design and administration of the program; however, we are only attending to the qualitative data for the current analysis.

Data Analysis

We first reviewed registration and employment records to document the shifts in numbers and proportions of youth and adults assuming explicit leadership roles in the program. We then reviewed annual summary reports of the main program implementations and changes that seemed to be associated with the shifts in roles and any policy documents describing the nature of the new roles. Based on these initial reviews, we selected two key aspects to analyze more deeply to understand how these shifts in roles were enacted in the program and how they changed youths' experiences: (a) changes associated with implementation of the studio mentorship model, and (b) how this extended into the development of a mentor-instructor "pipeline."

To address the first aspect, we chose to focus in on one class: Mr. V's 2D interactive game design class and compare Year 1 to Year 2 after the introduction of the studio mentorship model. Mr. V's class was chosen because it was taught by the same instructor both years and was observed by the same researcher; thus, it offered the clearest way to see shifts in student participation associated with the new model. We read all the field notes and summaries for these sessions, coded all instances of mentor interactions, and analyzed random samples of the field notes text for the amount of text devoted to teacher versus students/mentors talk and actions. To investigate how this developed into a mentor-instructor pipeline we reviewed the summary and research reports and memos and looked for illustrative examples of mentors envisioning and assuming new roles. While an in-depth treatment of all the transitions in student agency associated with the developments of the pipeline is beyond the scope of this analysis, we sought to provide enough insight into the kinds of expressions of youth agency that emerged in the years following the implementation of the *studio mentorship model*. To support the validity of our findings, we include the input of multiple observers from both within and outside the program, engaged in frequent and ongoing rich data collection over several years, use triangulation of different types of data, provide descriptive statistics to demonstrate patterns in the data, and give detailed examples that illustrate our claims (Maxwell, 1992, 2004).

Findings and Discussion

Central to the idea of cultural relevance as an emergent property of an educational program is increasing the autonomy and granting leadership to the participants. One of the most striking findings of our program is that it went from being designed and taught by adult high school teachers to being designed and taught by youth and supported by university researchers. In what follows, we describe the process by which the program shifted from one that was primarily led and taught by adults, to one designed and taught by youth while supported by adults. We describe the key transitions in this process and some of the changes that accompanied this shift.

Increasing Proportions of Students Involved in Leadership Roles

As shown in Table 2, some youth were assigned leadership roles in the program beginning in the 1st year. However, over the course of the 4 years, the

Table 2. Numbers and Roles of Participants in the GDMC Program by Year.

	Year 1	Year 2	Year 3	Year 4
Adult instructors	4	3	1	0
Youth Instructors	2 (supplemental classes)	2 (supplemental classes)	4 (consistent classes)	5 (all classes)
Youth mentors	8	19	14	15
Total youth participants	139	110	100	66
Percent of youth participants in a leadership role	7.2%	19.1%	18%	30.3%

proportion of youth taking on leadership roles increased over time while the roles of adults were reduced. While student enrollment only slightly increased between Years 1 and 2, the number of youth mentors was more than doubled. While there were fewer mentors in Year 3, the proportion of mentors to students grew. Furthermore, the number of youth instructors doubled. These youth instructors were students who had been associated with the program for several years and had served as mentors in prior sessions. In the following year, the proportions grew even further, with youth taking on all instructional leadership roles in the program. Conversely, the number of adult instructors steadily decreased until the Year 4 where there were no adult instructors. While most of the adult instructors were White, and all were male, the mentors and youth instructors more closely parallel the demographic composition of the youth participants: Over the course of the 4 years, roughly 90% of the youth mentors and instructors were African American and about 85% were male.

