

Chapter 8

Creating Within and Across Life Spaces: The Role of a Computer Clubhouse in a Child's Learning Ecology

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It is a quiet Tuesday evening in the fall. A teenage girl sits at a large green table with her head bent over a Venn diagram. A younger boy sits at a nearby computer searching for images on the Internet using Google. This familiar scene of after-school concentration can be found in any number of American community contexts, including a public library, a local school, or a family kitchen. However, in this particular case, we look farther into the room and find more youth at work using high-end technology equipment, including a full digital recording studio, new computers with professional design software, digital animation supplies, and the latest gaming technology. Welcome to the Simmons Computer Clubhouse, part of an international network of over 100 similar informal after-school learning environments where young people work with adult mentors to “explore their own ideas, develop skills, and build confidence in themselves through the use of technology.” Luis, a skinny dark-haired 13-year-old boy, sits at a computer station in the back corner of the room with a set of plastic action figures from the X-men comic series, a basket of play dough, and an Intel Digital Blue stop-animation camera. He is producing his latest movie.

Introduction

The clubhouse environment described above has its origins in concerns about equitable access to tools, people, and ideas that support the development of *technological fluency*—defined generally as the capacity to express oneself using a broad

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range of computing tools (Resnick & Rusk, 1996) and to adapt technology to advance one's own goals. Digital technologies offer children and adolescents rich opportunities to design and create artwork, movies, games, animations, interactive robots, and other artifacts. Online communities that reflect "cultures of participation" (Jenkins, 2006, 2009) allow creators to share their work, receive feedback, and expand their social networks. Informal collaborative relationships develop as learners share knowledge and codevelop interests. It has been suggested that participation in these informal collectives nurtures important twenty-first-century capacities such as collaboration, knowledge of how to build social networks, manage information, direct one's own learning, engage in design, and capitalize on opportunities for distributed cognition and the building of collective intelligence. Design activities, including information gathering, creative thinking, prototyping, improvisation, and tinkering, are thought to provide potential pathways to these crucial twenty-first-century capacities (Balsamo, 2010).

Although these cultures of participation are becoming more common, they are not equally accessed. Recent research has shown that despite the emerging cultural image of the average youth as constantly connected and technologically savvy, those who can actually create digital media or interactive environments are in the minority (Barron, Walter, Martin, & Schatz, 2010; Ito et al., 2009). More common are socially motivated genres of participation such as social networking and texting. Those that can use technology in more advanced ways have typically been deeply supported by parents, peers, or teachers that have expertise. For example, in a study of technologically sophisticated youth in Silicon Valley, (Barron, Martin, Takeuchi, & Fithian, 2009), we found that parents advanced their children's learning when they collaborated with them, learned from them, brokered outside learning opportunities for them, provided nontechnical support to them, or hired them to do technical work. Parents also played instrumental roles when they shared their technical expertise through informal teaching processes or provided their children with learning resources such as books or new media tools. Studies of school-based access to learning opportunities show that it is the more economically advantaged communities that offer electives focused on advanced topics such as computer science (Goode, 2007; Margolis, Estrella, Goode, Jellison-Holme, & Nao, 2008).

Other studies show that youth who live in communities in areas of lower socioeconomic status (SES) like Luis's often are not using technology at home or at school to do much beyond basic Internet searching, social networking, or typing out a report using Microsoft Word (Barron et al., 2010; Warschauer & Matuchniak, 2010). While these skills are certainly important, there are still stark differences among children and adolescents in access to learning opportunities that will help position them to use computers in ways that can promote their own development (Goode, 2007; Warschauer & Matuchniak, 2010). It is becoming increasingly evident that differences in the types of participation youth engage in will further contribute to inequities along gender, SES, or cultural dimensions.

Theoretical Goals and Methodological Strategies

Community technology centers can provide an important space for youth with less home access, offering multiple opportunities to learn through mentors and material resources (Kafai, Peppler, & Chapman, 2010; Penuel, et al., 2000). In our snapshot of Simmons, youth are diligently working on their stop-motion animation skills, tinkering with the timing of their movie soundtracks, and laying down complex beats in the recording studio. Observations of the creative work emerging from environments like the clubhouse raise a host of questions about the learning activities that take place there, how they evolve over time and place, and who is involved.

