Making Home "Work" with Technology:
How Families Design Home Learning Environments

Introduction

Despite today's changing landscapes of formal, *public* education, private spaces of *home* remain vital sites for young children's learning and development. And yet, in contemporary US contexts, domestic settings are also changing in ways that are consequential for learning, due in large part to families' increasingly wireless, mobile, and digitally mediated practices (Ito, Baumer, Bittanti, boyd, Cody et al., 2010). For children, the home is the original learning environment. Education research has a long history of observing the ways in which children learn at home (e.g. Erickson, 2004; Kremer-Sadlik & Gutiérrez, 2013; Rogoff, 2003) and how parents and caregivers influence this learning (e.g. González, Moll & Amanti, 2005; Lareau, 2013). Fewer studies have considered the leading role technology plays in mediating home-based learning even though digital media and technology increasingly saturate these spaces (Ito et al., 2010).

This paper addresses this gap in home-based studies of learning and development by examining what makes up families' emerging "media ecologies," or "the technological and social context in which young people are consuming, sharing, and producing new media" (Ito et al., 2010, p. 27). Recent research on media ecologies has addressed the pervasiveness of new media and mobile technology in families' homes (e.g. Levinson, Siyahhan, Pressey & Taylor, 2015; Ito et al., 2010; Livingstone & Sefton-Green, 2016). This growing recognition, however, presents new questions about how families design their homes to support technology use and how then young people use these spaces and materials for a wide variety of creative activities. What is missing from recent accounts of home technology use *is positioning families as designers of learning environments and attention to the specificity of their choices related to children's learning-* from how parents arrange furniture with technology in mind to when they decide to furnish their child with her first smartphone.

With this as a familiar backdrop, the current paper examines what sense children make of these design decisions and the "situated actions" (Suchman, 2007) that take place in domestic spaces so designed. The purpose of this paper is to address this by considering the following questions: *how do families design domestic spaces for learning with technology and how do children then spend their time working and recreating at home?* By focusing on the wider ecologies of home (i.e. materials, routines, environments) what comes into view is not only how the home is a potential site for reimagining sociotechnical possibilities for learners (Ito et al., 2010). This inquiry also makes visible how home is connected to broader contexts beyond it (such as school) that are often brought inside of it, and then brought to bear on the design of learning environments.

In what follows, I first review two key bodies of literature in which the present paper is grounded. Then I briefly describe the larger study of which the present analysis is only one part. I outline the data collection methods and the analytic approach. Next, I draw on a representative example, illustrative of the larger report (a chapter of my doctoral dissertation). Finally, I discuss how my participants made home "work" with technology.

Framing Literature

Media Ecologies

This study draws on literature within and beyond the field of education to engage questions about the "sociotechnical arrangements" (Star & Ruhleder, 1996) that underlie and support learning. In education research, a body of work on "media ecologies" (Ito et al., 2010) has suggested how learning involves interconnected systems and multiple mediational means (Cole, 1989). Indeed, today's learning environments continue to be re-mediated (Cole & Griffin, 1983) by digital technologies, and these instruments and applications proliferate rapidly. It is in part the very pace of technological innovation that seems to warrant on-going studies of new media practices. And yet, paper-based materials continue to co-constitute media ecologies alongside new and emerging technologies (Norman, 2013; Stevens, 2000). The interplay between digital and non-digital material forms is part of what is in question in empirical studies of today's media ecologies.

Designing Learning Environments

In order to understand the thinking behind various arrangements of media ecologies, I have also drawn on theories of design from related fields that are intertwined with cognition and learning (diSessa, 2000). For example, Norman (2013) suggested that despite what technology designers often think, they are not designing *things*, they are designing total *experiences*, in increasingly complex contexts of use. Reconfiguring the relationship between design and use, Suchman (2007) challenged the notion that people simply put into action the *a priori* plans of designers, arguing that designs are less pre-determined plans than orienting artifacts for contingent use-in-action. Her theory of plans as materialized in and through situated action and her insights about the issue of "contingency" in designing for technology use (Suchman, 2011) frame my analysis of the ways parents design- and children use- media ecologies at home.

Research Design and Methods

This study is part of a larger ethnographic project that was designed to examine how (especially mobile) technology and digital media influence family interactions at home. Participants included eighteen focal children in twelve families from diverse racial, ethnic, geographic, and socioeconomic backgrounds. Participants were recruited from local youth-serving organizations, camps, and other places where young people between the ages of nine and thirteen years old spend time; this period of development is significant for media engagement because it typically precedes the formal introduction of technology in school (Taylor, Takeuchi & Stevens, in preparation).

Data collection took place over two years in two separate US cities, and methods included the following: semi-structured interviews with parents and children (48 total); video recorded observations conducted during home visits, some of which were recorded by children using point-of-view cameras (i.e. GoPros®) (approx. 100 hrs.); experience sampling (90 total phone calls), a novel research method called Community Technology Mapping using Google Earth™ (Author & Colleague, 2017), which was also video recorded (16 digital artifacts); and Home Technology Maps, hand-drawn by participants (18). I analyzed these data qualitatively in rounds of open coding and then used "interaction analysis" (Hall & Stevens, 2016; Jordan & Henderson, 1995) in which I placed analytic focus on dynamic arrangements of material objects in-use (Csikszentmihalyi & Rochberg-Halton, 1984).

I produced detailed, multi-modal transcription of the talk, gesture, gaze, coordination of body movements (or lack thereof), uptake of tools and artifacts, use of space, and other aspects that played into moment-to-moment interactions (i.e. Tulbert & Goodwin, 2011). Because I was interested in the spatio-temporal dynamics of young people's interactions with technology and media in the course of their ordinary routines, I also generated mock-ups of home floor plans based on children's own diagrams of spatial arrangements (i.e. Home Technology Maps) and reconstructions from video recorded observations. I refer to these representations as "mediated floor plans," and the conceptual tool that emerged as I examined the design and distribution of activities therein as "mediated floor planning." I now turn to analysis of mediated floor planning and describe how one family made home "work" with technology.

