Research and Design of Learning Experiences for Families

Co-chairs
Megan Luce, Stanford University, mluce@stanford.edu
Jessica Umphress, Northwestern University, j-umphress@northwestern.edu

Discussant
Philip Bell, University of Washington, pbell@u.washington.edu

Authors

Maureen Callanan	University of California, Santa Cruz
Catherine Eberbach	Rutgers University
Shelley Goldman	Stanford University
Jennifer Jipson	Cal Poly, San Luis Obispo
Amber Levinson	Stanford University
Elyse Litvack	University of Washington Bothell
Megan Luce	Stanford University
Lucy R. McClain	Penn State University
Sinem Siyahhan	Arizona State University
Carrie Tzou	University of Washington Bothell
Jessica Umphress	Northwestern University
Tanner Vea	Stanford University
Heather Toomey Zimmerman	Penn State University

Abstract: In family activity children learn how to be participants in family practices, how to be learners and teachers within family relationships, and to approach learning and knowing in ways valued by their families and communities. Increased attention to children's learning across contexts highlights that meaningful learning can be ubiquitous across time, space, and situations. However, we need more understanding of how learning can be constructively linked across facets of children's lives, especially as they move through the world with their families. This poster symposium brings together people working on research and design of family learning experiences, in a variety of contexts. We aim to further understand 1) processes of learning across practices, time, persons and social/physical contexts, 2) the nature of learning processes in families, considering varied goals, values, and possible learning situations, and 3) what is being learned from new forays into research and design for family learning environments.

Symposium Overview

Families play a prominent role in children's learning about the world around them, and families are an obvious context in which children learn to become a certain kind of person ("becoming in practice"). For example, children of politically engaged parents often become politically engaged as emerging adults (e.g., Dinas, 2013), and family attitudes toward and engagement with science contributes to whether children see science as an identity or trajectory that they can pursue (e.g., Archer et al., 2012). In family activity and conversation children learn how to be a participant in family practices, learn how to be learners and teachers within family relationships (e.g., Goodwin, 2007; Ochs & Taylor, 1995), and learn to approach learning and knowing in ways that are valued by their families and communities (e.g., Rogoff, 2003). In many ways, family life sets the stage for children's learning both at home in the early years as well as throughout their diverse activities across their lives.

Although schools have long made efforts to involve families in their children's learning, and museums and other informal education institutions often design for learning with attention to how adults might play a role in children's learning experiences (e.g., Crowley, Callanan, Tenenbaum, & Allen, 2001), designing for family learning in its own right is less represented and research on family learning in informal settings is slowly converging on a coherent disciplinary framework (Ellenbogen, Luke, & Dierking, 2004). This is the case even at a time when increased attention in research and theory about children's learning across contexts highlights that meaningful learning can be ubiquitous across time, space, and situations (e.g., Connected Learning Research Network; Ito et al, 2013; LIFE Center). A growing body of research on Science, Technology, Engineering, Art, and Math (STEAM) learning in the home and other everyday or informal settings suggests that engagement with STEAM ideas is fluid across settings and activities, and can look very different from what happens in school. For example, Barron, Martin, Takeuchi, & Fithian (2009) have found that family members

support children's interactions with technology in a variety of ways including collaborating and providing information and resources. In math, families draw on cultural resources, values and mathematically-relevant problem solving to accomplish everyday goals that include budgeting and planning for a special event, making home improvements, and engaging in leisure activities (Goldman et al., 2010; Pea & Martin, 2010).

These sorts of studies point the way towards the need for more understanding about how children's learning can be constructively linked across varied facets of life. For example, how does a child transfer her understanding of a biology concept from her classroom science lesson to a nature walk with her parents? How do the media practices of a family shape the epistemic practices of media use elsewhere? How do families translate and/or adopt learning practices imported by group members through new tools, toys, or shared activities? How can learning design respond to and be effective in these contexts? In contribution to answering questions like these, this symposium brings together people working on the research and design of learning experiences for families in a variety of contexts. As a community of analysts, researchers, and designers, the collective aims to further understand 1) processes of learning across practices, time, and social/physical contexts, 2) the nature of learning processes in families, considering the varied goals, values, and possible learning situations, and 3) what is being learned from new forays into research and design for family learning environments.

The work represented in this symposium is grounded in the premises that children and their parents interact successfully with many kinds of learning opportunities in their everyday lives and that well-designed resources and tools can help families engage in collaborative learning. Symposium participants will address challenges and lessons learned from designing for and researching family learning, and we aim for attendees to participate in a discussion about translating research findings into design principles. This symposium will address the research and design of learning experiences for families by focusing on the following issues:

1. Developing case studies of family learning processes in informal environments
2. Identifying the unique challenges in researching and designing for family learning
3. Leveraging design to provide opportunities for *collaborative* learning processes in family activity.
4. Understanding how research and the design process work together in family learning/family-focused environments.