The case study analysis we present in this chapter is part of a larger research program investigating conditions and consequences of persistence of engagement in technologically mediated design activities that offer adolescents opportunities for imaginative work.¹ A focus on engagement in research on learning, in contrast to an exclusive focus on knowledge acquisition, is consistent with contemporary theories of learning that conceptualize moments of learning as part of a process of identity development (Beach, 1999; Nasir, 2002; Wenger, 1998). Participatory views of learning draw attention to membership in communities of practice that are defined by affinity groups (Gee, 2000) based on interest-driven activities (Wenger 1998). For newcomers, joint endeavors offer not only opportunities to develop knowledge in a particular domain but also increasing levels of commitment, sense of belonging, and identity as a practitioner that develops and is sustained across time and place. Practice-linked identities typically emerge when learners view their own engagement in the practice as an important part of who they are (Nasir & Hand, 2006) and when this connection is made, self-sustaining strategies of continued learning can often be observed (Barron, 2006). Members of affinity groups come to develop practices and sets of experiences that position them to engage the world in particular ways that offer continual opportunities for learning.

Youth who lived in the community served by the Simmons Computer Clubhouse, on average, had much less access to computing tools at home than their Silicon Valley neighbors whose parents worked in the technology industry (Barron et al., 2009). The goal of the clubhouse study was to better understand how this intentionally designed space provided opportunities for learning and how it intersected with

¹ In this research program, we use both quantitative approaches and ethnographic approaches. Surveys allows us to collect data from large samples in order to compare communities with respect to the breadth and depth of creative production activities that adolescents have experienced (Barron, 2004; Barron et al., 2010). This quantitative approach also allows us to examine the relationships between variables. The ethnographic case study work allows us to more deeply understand the social processes that lead to and sustain engagement. It allows us to see the dynamic nature of a child's learning ecology and how it changes as new learning resources are made available or disappear.

other spaces for learning such as the their own homes, the homes of friends and relatives, schools, libraries, churches, and virtual settings such as online environments. We have selected one clubhouse member, Luis, as a focus for this chapter, because his level of productivity at the clubhouse was relatively high and we were interested to see how his learning history and learning processes compared with those from the community whose parents were employed in the information technology industry.

Our particular approach to case studies involves taking a longitudinal perspective. Interviews and observations are summarized to create portraits of learning about technology in a genre that has been called “technobiography” in recent work (Henwood, Kennedy, & Miller, 2001). A life narrative approach allows us to chart a learning history in terms that go beyond metrics such as numbers of courses taken to include the meaning and attribution behind decision making and narratives of how the learning activities unfolded across time and setting (Bruner, 1994; Elder, 1994; Linde, 1993).

Our representations of Luis’s activities in narrative form provide what might be called a wide-angle view of learning, losing direct observation of micro-interactional phenomena but offering a glimpse at the dynamics of learning and interest development over weeks, months, and years (Lemke, 2000). Our methods involve observation, interviews, analysis of the artifacts learners create, and data collection through an occasional questionnaire. To advance our conceptualization of learning over time and settings, we create visualizations that map key learning activities, relationships between activities, where they take place, and the people and resources involved in each activity. In the next section, we provide Luis’s technobiography and then present a visualization that maps his activities across time and setting.

Luis’s Learning Pathways

Luis was 13 years old and in the last months of seventh grade at the time of our final interview. We had been talking to him and observing him in the clubhouse for two years. He lived in the low-to-middle class primarily Hispanic, Northern California community served by the clubhouse and attended the local public middle school. Luis had been coming to the Boys and Girls Club after school for five years. He shared the one computer at his home with his parents, his sister, and his brother. Luis often used it to play games. Although the family did not have Internet access or a printer, his older brother had an analog video camera. When Luis was 10 years old, his brother showed him how to shoot video and use the animation special effects available within the tool.

Getting Started at the Clubhouse

Luis became a member of the computer clubhouse when it opened on-site at the Boys and Girls Club when he was 11. “I’m not sure how long I’ve been here at



Fig. 8.1 Luis positioning the Intel Digital Blue camera and various action figures for one of his stop-motion animations

the computer clubhouse, but it's been a while. I animate a lot here. I do stop-motion. I also make photos on Photoshop."

Luis noticed the video camera equipment in the space and, using his existing knowledge and interest from working with his brother, set out to make live action movies with his friends, "I just asked [the clubhouse coordinators] what it was and they told me and it was for taping and stuff, so I just started running around taping my friends, trying to do scenes and stuff...." The clubhouse was equipped with Intel Digital Blue cameras and although the clubhouse coordinators had taken a workshop on how to use them, they were not experts in this field. The camera set, which could be used to shoot both video and still images and came with its own editing and special effects software, became Luis's main tool for creating. He returned to the cameras again and again, experimenting with different methods.

Luis: "Well when I first saw the camera I didn't know what it was for, and [the clubhouse coordinators] didn't know either, so my friends and me were just doing stuff, like movies making it look like people were going super fast. Then I started getting ideas about like moving things and then taking pictures."