Changing Roles of Youth Mentors

In addition to the shifts in the number of youth taking on leadership roles, there was a qualitative shift in the types of roles they took on. For instance, for fall semester of Year 1, while their official job title was "mentor," the youth mentors primarily did administrative tasks such as collecting registration information, directing youth and parents to classrooms, watching the lobby for latecomers, assisting in class transitions, and taking attendance. Of the thirteen 40-min to 1-hr classes we observed, there was a youth mentor present in less than half of them. Furthermore, in most cases when they were there, they did little in the classroom: In only three of the six classes with aides were there examples of aides providing instructional assistance to students. Of these three, two were only brief examples of helping out one or two students who raised their hands with technical difficulties. In summary memos of the classes, the observer noted things like, “The aide kept disappearing from the classroom,” and “The aide looked like he didn’t know what was going on.” In one session, the aide’s role was seemingly noninstructional, he came in over 15 minutes after class started bringing in a student who came late, sat in a corner watching the class and listening to his *ipod* on headphones, and then half an hour later told the instructor it was time to switch classes.

In the following semester, we had told all the youth who had attended the program in the fall that if they continued participating in the program and built up their skills, they could become paid mentors. Through this process, we were able to double the number of youth who were mentors. We also worked with the adult instructors to embrace a studio mentorship model where instructors posed open-ended design problems, demonstrated enough for students to understand how to approach them, and then the mentors would assist students with any troubles they encountered and the instructor would serve as a resource for the mentors (Hetland et al., 2007; Sheridan, 2011; Sheridan & Clark, 2010).

To demonstrate how this shift toward a studio mentorship model was associated with a striking increase in youth agency and leadership, Mr. V’s interactive game design class allows a unique vantage point. In what follows, we describe a session with a teacher before we implemented the model and a session with the same teacher after. The teacher, Mr. V., is a high school computer programming teacher who had been teaching in the program for 2 years prior to our collaboration. In the first class description, his aide, Lionel, is a high school student who is in the IT track and has been a past participant in the game design program. In the example described of a class following the introduction of the studio mentorship model, there are five mentors who are supporting an open-ended game design problem designed by Mr. V.

> A class session in Year 1 2D game design/programming class before instituting the studio mentorship model: As about 20 students, mainly African American boys ranging in age from 8 to 16, stream into the high school computer classroom on a Saturday morning; they see a zombie game playing on the screen. This is the third week in the fall session, but for about one third of the students, it is their first day. As students watch the game, the instructor, Mr. V, explains how the game works and that they are going to write this game with programming. All the students look interested, and one shouts, “Cool!” when zombies start popping up from tombstones. Mr. V. tells the students, “Gaming is one of one of the biggest jobs in IT and programming is what makes games work.”

The students seem eager to start, but technical difficulties stall the class. For the next ten minutes, Mr. V. and his aide, Lionel, troubleshoot computers and move kids to work in pairs on functional computers. Once everyone is settled, Mr. V demonstrates the zombie game, asking students to explain it. A student responds, "Click on the zombies before they disappear." Mr. V. explains the basic structure of the game in programming terms: "initialize, game loop, finish game." He shows them how to write the code for one zombie, which they can copy for every zombie they want to add, and tells them: "Click on 'write new method' and call it 'Move Up and Down.'"

The aide, Lionel, who was a former participant in the program and is on the IT track in high school, stands to the side watching, sometimes veering closer to look at what students are doing on their screen. Mr. V. circles the room to see whether students have done it, asking how far the zombies should go down. After receiving several replies, he comments that it should be the entire zombie height. Mr. V. helps individual students who are having difficulties. The students who have finished the task start surfing the web and playing other games. The students who were having difficulties are waiting for help. After Mr. V. helps one student figure it out, he asks him to explain it to another student who needs help.