We bring together eight posters that present studies of family learning in the following contexts: gardening in the backyard, exploring museum and botanical garden exhibits, nature walks and beaches, playing video games and engaging in other media use at home. The learning activities that are studied span topics in science and media: astronomy, identifying and observing plants, soil testing, exploring natural features of a beach, and learning through computer and iPad® games. This body of research and design of family learning processes draws upon socio-cultural, informal learning, and joint media engagement theory and research (e.g., Nasir, Rosebery, Warren, & Lee, 2006; National Research Council, 2009; Takeuchi & Stevens, 2011), and employs a variety of analytic lenses including case studies, interaction and conversation analysis of video-recorded activity, and mixed-methods approaches including video, questionnaires, and interviews (e.g., Jordan & Henderson, 1995).

In addition to brief descriptions of each poster here, separate poster abstracts are listed in the next major section. Jennifer Jipson and Maureen Callanan present research on young children's concepts of astronomy and family conversations about astronomy. They have collaborated with educators and museum exhibit designers to create astronomy activities for families with young children, and they will offer reflections on how to effectively navigate combined research and design collaborations. Jessica Umphress introduced a designed activity (soil testing kit) into families' established gardening practices. She presents in-depth interaction analysis of questioning and epistemic practices used when exploring the science kit. She also analyzes the features of the designed activity that may have contributed to the results.

Megan Luce, Shelley Goldman, and Tanner Vea designed playful, exploratory learning experiences for families that provide science-related activity prompts and conversation starters at various locations and environments. They present analyses of the ways that family members engage in science-related activities at a local beach. They also discuss the potential for location-based science learning activities to offer learning opportunities that are flexible and fit with families' varied goals and interests. Heather Toomey Zimmerman and Lucy McLain also designed for collaborative discoveries and conversations on self-guided nature walks. They present research on how their designed learning tools functioned in family processes of identifying plants and other features in nature. Their research highlights the need for family learning materials that can be flexibly used by families within forms of social interaction.

Catherine Eberbach studied how families observed and discussed pollination at a botanical garden. She offered parents simple "instructions" in conversational strategies (e.g., asking *wh*-questions) they could use to engage their children. These strategies evoked elaborative talk and encouraged shared noticing of phenomena. Catherine will discuss how conversational strategies may be a transportable tool that can be used across contexts

to facilitate *collaborative* family learning. Carrie Tzou and Elyse Litvack designed science backpacks, with activities related to current science content in school, which children could check out from school and take home. Based on videos the families took of themselves, Tzou and Litvack report on the ways in which families appropriated the backpacks at home, and offer insights into designing for family learning that straddles home and school.

Sinem Siyahhan reports on a design-based research study that investigated the effectiveness of different game design elements in supporting collaborative intergenerational play experiences where parents and children reciprocally take on expert and novice roles. She will offer insights into how video game-based learning experiences can be designed to position parents and children as learning partners. Amber Levinson reports on in-depth case studies of how Latino immigrant families use media at home. She also introduced an iPad® into the families' homes to better understand the roles that media devices come to play in family life and learning. This research has implications for potential innovation in designing for family learning through media.

Poster Symposium Format

The symposium format will include a 10-minute introduction by the co-chairs, followed by 50 minutes of browsing posters, and the final 30 minutes will be used by the discussant to synthesize and comment on the presented work and to facilitate questions from attendees.

Discussant

Dr. Philip Bell, University of Washington and the LIFE Center, will provide synthesizing remarks based on his expertise in informal learning research and theory. The issues addressed will align with the main issues of the symposium: 1) How do we move forward as a field in research on family learning processes in informal environments? 2) How can we expand our methods in family learning research? 3) How can design be leveraged to provide opportunities for collaborative learning processes in family activity? Dr. Bell will also co-facilitate, with the chairpersons, a question and discussion session with attendees and presenters.

Individual Posters

My Sky Tonight: Researching Young Children's Ideas about Astronomy and Designing Informal Astronomy Activities for Families

Jennifer Jipson, Cal Poly, San Luis Obispo, jjipson@gmail.com
Maureen Callanan, University of California, Santa Cruz

In this collaborative project, cognitive developmental and educational researchers are working with astronomy educators to study preschool-aged children's conceptions of astronomy, and to develop and test new activities for preschool children and their families. The focus of the design project is to develop developmentally-appropriate astronomy activities for 3-5 year-old-children and their families to engage with at planetariums, nature centers, and other informal learning environments. To explore the ways in which families engage in everyday conversations about nature, including astronomy, we conducted a two-week diary study asking parents to keep track of their children's conversations about nature. Sixty families participated; while the majority of parents are highly educated and largely European-American, we also included a targeted sub-sample of 15 Mexican-heritage families with basic schooling. We also invite the same families to visit a local museum where prototype astronomy activities were being tested, and observed family interactions. In this poster symposium we will report on preliminary findings regarding (1) the frequency of preschool children's spontaneous conversations about astronomy, presence of talk about causal mechanisms and evidence, and how these conversations vary by age, gender, and schooling background of parents, (2) observations of preschoolers and parents' collaborative engagement with workshop astronomy activities, and (3) reflections on the challenges involved in such a combined research and design collaboration.