While he was learning the process of stop-motion, Luis experimented with animating paper drawings. "Just to draw a bunch of animations on paper and see how it worked. ... It worked out pretty good. I drew a picture and then I take a picture of it, then erased it, then drew, just moved it a little, drew it, and erased it." The paper drawings evolved to claymation, from which Luis then developed his own style, a combination of claymation and plastic action figures, like the ones shown in Fig. 8.1.

While Luis was finding his own technical way with the equipment, the clubhouse coordinators recognized and encouraged his incoming interest in film-making and offered new ideas.

Coordinator: “To begin with, I guess he’s always been into movies and stuff so we would always take the cameras out and him and his buddies would go out there and shoot these little fight scenes and make little sound effects with their mouths and stuff like that and bring it back in. They made little clips of them fighting and stuff. We had a box of clay that we would bring out ... we showed them how to use the stop-animation tool in the software. I think he just started ... I know, like his brain just started thinking up all these other ideas. He came up with just a bunch of different scenarios.”

The clubhouse coordinators included Luis in field trips connected to his interests, including one to the game design company Electronic Arts. Luis remembered, “That was pretty cool. We learned a lot about its history. We got to try some games that hadn’t come out yet.” The coordinators also often promoted his work by showing his movies to guests and new members.

Movie-Making Process: Idea Generation, Feedback, and Revision

Luis describes his process in a nutshell as, “think about it, get some supplies to make it, and then do it.”

Think About It

For inspiration, Luis drew heavily on contemporary media, from popular cartoons to Hollywood action and Kung Fu movies, using them as touchstones and markers of the kind of movie he wanted to make. He sometimes cited what he saw as a flaw in a narrative as the spark for a movie of his own, such as bringing a favored dead character back to life. He also talked about watching and enjoying other stop-motion films including claymation.

He also was able to generate design process ideas from examples in mass media, such as when he picked up the ideas of developing concept art (drawings to guide digital look and feel) and storyboarding from a special feature in a video game:

Luis: In the video games, there are a few things you can unlock and it’s in the extras, it’s called extras and it shows you the storyboard of how...um...about the scenes in the game. They look pretty much like a comic and no words. They just like show what they are doing and write down what they do.

Get Some Supplies to Make It

Once Luis has planned out his general idea for a movie, he gathered the materials he needed to produce his work. Initially, this included action figures from home for the characters and play dough and clay from the clubhouse for different effects (such as using red play dough to model spilling blood as shown in Fig. 8.2). As he made more movies and got feedback from himself and others, he looked for new tips and tricks. When his friends complained about seeing the clubhouse



Fig. 8.2 Battle scene created by Luis with red clay used to simulate blood and animation effect added to convey explosion

computer equipment in the background of a scene, Luis began to make his own backgrounds for different shots. He also looked for new ideas and solutions to problems online, especially from a site called zipster.com.

Sometimes I use boxes as houses. I'm looking forward to getting some fishing lines so I don't have to use my fingers to hold them up. The fishing line, you won't be able to see them.

Then Do It

Luis worked tirelessly to position, shoot, and edit his movies. He added his own sound effects and music, sometimes using the clubhouse sound studio. Once the shots were assembled in the Digital Blue software, Luis added edits and special effects to enhance the narrative.

Luis's workspace at the clubhouse was frequently crowded with boys who were very much a part of the scene, laughing and giggling while making sound effects, and gesturing with the action figures that appear in the movies. They contributed ideas and offered advice in terms of what they liked or did not like. In addition to being audience and critic, they also occasionally contributed sound effects to the films.

Luis's process of revision entailed reflecting on movies he had already made and setting goals for new ones. In some cases, this was self-critical, attempting to fix mistakes he saw in his previous work. Luis described his desire to make more complex and better-structured films.

Interviewer: So how would you do it so it would make more sense?

Luis: Actually have like a story in it instead of just random fighting.

Interviewer: And where did you get that idea?

Luis: Well, I watch a lot of Jet Li movies and I like fighting. So I just tried it. But um the first one was just random punches. The second one is going to be more choreographed.

Boundary Crossing: Connections to Home and School

Although access to camera, computer, and the editing and effects software designated the clubhouse as the main site for his movie production, Luis was able to work on elements of his movies in multiple contexts. His work in the clubhouse was often directly impacted by what was occurring in these other contexts.

Movie-Making and the Context of Home

Despite the fact that his family computer was old and not equipped for video production, home remained an important context for design. Luis played games on his Playstation, exploring the extras, sketched and storyboarded movie frame ideas, received feedback on his work, and procured the resources he needed, such as action figures. His mother and older brother were central figures in the development of his projects.

Interviewer: Does Luis at home sometimes draw things that are for movies that he makes [at the clubhouse]?