At this point, the site coordinator comes in and gives a 5 minute warning that it will be time to switch classes. Mr. V. seems flustered and goes back to the demo laptop showing students the next steps they will be doing in the game the following week, while telling Lionel to help students having trouble. But many of the students seem to be shutting down their programs for the end of the class, so Lionel goes to over to the only pair left working and looks at what they are doing. Kids from another class start to stream in for their session. When a project assistant who had been in another class came over and asked Lionel how things went, he shrugged and mumbled, "We really didn't get to do much." (Field notes, 12/8/2007)

A class session in Year 2 2D game design/programming class after instituting the studio mentorship model: This is a December session in the Fall of Year 2 and five high school student mentors (including Lionel) are meeting with Mr. V. for about 15 minutes before the session starts. Mr. V describes the broad aims of the session, referring to four concepts/skills listed on the whiteboard that relate to how sprites work in a game. He reminds the mentors that while the students all should create games that use these four skills, mentors should not just tell students what to do, but rather encourage students to play around with the possibilities of sprites in games and ask them guiding questions about their projects. Mr. V. asks the mentors, "How would you explain the difference between a sprite and an object?" One responds, "T. [another mentor] says that a sprite is the clothes and the object is the body." Mr. V. says, "I hadn't thought of it that way, but yeah," acknowledging that this as a useful analogy. As they are talking, the mentors are also checking the software on the computers and closing down nonfunctioning computers. There is

> friendly banter, such as a mentor opening the instructor's laptop and saying, "Wow, Mr. V. Why don't you clean the screen?" Mr. V. and a mentor are searching for a game she designed to use as a demonstration, while another mentor is play-testing a game he designed that he would like to show the class.
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> As the students file in, the mentors orient themselves to different groups of 2 to 3 students and give individualized instruction and help on beginning to design a game. While the mentors focus on their particular students, they remain alert to the others. For instance, when one mentor was consulting Mr. V. about technical difficulties, another mentor went to the students he had been working with and suggested next steps for them to work on. Another mentor calls Mr. V over to help with a problem she and her two students are having. The mentors interacting with their students frequently engage in questions with them about what they are trying to do and suggest potential approaches they might choose. Two students are searching the internet and Mr. V. looks quizzically to the mentor working with them, who responds, "They wanted to know how to put their own picture on the background so I showed them how they could import an image from the web."
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> While most of the mentoring was helpful, there were occasional rough edges in the mentors' interactions with students: One mentor became absorbed in solving a problem students were having and forgot to let them help figure it out, shouting out, "Bam! I'm a genius!" once she solved it. Another was gruff with his young students, saying strongly: "I've told you before and I'll say it again: everything in GameMaker has a sprite and an object." (Later Mr. V. casually mentioned to him to watch out for his level of sternness, pointing out that, like Mr. V., he comes from a military family where that might be a typical way of phrasing things, but that it can be off-putting to some.) All the mentors and students were engaged in working the entire class session, something that was never the case in any of the sessions with this instructor in the prior year. The students accomplished more in this session and the games they made were more individualized and diverse than in any of the sessions the year before. (Field notes, 12/15/2008)

Changes Associated With the Introduction of the Studio Mentorship Model

Comparing these two examples points to a number of ways the studio mentorship model changed our program and, we think, opened the path for the program to develop its emergent cultural relevance and achieve its aim of improving students' attitudes and self-efficacy in technology. We see increases in student engagement success in learning programming concepts in order to design games and more complex game designs.

In Year 1, the instructor created step-by-step instructions on projects he thought would be engaging to the youth in the program (e.g., learn about programming a loop function by creating a zombie game, make a game where a T-Rex eats bunnies). While the youth *were* initially attracted to this approach (e.g., shouting "Cool!" as the screen came up), it did not sustain engagement or independent work to create a project for which they felt ownership. For instance in the above example, students were given zombie characters to use, told how they should move (up and down), and even how far (the height of the zombie). Their one aspect of freedom was how many zombies to create and where to place them. But since 90% of the students did not even get one zombie working according to his specifications, Mr. V. did not feel ready to allow greater latitude. Struggles with completing and feeling ownership of work were not limited to this one session. Despite being encouraged to save their work to the intranet or on Flash drives we provided, few students in Year 1 saved their work.