Analytic Findings

Although all children in the study identified home as the place they felt most engaged with technology and digital media (and school as the place they felt least engaged), many children could not escape the demands of homework, chores, and other assigned responsibilities while at home. Even during discretionary time after school or during summer, participants negotiated (with parents and siblings) how they would spend their time using technology. Together with their parents, young people made it so that home "worked" with technology. This involved young people finding a balance between technology use and assigned work, which often challenged the limits of parents' plans and designs. The result of these negotiations was that the "mediated floor planning" and associated situated actions were the collaborative accomplishment (Suchman, 2007) of interactions which were "multiply floored" (Erickson, 1982).

The following empirical example illustrates how these negotiations took place in practice. When I arrived to observe nine-year-old twins Oscar and Eddie, they were already immersed in their typical afterschool activities: watching TV, completing homework, and playing video games. Their homework assignment on this particular day was an on-going project in their language arts class that asked them to create a book cover for their favorite book. Both Eddie and Oscar had chosen to create book covers based on *Pokémon Deluxe Essential Handbook*, an encyclopedia of over seven hundred Pokémon, thoroughly dog-eared and annotated by the twins, who each had their own copy. While they worked, their mom Steph completed household chores and helped them with their homework.

Rounds of working on homework, which the boys completed primarily while sitting at the kitchen table, were punctuated by "technology breaks," a strategy their mom implemented in the afternoons and evenings each day after school. Technology breaks were designed as ten-minute periods of free time during which the boys could play on their tablets, watch TV, go to their bedroom to play a game on a video game console, or some combination of these activities. However, because the TV remained on in the living room adjacent to the kitchen where they worked, homework and technology breaks were rarely entirely distinct; the boys tended to gaze at the TV throughout the observation, regardless of whether they were putatively in the "homework" or "technology break" phase of the activity structure. For example, about forty minutes into this activity, Eddie watched TV, while his mom attempted to provide some structure to the twins' homework plans (see Appendix A, Transcript 1).

Steph also provided material supports for their work and presented these as alternative options for completing the task. She arranged a clipboard with the assignment instructions for

their reference, and her laptop was made available as a resource for researching Pokémon illustrators. The encyclopedias themselves (2 copies) were also close at hand. And while Eddie worked on one section of his cover, Oscar worked on another using separate material resources and research strategies (see Appendix B, Figure 1). In this way, they were able to "maintain separate floors for interaction" (Erickson, 1982), an arrangement significantly mediated by available technologies as well as by their mom's support, but nonetheless effective for making home "work" for learning with technology.

Discussion

The accomplishment of floor maintenance in complex media ecologies involves coordinating the use of materials and talk in ways that conform to design constraints but also make use of these constraints as resources (Erickson, 1982). Erickson used the concept of "floor maintenance" to refer to how people collectively manage staying "on topic" during conversations. He wrote that "topics and the people who produce them must have a floor to be in" and that as such, "the 'floor' is a sustained focus of cognitive, verbal, and nonverbal attention" (p. 47). Maintaining the floor in terms of shared attention and resources, then, is a collective accomplishment. This paper has described an instance in which material resources and interactional resources contributed to and co-constituted how the floor of interaction took shape in one home media ecology.

Designs (i.e. implementing "technology breaks" or arranging a clipboard with assignment instructions) are never able to perfectly pre-determine how active users will take up technology and use it to achieve intended goals (Suchman, 2007). What takes place during on-going activity is always contingent on multiple factors, only one of which is (intermittently) the intended instrument of interest (i.e. the book covers). Some degree of "multiple floor maintenance" is required to accomplish intersecting- and sometimes conflicting- goals. In the case of the twins, their mom's maintenance of multiple floors for interactions made home "work" for learning with technology.

The demands and interests of heterogeneous factors- human, machine, local (i.e. in-home), removed (i.e. school) intersect and influence how learning takes place with technology at home. Parents are accountable to these interests, and their designs for learning with technology reflect this. Understanding how these designs are contingently taken up and put to use by young people will continue to be important as we strive to connect the public education of all children to the varied- and vital- learning opportunities available in private homes.

Appendix A

1   Mom: Okay, you can take a ten-minute break. (2.0) Then you need to do more homework.
2   Eddie: *((sits on couch, uses tablet))*
3   M: Got it? (1.0) [Eddie]? (1.0) Yes?
4   E: *((watches TV, uses tablet))*
5   M: Okay, so it looks like the only thing YOU have left for today is your book cover. *((straightens chair at the kitchen table)).* (3.0) And I'll have [Oscar] leave out all of the (1.0) materials. I'm writing 'front' on here and 'back' so you know which one is the front and back and then we can erase it once you're done, okay Eddie?
6   E: *((using tablet))*
7   M: Yes?
8   E: [softly] Yeah. *((clears throat))*
9   M: EDDIE.
10   E: Ye::s.
11   M: Okay.

Transcription conventions: Turns at talk are numbered per speaker. Pause length is numbered in (seconds). *((Activity description))* appears in double parentheses and italics. Researcher's additions are in [brackets]. EMPHATIC talk is capitalized. Elo:::ngated enunciation is shown with repeated colon.

Appendix B

Eddie (left) uses Pokémon handbook to select cover image while Mom and Oscar discuss options for the "back flap."

Oscar (left) researches a Pokémon illustrator on Mom's laptop while Eddie watches TV and plays on his tablet.

Figure 1. Mediated floor plan showing how homework was distributed across space and materials in a section of the home.

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