Mother: He draws ... the same animation he does, he draws his own figures that he has at home from a book or something and he makes like ... you know like in the newspaper, the little comic things, he makes little squares and he draws it and puts little comments on them.

Luis's older brother had moved out of the family home, but was close enough to have a significant impact on Luis's learning. In addition to initially introducing him to and teaching him about video production, at his brother's house, Luis used his faster computer and played games with him on his Xbox. He also received important feedback on his video design work.

Like with my brother, he saw [characters in my movies] just like floating around instead of moving their feet. So he would tell me put toothpicks in the hold in them, on their feet, so it looks like they are actually walking.

Luis and his mother frequently talked about subject matter for his movies, with her suggesting that he do something "funny, because he is funny, he has a good sense of humor" and him replying that he "likes monsters and gore." In addition to being an audience for his projects and discussing ideas, Luis's mother also monitored Luis's work on the computer. At the end of seventh grade, Luis's grades in school were falling to the point where he was worried he would need to repeat the grade. His parents attributed some of this to his spending too much time on his extracurricular computer projects, like the computer animation, and sought to limit his work.

Mother: Well, his grades kept coming down and we had a conference and the teacher was concerned because Luis is like a super smart boy and that he was wasting his time on not doing what he's supposed to do. Me and his Dad know that he does those kind of things, the animation on the computer. Me and his Dad don't put him down about it and we, you know, we are standing right by him if this is what he wants

and we'll support in every which way like I do with my little girl. But, um ... he needs to know that he needs to keep doing what he needs to do in school and then in the computer clubhouse he needs to do what he needs to do. It's two different worlds. If he doesn't graduate, if he doesn't ... if he's getting bad grades, that's where we know how to punish him, right here because this is his main interest. We had to restrict his activity at the clubhouse because he was not focusing on school.

At the same time, the close attention Luis's mother paid to his work at the clubhouse allowed her to recognize the importance of capitalizing on his outside interests to motivate his production. She does not seem to have the same detailed level of understanding about what is going on in school.

Mother: "I think if ... if they did have this kind of project in school, it would probably keep a lot of children out of trouble from going into the street and trying to find something bad to do. All they have in school is just work, do your homework and recess time. Sometimes I think that during recess they should, you know, the kids that are interested in doing this, give them reasons ... if they want to do something in the computer, let them go do it instead of wasting their time outside fighting and arguing like other little kids. They don't let them go into the computer only when he's in class. I don't think they ... they don't let them use the computers to do fun projects."

Movie-Making and the Context of School

About once a week, Luis used the Internet for research or used the school computers to type out his school assignments. After he started developing movies at the clubhouse, he found ways to use opportunities at school to advance his own learning and production. He talked about having access to some new programs, including an animation program called Sweep, "like a flash animation but you could draw something, like move it around." He found time to work on his clubhouse movies in school, storyboarding scenes during free time. He found an elective class in school where they used iMovie. As part of the class he worked with a group of peers to create a movie, all participants taking on roles of actors, scriptwriters, and directors.

That same year, he brought a CD of work created at the clubhouse to school and showed many of his teachers there.

Luis: I actually showed [some of my video work] to my teacher and she said she really liked it. She learned that I knew how to animate. The computer lab teacher actually, she liked it a lot. I showed her on the DVD of my work and she really liked it...

According to Luis, his teachers were surprised to see what he was able to do, "They were kind of amazed, like they liked it a lot. Their eyes were wide like looking at it." In addition to making him feel "real happy" and "kind of like proud of himself," this opportunity to represent himself through his movie productions led to new opportunities in school.

Luis: Well, the experience. It's been really fun and uh...all the ideas coming up, the opportunities. Like my PE teacher, he is paying me \$50 to make a stop-motion animation about the

movie War Ball, I mean, the game. He's going to show it to his class this year to learn about how to play it, more like a "how to" movie.

Luis at the End of Seventh Grade

At the time of his final interview at age 13, Luis had firmly established himself as a video production artist. He had over 30 items stored in his folder on the clubhouse server, including movies and sound files. He estimated that he had taught five boys at the clubhouse about stop-animation movies. His films included a tagline for his production company, "I like bacon productions," a phrase that Luis was fond of using from the TV show *The Simpsons*.

He had plans for the future, including learning more about "stunt choreographing, also fighting, more about making movies and stop-motion" and "making longer movies." In the short term, he was trying to get actors together to make a live-action horror movie based on *Resident Evil* and had Halloween as a due date. More long term, he said he planned "to get myself a computer, and I might become a computer programmer or a video game designer."