The level of increased student engagement and productivity was striking in the *studio mentorship model*. While analyses of field notes of the class in Year 1 show that there were numerous instances of off-task behavior and students disengaged from work in every class session of Mr. V as observed, there were no recorded instances of off-task behavior in his class after the model was introduced. The studio mentorship model led to far greater engagement than tasks that were "designed" to be relevant to students, focusing instead on a collaborative approach to more open-ended problems (Hetland et al., 2007; Sheridan & Clark, 2010). In Year 2, there was ample documentation of students talking with each other and the mentors about their work. In Year 1, very few of the students completed a game other than reiterating a simple tutorial; in Year 2 nearly all of the students completed at least one independent game, and many completed several. Students in Year 2 were more likely to save their work from week to week.

Mentors also showed striking growth in autonomy and instructional interactions. In Year 1, the mentors were seen as aides who were potential resources to the instructor as needed, and this is reflected in how they behaved. For instance, Lionel helped out with the broken computers and stood in wait until Mr. V. called on him in a time crunch. Despite that Lionel had a good deal of technical competence and a capacity to understand and support the students' learning process, the current structuring of his role as mentor did not allow him to "make visible" the extent of his competence (Heath, 2005). The way his role was constructed was to help out when things went wrong—he was successful in helping with broken computers, bewildered when asked to assist students who had already given up on the task in the last 5 minutes of class. The limited role construction is even more apparent in the example of the aide, who also had considerable technical knowledge and expertise, yet sat in the back of the room wearing headphones for the entire class. Organizationally, we constructed his role so that he believed his job was to bring the students to and from class even though he was selected for being a mentor because he had technical skills, knowledge, and experience in the program. At this point, we failed to envision how to use his experiences and expertise in a more generative way, and we did not provide adequate support for him to envision.

In contrast, in Year 2, we explicitly described the role of the adult instructor as more of a resource to the mentors rather than the exclusive source of instruction. The instructor was to set the broad goals and challenges, and the mentors' role was to work with all the students on their projects that addressed these goals and check in with the instructor when they encountered difficulties or had a question. In turn, the instructor would assess how the class as a whole progressed on learning core concepts and advise youth mentors on their pedagogical strategies (e.g., Mr. V. suggesting that the student tone down the sternness of his language, encouraging mentors to think of ways of explaining the ideas to students). Looking more broadly across the sessions we find this pattern reflected in the balance of text in the field observations devoted to teachers, youth mentors, or students during class sessions. In Year 1, the class is largely teacher driven and nearly three fourth of the text (74% of coded units) describes Mr. V's words or actions. Analysis of Year 2 with the same instructor has less than one third of text (31% of coded units) devoted to the teacher. Mentors and students' actions and conversations about work dominate the classroom observations.

Once mentors were consistently engaged in instruction, they also took greater initiative—finding more routes to use their knowledge and make their competence visible to the community. In the example above, one of the mentors spontaneously shows the students how to import images into the game to make a more personalized visual scene. This was not part of the lesson, but he spontaneously adapted it to students who expressed an interest. Another brings up a useful analogy to use when teaching students about the difference between sprites and objects, while another uses a game she designed on her own as a demonstration tool. The mentors became consistent generators of ideas and resources for curriculum.

The Mentor to Instructor Pipeline

While the introduction of the studio mentorship model was an intentional action, the youth leadership that emerged from that introduction was more fortuitous. Our research process, which involved a careful documentation of what happened in each session of the program, allowed us to see youth's steps toward leadership and find ways of supporting and expanding upon these roles. Our field notes show a transition where mentors began as generators of ideas for curriculum and teaching strategies within a class and then moved to generating ideas for whole courses and becoming instructors themselves. While we cannot address the full complexity of these shifts in this current analysis, in what follows we describe the broad shifts in the program from being taught nearly entirely by adults to a program entirely taught by youth.

Year 1: Limited But Successful Examples of Youth Taking on Instructional and Curriculum Design Roles

In the fall of Year 1, all of the courses were taught by adult males. A high school student was asked to be a guest speaker for one 40-min "special" class session of these courses was led by a high school student, where he presented about an internship where he had used Google Sketch-up to create 3D models of local buildings and led a project where students worked on creating a model of the high school where the program was held. This was marked as an unusual event, with the site coordinator filming the class, and asking all the adults on site to watch.

In the spring of Year 1, ballooning enrollment but with uneven attendance led to there being occasionally insufficient computers in the labs for the main courses. To offset this, while the same teachers continue to teach the core courses, a high school student was occasionally asked to fill in the gaps. On our request, he designed mini-sessions (15-20 min) that either involved brief periods of playing and analyzing games such as Civilization or designing with a "drag and drop" 3D design tool that did not require programming (MissionMaker). While these classes were often ad hoc and short, we found it impressive that a high school student was prepared to lead a group of youth, some of whom were his own age or older than him, often with little forewarning. Seeing the success of these two high school youth in these initial instructional roles helped us to be more alert to new possibilities for youth asset building as they emerged.

Year 2: Asset Building Through the Studio Mentorship Model

The introduction of the mentorship model created situations where mentors were consistently differentiating instruction for individuals who entered the program late, or who needed more challenge. In nearly every field note session, there is at least one example of a mentor redefining the problem, encouraging an additional step, or reviewing earlier skills. For instance, when one student was frustrated that his sprite was gaining too much speed and making the game too easy instead of just showing him how to adjust the speed, a mentor asked a deeper question, "How else can you make it harder?" And made a suggestion, "Make more objects—that's what I did in my game [referring to a game he had made and showed him earlier]." In addition, in Year 2, mentors continued to teach the supplemental courses they had in Year 1. Throughout the year, we also had many conversations with mentors about their ideas for the program. Mentors regularly suggested potential other software we could use, potential competitions for students to enter, brought in examples of their own and other work, and made suggestions for what classes could focus on. For instance, two of the mentors suggested students should learn tools for image creation because they were involved in more personalized games and simulations. We agreed and the two mentors designed and taught several sessions in Adobe Illustrator, Photoshop and Flash.

Year 3: Continuation of the Studio Mentorship Model, Youth Initiatives Toward Instructional Leadership

This growing leadership among the mentors was reflected in a stance where youth took the initiative to adopt new roles as the program changed. For instance, when Mr. V. who taught the entire portion of 2D interactive game design/programming left due to a job relocation, one of the mentors nominated herself as a replacement. She had been a long-time participant and mentor in the program, recently graduated from the technology-oriented DCPS high school, and was enrolled in a computer science program in college. Her initiative to become an instructor reflects her growing sense of agency and the GDMC's work on asset building. The way she frames her motivation for teaching reflects a second dimension of culturally relevant pedagogy and computing, *connectedness* to a broader community (Gay, 2000):

> You feel like you were kind of in a way helping the community. I know that sounds kind of corny. But you definitely feel like you are doing something good.

Her discussion of why she is committed to the program also demonstrates her *reflective action* and awareness of the students' technosocial backgrounds and related issues of social justice, a key principle of culturally relevant computing (Scott et al., 2010). As she explains,

> I also just felt like, like students that are in this area primarily do not get exposure to a lot of these things. They don't get a lot of exposure at all. And in college like using these tools will put them way ahead. . . . And like what I was saying earlier about how a whole a lot of students drop out [referring to an earlier comment she

> made about how she "keeps hearing stats like 90% of students that come out of DC public school systems drop out their sophomore year" of college]. I felt like a program like [this] if somebody wants to go into computer science or something computer related this will definitely help them along. And I just feel like it's really important. . . . I felt like it was really *really* important that a lot of students in the area had exposure to these types of things because I don't even know if they would have known stuff like this *existed*, you know what I mean, unless they knew somebody that knew somebody.