Summary and Discussion

In this chapter, we shared the learning history of one child in the form of a technobiography. Our cross-setting focus led us to describe his activities at the computer clubhouse, at home, and at school. Expanding the temporal dimension from days to years allowed us to chart the development of his engagement in movie-making over time, his design process, and the way that his social network evolved to support his learning. His pattern of sustained activity resulted in more stable interests, depth of expertise, and an identity as a stop-motion animator (Hidi & Renninger, 2006). We were able to understand the ongoing design activities Luis engaged in as he came up with new and creative solutions, tinkered with different ideas and tools, and created new words in his head that he translated through developmental design phases into the shareable medium of video. Encouragingly, these activities reflect those that researchers believe can build critical twenty-first-century skills (Balsamo, 2010).

Figure 8.3 maps his activities using a timeline representation, a visualization that allows us to see patterns of learning activities and to quickly compare the pathways and resources of different case learners. Age is represented along the horizontal dimension and setting (home, school, community center) along the vertical dimension. Although Luis played games on a computer as early as age eight (represented by the computer icon for "first used a computer"), his first digital media productions took place at the clubhouse when he was 11 years old (represented by the light bulb icon for "onset of fluency building activities"). At the top of the diagram, people and other resources that supported each of Luis's activities are noted. As this diagram

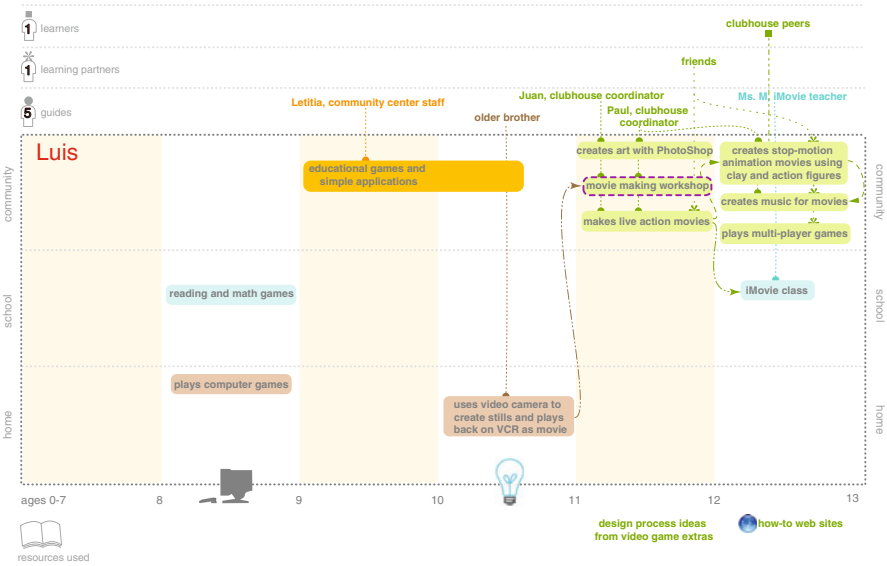


Fig. 8.3 Graphic visualization of Luis’s learning pathway over time and across setting²

shows, and as the narrative reveals, Luis was able to recruit the help of the clubhouse coordinators, his mother, his brother, teachers at school, and peers in the clubhouse to support his movie-making work. He also drew on Internet-based resources, professional movies, and storyboarding examples within videogames as inspirations and sources of learning.

Luis’s timeline makes apparent the centrality of the clubhouse in his learning ecology— it is the main site of his production, providing him with new powerful creative tools, new learning partners, and a dedicated space for daily work on his projects. The timeline also exhibits a path into these activities from his preexisting interest in animation and games, and outcomes from his new skills and knowledge, as he found new opportunities for learning in school. Three important themes emerged in this case that we discuss below.

1. *The clubhouse was critical for the development of Luis’s skill and identity as a producer of stop-animation films.* His prior interests and experiences with video and animation from his analog video work with his older brother and his love of video games and cartoons, primed him to take advantage of the digital video opportunities available at the clubhouse. These interests were the basis of his initial inspirations, and the tools and Internet access at the clubhouse enabled Luis to explore further, learn more, and develop his ideas and talents in the area. Specific elements at the clubhouse that supported Luis’s interests and allowed

²There were no technology learning events to map for Luis before age eight, the age at which he reported he first used a computer.

him to develop them in different ways include access to the tools of production and coordinator recognition and encouragement of his work. The stop-animation camera, the software, his action figures, and clay were basic materials provided to him by the clubhouse and his parents, which he was able to combine and recombine in different ways to produce his artistic visions.

2. *The clubhouse work motivated and made possible diversification of Luis's learning opportunities.* While interactions within colocated settings are critically important for development, it is also clear that there are learning processes that involve the *creation of activity* contexts in a new setting or the pursuit of learning resources that are found outside the primary learning setting. Luis actively sought out feedback, new representational tools, and ideas across settings. Luis continually sought out resources to feed his imagination. Ideas for story lines and techniques came from his exposure to mass media, including video games and Hollywood movies. Ideas for the representational form of a storyboard and other design tips came from behind-the-scenes footage in a video game DVD and online "how to" websites. The continued engagement in film-making created an ongoing cycle of learning for Luis. As he was out in the world viewing stories and professional films, he watched for directors' cuts and angles for shots and their narrative story lines. As he envisioned special effects in his claymation action drama, he generated visual design goals that set in motion the pursuit of learning new techniques that advanced his dual aims of realism and a professional look. At a much broader and perhaps more generative level, his very relationship to film viewing changed such that he was no longer simply watching or being entertained but rather was looking with an eye toward learning in order to expand his repertoire of productive strategies (Gutiérrez & Rogoff, 2003).

His language reflects his attention to aspects of the expressive and designed aspects of what he creates and we hear from him terms such as "choreography," "realistic," and "animate," as he described goals for his future work, marking his membership in the broader community of practice of animators (Lave & Wenger, 1991). This pattern of a practice-linked identity, leading to a persistent pursuit of learning opportunities, is consistent with what we have observed in case studies from more affluent communities and speaks to its generality, at least when a minimum of resources are available (Barron, 2006). His articulation of a possible future self (Markus & Nurius, 1986) as a programmer or game designer provides further evidence of the importance of his cross-setting activity for his identity development.

Across the observations and interviews we found that Luis's learning partners played a variety of roles. Luis's social interactions around his film-making grew as he became more committed to claymation as a medium. As we noted in the introduction, our prior work on parents' roles in their child's learning about computers and technology identified several roles that parents played that directly or indirectly supported knowledge development. These included the roles of learning broker, project collaborator, teacher, employer, resource provider, nontechnical consultant, and learner/audience (Barron et al., 2009). Definitions and examples of these roles are provided in the appendix. In contrast

to Lareau's (2003) well-known argument that lower SES families follow a parenting practice of "natural development," Luis's parents engaged his hobbies in important ways. They primarily played roles that did not require expertise with technology, most notably those of resource provider and audience. As he sought out feedback from his family, he developed a sense of the desires of different audiences, and in response to a request for a different genre of story he strengthens his commitment to his own vision. Other pivotal roles were played by the coordinators at the clubhouse (including teacher, project collaborator, learning broker, and resource provider roles), his schoolteachers (including audience and employer roles), his friends at the clubhouse (including audience and project collaborator roles), and his brother (including teacher, nontechnical consultant, and audience roles). In fact, each of the seven roles, originally developed based on research with parents in Silicon Valley, most of whom worked in the technology industry, was filled for Luis by someone in his social network. Luis's parents also played the role of a monitor. In Luis's case, his challenges in school led to restrictions on his club time. His parents believed that access to the club was one way that they could motivate him to work harder on his school assignments. Despite this, increasingly, the growth of his learning network is attributable to his sharing of expertise and the subsequent uptake of his expertise by those at school.

3. *Links between the clubhouse, home, and school were present but could have been stronger.* Despite his slipping grades at school, Luis's work at the clubhouse clearly demonstrated a rich imagination, persistence, attention to detail, and resourcefulness in furthering his own development. These characteristics are markers of the potential to thrive as a learner. Had his teachers been attuned to his expertise development earlier, they may have found ways to build on his excellent out-of-school learning skills to reengage him in academic content. Typically, parents act to coordinate across settings and in Luis's case they intervened to reallocate his time at the clubhouse so that he would spend more time on schoolwork rather than try to bring his talents to the attention of school staff.

The fact that Luis took the initiative and brought his animations to the attention of his teachers was remarkable and the digital form of his work made it possible. His recounting of the surprise and admiration of his teachers teach an important lesson about the missed opportunities for nurturing a child's development when the school-based work is the primary lens through which teachers come to know their students. The invitation by his PE teacher to create a "how to" video in exchange for financial compensation marked a potentially transformative moment as it sets up yet another design challenge and learning opportunity for Luis while positioning him as a creator worthy of pay. Had the boundaries between the school and the clubhouse been more permeable, mentor-teacher collaborations may have been possible that could have further amplified the possibilities for learning.