She connects this to her own experience of having no exposure to it before attending the program and the technology high school: "because I didn't know anything about programming really. I just knew it existed. I didn't know how to get into it. I didn't know you know like what how to even start off trying to learn something like this. I just kind of was like, no."

As instructor, she offered sample lesson plans to us for feedback, enlisted a friend and fellow computer science student to be her coinstructor, designed and taught the curriculum, and supervised the mentors in the class. Other senior mentors continued to design and teach supplemental class sessions, and these sessions were now consistently based on youth's proposed ideas rather than simply filling in administrative gaps. To continue building youth as leaders, we extended the mentorship program, to allow students who had less skills or experience to be hired as a mentor-in-training. At that point, they would need to develop their teaching and technical skills if they would like to become a mentor.

Year 4: Youth Take on All Instructional Roles, Leading to a Broad Increase in Percentage of Students Taking on a Mentoring Role

In Year 4, we unexpectedly lost the other longstanding adult teachers and also the access to the site where the program was held. These disruptions, particularly at the end of the funding cycle for a program with sophisticated technology demands, could have easily ended the program. However, through the studio mentorship model, we had developed the skills and experience of a group of youth who were then ready to envision and move into leadership roles. Youth who had been instructors the previous year volunteered to take charge of all classes in the program. Experienced mentors proposed for the introduction of assistant instructors, who they believed would help design and implement lessons. In response to these youth initiatives, we collaboratively developed a pipeline of roles with increasing responsibilities for youth: mentors-in-training, mentors, assistant instructors, and instructors. There was a dramatic increase in the percentage of youth—from 18% to 19% in Years 2 and 3, to 30% in Year 4—taking on some leadership role.

With nearly one third of the youth participants taking on a leadership role, there came a pervasive culture of youth taking initiative. In nearly each week's session, different youth suggest new lesson ideas or new software. All the assistant instructors took responsibility for designing and teaching at least one independent lesson. Youth would see and create opportunities for themselves. For instance in a collaborative project with the Federation of American Scientists (see Khalili, Sheridan, Williams, Clark, & Stegman, 2011, for a description of the project), one mentor took on the role of doing more extensive research on the science content for the games to teach other mentors and students. The most experienced instructors took even greater ownership of the program: They initiated discussions with the principal investigators about potential avenues for seeking out funding for continuing the program beyond its initial funding deadline. This degree of agency expressed by the youth—their vision of themselves as leaders and creators of new possibilities—extends far beyond our initial conception of their roles when we introduced the studio mentorship model.

In addition to initiating new ideas, the youth instructional team also developed the capacity to respond to the inevitable problems that emerge in a technology education program. For instance, one session was planned to have two computer labs and one was unavailable. In their presession meeting, the instructors, assistant instructors, and mentors decided that some of them would lead a paper and pencil game brainstorming session for half the group while the others were teaching in the computer lab. On another occasion, the planned software was unavailable and the youth instructors devised another plan using software that was free and quick to download. In these self-designed roles, are able to "make visible" their adaptable competence and a considerable fund of technical knowledge to draw upon.

Youth had created a learning community that was quite different than the one we initially designed and clearly reflected themselves and felt "safe" for failed experiments. One session, where a 15-year-old assistant instructor, George, tried to teach something new stands out as an example of this "safety" to experiment and fail. The mentors were trying to solve the problem that the new computer lab no longer had access to Maya. As a solution, George proposed to teach a 3D modeling lesson using the software *Sketch-up*. Since the software is fairly simple and intuitive, he thought he could teach it with little preparation. However, he had difficulty trying to simultaneously remember and explain the functions to students. He fumbled his speech and kept making mistakes on his demonstration screen. There was boisterous banter with many novice students confused and raising their hands and several experienced students jokingly shouting out comments such as “I’m three steps ahead of you; I should be the teacher instead!” George held his ground, asserting: “It’s a lot harder to teach it than just to do it. If I could just sit down at a computer, I could do it in three seconds too.” As the other mentors saw George struggling, they fluidly shifted to working with small groups of students, thus quieting the larger group down while George took some time to get his thinking back on track. No adult needed to intervene and remind the students that it is hard to teach or to pay attention. There was teasing and laughter about it—with the students and mentors mimicking George’s confusion and “blank” moments in front of the class—but the tone was friendly and George felt comfortable enough to make fun of himself also and to try teaching it again (with more preparation) in another session.