In closing, the clubhouse was critical in helping Luis to develop the kinds of technological fluencies that may position him for further learning and creative work, demonstrating that intentionally designed environments can help bridge the digital

divides that are of growing concern. As his case study illustrates, understanding the origins and consequences of sustained engagement with content requires research methods that go beyond more commonly assessed near-term knowledge gains (e.g., after the completion of a course). It is important to trace connections between learning activities and to characterize how content-related interests evolve over time and across life settings. As this case study and more broadly the research in this volume suggests, a better understanding of how learning takes place across settings and time, and of the possible synergies and barriers between them, may help educators and parents find ways to supplement school-based or home-based opportunities. The rapid increase in access to information and to novel kinds of technologically mediated learning environments such as online special interest groups, tutorials, or games makes it particularly important to understand how, when, and why adolescents choose to learn and the emergent developmental processes that can arise once interest is sparked. These new opportunities for specialized interests to develop are due to what has been called the “long tail” of learning resources (Anderson, 2006). The Internet, for example, allows for the proliferation of communities of learning that cater to very specific kinds of interests and that are available to anyone who has access to the Internet and the skills to understand them, such that even young learners can develop high levels of competence. It is conceivable that in the future, teachers may be supported to take on the role of learning broker intentionally and that parents who do not perceive the benefit of helping their child pursue their interests or do not find ways to attend to their interest may be encouraged to do so. It is such hobbies and pleasurable pursuits that often provide a sustaining pathway of learning that can pave the way to careers and new ideas about possible selves.

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Appendix

Notes on Methods

Data Collection

Luis was formally interviewed twice, once in the spring of 2004 and once in the fall of 2005. At the time of the first interview, the survey of Access, Interest, and Experience was conducted. His mother and the two clubhouse coordinators were also interviewed. Observations at the clubhouse took place across 14 months.

Data Representation and Analysis

Our multi-informant interview methods yield reports on learners' histories in the form of conversations between the interviewers, the learners, and their parents. Responses to questions posed by the interviewer include rich information about children's activities, their learning resources, and the ways their parents and peers support their learning, as well as their future goals, attitudes, and interests. We view these as stories or accounts, and realize that retrospective accounts are subject to biases in memory and that the interview situation itself is a social situation that has its own demands. Beyond these informant accounts of learning, the interviews offer a sample of language that can be analyzed with respect to vocabulary, means of expression, and syntax.

In order to maximize the potential for developing new insights from these records, our research team has created a number of intermediate representations that summarize the raw interview data. Each representation highlights unique information contained within the records. These representations include: *narrative texts* that tell a learners' story along a number of set dimensions; *Excel spreadsheets* that tabulate types of learning resources and allow us to code and quantify variables such as the number of people in the child's knowledge network or the number of structured learning contexts a child has participated in; *lists* of the technical terms a learner used while recounting their history or describing a project they created during the Artifact-Based Interview; *formal codes* for parent roles that are applied to turns; *graphs and tables* that present descriptive statistics for each code; *parent participation diagrams* that show which parents played specific roles for each child; and finally, *timeline representations* that locate fluency-building activities across setting and time, depict relations between activities, show the involvement of peers or adults in the activity, and note the types of material resources used for learning. Each type of representation offers us new ways of understanding the activities and learning of our focal learners. For example, the timeline representations offer a quick overview of the onset and duration of activities and where they occur. Bursts of activity and the increasing distribution of learning activity over settings become

apparent. Placing these learning maps for different learners side by side has helped us attend to significant variations along dimensions of time and resources.

The first clubhouse was housed in an art museum in Boston, adjacent to MIT. Media Lab graduate students ran the club, collaborating and mentoring youth who came to explore, play, create, and invent with professional computing tools of the day. Visitors to the Boston clubhouse were struck by the energy and productivity of youth in this space and soon funding was made available to replicate this model in the USA and internationally.

Tools for Data Collection

Survey of Access to, Interest in, and Experience with Technology

Several scales from a survey developed for use in previous studies were administered (Barron, 2004; Barron, Walter, Martin, & Schatz, 2010). Both Likert-response items and checklist format questions were posed. The questions were designed to tap into four main areas: (1) students' access to technology at home and school; (2) history of technology use across communicative, entertainment, learning, and fluency-building activities; (3) students' use of formal and informal learning resources; and (4) motivational aspects of learning about technology including interest, confidence, and valuing of technology as a subject and potential career.

Learning Ecologies Interview

This interview is designed to give us a portrait of how the child is learning to use technology across the contexts of home, school, community (e.g., church, libraries, clubhouse, camp), and through distributed resources such as books, tutorials, and magazines. This interview also gets at the child's sense of what it takes to be good with computers, their plans for learning, and how they see themselves in relation to technology. A simple diagram illustrating different settings is used to help focus the child and interviewer's attention.