Conclusion

In this article, we describe how the GDMC program moved from one that was designed by adults to be engaging and relevant to the population it serves, to one where we supported youth in their efforts to recreate and transform the program. We claim that supporting the development of youth agency made GDMC more flexible and adaptive in the face of considerable challenges such as loss of our site and instructors. Because youth felt ownership of the program and felt agency in it—they proposed and carried out solutions that kept the program thriving. Youth’s agency led to dramatic role transformations, from a handful of youth who were mentors in name only, to a third of the participants taking on mentoring roles and all of the primary leadership and instructional roles assumed by youth. As youth envisioned and enacted leadership roles and created a community of learners, the GDMC program became more individually, socially, and culturally relevant.

We present a view that cultural relevance emerges when a program takes a consistent stance that the youth are assets to the *design* of the program, and opportunities and efforts to support youth in this designing role are seen as central. This asset building is a core aspect of culturally relevant pedagogy; youth’s prior knowledge, cultural background, and experiences all become potential resources to build connections to new knowledge and ways of thinking (Hilliard, 2003; Howard, 2003; Lee, 2007). A key insight from our work is that the *studio mentorship model*, which involves supporting students in a *designing* and *mentoring* role, heightens this effect. First the studio approach to learning fosters agency. Youth repeatedly described a sense of agency coming from learning to design games, programs, and 3D models. One youth calls his design of his first 3D model in Maya an “epiphany” where he realized “I can make any idea real.” Another youth emphasizes how learning to program gave her a sense of power: "I was just like if it's all like this, I love it. . . . I really like this. Cause you feel powerful. You feel really powerful. . . . Like the user is doing what I am telling them to do." When we created a studio environment that gave youth more freedom and support in developing their own designs and programs with technology, they developed a greater sense of agency—they could make their ideas real. Second, when we combined this design studio environment with mentoring roles, the youth began likewise envisioning, planning, and "making real" their ideas for the program. As described earlier, youth took the initiative to design new ways of explaining and demonstrating things to other youth; designed new lessons, courses, instructional roles; and ultimately became the drivers in designing and teaching the program. Their language, actions, and new initiatives all parallel what Brice Heath found in her linguistic analysis of the language youth used in other arts programs—a sense of "asserting possibilities" (Heath, 1999, p. 25). We found that when GDMC gave students the opportunity not only to design games but also to design instruction; they also designed highly personalized leadership roles for themselves. What began as youth agency expressed in their individual technological work led to a transformational stance to the kinds of mentoring roles they took in relationship to peers and leadership roles in the program.

Informal technology education programs are poised to support this kind of designing role for students: The flexible structure allows for more varied roles and ways of participating than in a traditional classroom, the tools allow for open-ended creative and collaborative production, and the widely diverse forms of technology available allows for expertise to be distributed (Kafai et al., 2009). A perspective rooted in culturally relevant digital pedagogy and studio design focuses on how students' diverse individual and cultural backgrounds can be assets in the development of technological tools and instruction. In the GDMC program this asset building took the form of students' choosing to use and teach tools they had experiences or interest in, designing content that reflected their interests and knowledge, and adopting teaching and mentoring approaches that built on their connectedness to the community. We suggest that urban informal and technology educators make program decisions with a consistent eye toward youth asset building, that is, finding opportunities to provide greater agency and leadership to an increasingly broader percentage of the participants, including a designing role, even when it seems at the expense of other potentially worthy educational goals (such as a more comprehensive curriculum).

Indeed, we believe this approach to informal education can expand our definitions for rigor in urban education more broadly. Youth in the GDMC program demonstrated competence and initiative in more ways than we could have imagined once they were given the opportunity to do so. In just the few of the examples we discussed in this article, we see examples of youth noticing gaps and proposing and implementing solutions in our program (e.g., the two mentors who saw we needed more instruction in image creation and thus taught sessions in Illustrator, Photoshop, and Flash). We see them adapting to real-world challenges with initiative and resourcefulness (e.g., devising in-the-moment solutions when the program lost its site, when planned software was unavailable, when there were insufficient rooms or computers for the students). We see youth handling difficulties with aplomb, such as when George kept his composure and sense of humor in his faltering Google Sketch-up class. Asserting possibilities and responding to these kinds of challenges represent a kind of "hidden curriculum" of the GDMC program. Observing George's teaching attempt and many other scenes like it was often unnerving for us as educators and researchers. We watch the youth take on these adult roles and responsibilities, and we are not sure in the moment if we should intervene to protect them, restore order, and ensure productivity—and yet only by attentively waiting it out can we (and the youth and their peers) see the extent and depth of their competence. Rather than using more limited conceptions of rigor such as outlining high-level content knowledge goals and skills and assessing their achievement, we propose a view of rigor of creating opportunities for youth agency and leadership and observing and documenting the competences they demonstrate in these opportunities. We believe this approach represents a far more meaningful, valid, culturally responsive, and rigorous test of learning—and a predictor of youth's likely success in their future lives and careers—than any test we could devise a priori (Hilliard, 2003). As urban education programs develop new forms of technology education, our experiences in GDMC suggest that providing open-ended design opportunities for students allows them to make visible the skills, experiences, and knowledge rooted in their individual and cultural backgrounds and that a pedagogical approach that explicitly views youth's prior technological experiences as asset in developing curriculum and peer mentoring relationships can lead to highly competent technical work, youth agency, and design and assumption of leadership roles. New technologies offer new chances to envision better and fairer assessments. Persistent negative effects on self-efficacy, motivation, and performance due to stereotype threat in traditional assessments make the development of these more authentic forms of assessment even more critical for urban educators (Aronson & Steele, 2005).

To be sure, giving youth agency and assessing their learning demand attentive adults. While we no longer directly designed lessons, as program leaders we listened to students' ideas and sought out opportunities for them to implement them in ways we thought were likely to be successful (e.g., trying something out with a small group before designing a class). We took extensive notes on nearly every class session. We gave feedback on their ideas and aspects of their instruction. But in addition to supporting individual youth's agency and leadership development, this stance toward youth asset building can also yield unexpected programmatic gains. When a third of the participants are supported to not only learn but to also share knowledge, the options for instruction become much more fluid. GDMC had more capacity to quickly and inventively respond to unexpected challenges (e.g., loss of teachers, loss of program site) through youth's preparation through their prior instructional experiences and their resourcefulness, energy, and leadership.

In our own and others' experiences, youth frequently astound us with their inventiveness, competence, and agency in the digital technology fields, even when facing considerable sociopolitical barriers. While we should appreciate their achievements, we should not assume they will naturally emerge. As educators and researchers, we need to engage in the reflective and asset-building processes where we recognize, support, and extend students' capacity to design and express their agency (Gay, 2000, 2002; Howard, 2003; Lee, 2007). We see this focus on viewing youth as assets and finding ways to support their initiatives and agency as a key route to developing diverse technology innovators and leaders. A mentor envisions her future career in computer programming:

> Maybe I can help out by making something that makes it easier to find criminals or [a program] that improves the way they do business. . . . If I do end up making video games maybe I will innovate the way the video games are seen . . . or may be used in the classroom…. . . I just would really like to honor, to make something better, as opposed to just. . . you know going with the flow, I would actually improve something at some point.

Building on their practice of designing games and designing instruction, youth design a new role for themselves as innovators of all our futures.

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