Artifact-Based Interview

This is a semi-structured interview that is designed to provide a focused look at what kinds of projects youth are doing and how they learned, how the projects came to occur (pathway), and the opportunities for fluency building within different projects. We asked interviewees to select one project to show, but often they would share more than one. Questions focused on the story of creation and their learning, although, when appropriate, we asked interviewees to define terms or share technical knowledge. This interview was video-recorded with the camera focused on the screen and keyboard to capture the visual referent of the interviewee.

Parent Interview

The goal of the parent interview was to obtain a developmental history that would help confirm the information provided by the focal participants and to better understand parent perspectives on their child's activities and how they saw their role in helping their children learn. We were also interested in understanding the parent's own experiences with technology and so we began the interview with a request for them to tell the story of their family and technology.

Learning Partner Interview

These interviews focused on how the adult clubhouse mentors recalled working with the focal case learners and their history of coactivity with them.

Coding Categories for Parent Roles in Learning

Description		Examples
Teacher (T)	Parent has taught child how to do something on the computer over some period of time, which can be either high- or low-fluency in nature (word processing to programming). The parent possesses more knowledge about the subject than the child	<i>Father:</i> And back then the scanner we had was not very good. So that's when, I think, I started showing [child] Photoshop. So he could draw on Photoshop and include it into his reports. I showed him some basic things and he took off from there <i>Father:</i> I think [child] picked that up mostly on her own. I explained for her what the concept is though and how you need to define it so that it can be shown anywhere. I told her that <i>Mother:</i> I know that [child] and [father] have a pretty close relationship. He will write macros for him. I know that there has been a lot of collaborative work that is way over my head. They will sit and discuss things. That is a learning process like a work place <i>Father:</i> The only thing he did get help with is there are always the tidbits of educational information you will not get out of the book, and we sat with one of my MIT buddies. It took him and Caleb about 8 h to get the final bug out of this. <i>Child:</i> My Mom signed up for the school newsletter and she said they were saying they were short a few members [on the Robotics team] and does anyone want to sign up <i>Child:</i> Yeah. I make music, too. But I don't have the program right now. My other dad has it and I asked him to bring it next time <i>Child:</i> I'm not sure, but I think six, seven. I don't know. And then [my dad] got me an HTML book also so I started learning HTML. I got into websites <i>Mother:</i> Yeah, we got him Macromedia Dreamweaver, that is when he started learning how to do the web pages
Project Collaborator (PC)	Parent has collaborated with child on a project. The parent may or may not know more about the subject than the child. The project is a shared learning experience	
Learning Broker (LB)	Parent seeks learning opportunities for child by networking, the Internet, parents, and other information sources. Signs child up and provides necessary support for endeavor	
Resource Provider (RP)	Resources provided to the child beyond the family computer (e.g., books, video equipment, software, accounts, etc.) in support of their technology learning Resources can be those owned by the parent and used by the child or purchased specifically for the child	

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	Description	Examples
Nontechnical Support (NTC)	Parent provides information/ advice to child on nontechnical issues such as business or artistic design. This role also covers when a parent gives advice about continuing in his/her learning such as project management, learning organization, or basic encouragement	<i>Father:</i> I kind of knew that [child] would be like: 'Oh, we can do this and this and that.' But I wanted him to focus and understand the business side of things. You get a task and you are told to do it this way. I was trying to make him concentrate on the assignment <i>Child:</i> In terms of like charging money for [my IT services], I think that's just cause I want to have money for things. My Mom also, she has her own, like a business, just so she can do work for people and take deductions and stuff. So I talked to her about it
Employer (EMP)	Parent employs child for technical services rendered. This role can include a formal paid position or more informal activities such as technical support for a home computer	<i>Interviewer:</i> So [mother] has got her own computer? <i>Child:</i> Yeah, but I take care of it and that sort of thing, you know what I mean. All the updating and stuff <i>Parent:</i> No actually it was because I was working for this new company and I decided it would be good to get [child] to help me, I wanted to bring her something that would be interesting so just told her, heck, why don't you take this piece of software and find really good bugs and I think that I paid her something like \$25
Learner/ Audience (LRN)	Parent learns technical skills/content from child or looks at child's work on the computer	<i>Child:</i> [Father] didn't even know ... he doesn't even ... like he always asks me to give him like a...how to do that, like you know, like a tutorial on how to do it
Monitor (MON)	Parent imposes rules or limits on child's technology use (time, activities, websites, etc.) out of concerns for child's safety, identity, balance, academic performance in other areas, health, etc.	<i>Child:</i> Well, like I said, I help my Dad when he has questions about his work <i>Mother:</i> The amount of time we have allowed him to be on the computer has increased over time. When he was very young if he was spending more than an hour we would try to get him out of there <i>Mother:</i> I feel kind of weird with the concept of [child] playing a game with someone that he has no idea who they are. We let him do it online but with someone he knows