Complex Family Questioning Around a Garden Soil Science Kit

Jessica Umphress, j-umphress@northwestern.edu
Northwestern University

Families often have shared internal practices, interests or hobbies that can be the site of rich learning and conversations. Some of those practices, like gardening, can naturally span generations and involve informal apprentice-type relationships where knowledge is passed down to younger gardeners during the act of gardening together. Do these relationships and activities leave room for both children and adults to ask questions and meet each other on equal epistemic footing, or are they epistemologically hierarchical?

In this research 10 gardening families with children ages 7-12 years old videotaped themselves doing a science kit about their garden soil in their own homes. The kits involved a multi-part activity wherein the

families collected a soil sample, manipulated it to make it testable, combined the sample with different chemical reagents to reveal nutrient levels and other properties, interpreted the results, and applied them to their own gardening plans and experiences. The learning goals for the kit included having the families be able to talk about the relationship between soil and plants, and being able to make meaningful connections between those ideas and their own gardens. One research goal for the activity was to reveal the epistemological properties of parent/child interaction around their shared practice of gardening together. Who would be the knower and how would knowing get done or knowledge be built while using the science kit?

Analyses of question practices in the resulting videos reveal an interesting and complicated epistemological relationship between parents and children around the science kits. For example, analyses show that while parents did take a fairly managerial stance towards the activity, they also engaged in deliberate and genuine information-seeking and worked to solicit their children's opinions about what was being revealed by the kit. In turn, children actively engaged in asking questions about the activities and results, and also asked frequent repair questions (e.g. Schegloff, 1992) to ensure that they were understanding what was happening and the relationships between the chemical properties of their soil and their garden plants. Further analyses show that although functionally parents' questions are doing real epistemic work with their children, more than half of them were simple polar questions (i.e. requiring yes/no responses). On the other hand, more than half of children's questions used question words (e.g. what, where, why, etc.) that place a greater demand on their recipient by requiring more complex responses. Is this a meaningful disparity in how the work of knowing gets done in this setting, a developmental difference in how questions are asked, or simply an artifact of the design of the science kit? These and other results will be shown in the poster.

Evolving Participation Structures in Family Science Activity

Megan Luce, mluce@stanford.edu
Shelley Goldman, Tanner Vea
Stanford University

In our efforts to design and research playful science learning experiences for families with young children (4- to 11-year-olds) we created activities and conversation starters that are meant to engage families in science exploration "any time, anywhere." Drawing upon socio-cultural and informal learning theory and research, we aim to design science-relevant activities that are exploratory, fun, open-ended, and that spark conversation and collaborative sense-making about the world (e.g., Allen & Gutwill, 2009; Hammer & van Zee, 2006). Our goal is to prompt children and families to explore the world, be inquisitive, and use their senses to observe, discuss, reflect, and learn. The experiences we designed locate points of interest in the environment and cue families as to how they might engage, question, and explore (see also Zimmerman & Land, 2014) without the need for specialized tools, instruments, or objects. The content and science exploration prompts are generally in the purview of, and benefit from, parents and children's cultural understandings and funds of knowledge (González, Moll, & Amanti, 2005). For example, one set of activity prompt invites families to predict and test what will happen when they throw a buoyant ball into the ocean waves…

> What do you think will happen if you throw a ball out into the waves?
> Throw the ball out into the water and see what happens!
> Does the ball tell you anything about wave patterns, rates, or direction?
> Try this: each person chooses a spot on the beach where they think the ball will come back to.
> Throw it out! Who guessed closest?

In this poster we present case studies of families pilot-testing a set of activities designed for exploration at coastal environments. Three families used wearable GoPro® video cameras to record themselves during a trip to a beach. The activities were available for view on a mobile device, but each family chose to use the print-outs we also provided them.

As one lens on understanding family learning processes over time, we focused the video analysis on the various ways that family members engage each other and with the activities over time during their trip (Jordan & Henderson, 1995). From studies of informal science learning we know that parents and children may take a variety of roles during museum visits, and parents ask questions, provide explanations, and help children frame their experiences (Callanan & Jipson, 2001; Zimmerman, Reeve, & Bell, 2008, 2010). We present analysis of "participation structures" (Philips, 1972) that emerge and change as families navigate science activities and conversations outdoors. We report case analysis for three families, which indicate that 1) families move through a variety of stances including questioning, being an expert, being skeptical, and rescuing interests, and 2) collaborative sense-making seemed to be facilitated when both parents and children didn't know the "answers" or when they came across surprising phenomena or inconsistencies in their ideas and observations, 3) epistemological orientations (what counts as "knowing," how we know, who knows) shift over time and in

relation to phenomena under consideration. We discuss the potential for our location-based informal, or casual, science activities and conversation starters to contribute to playful family science learning that can take many forms within and across families. We offer suggestions for design principles of science-relevant activities and conversation starters that families can do "anywhere."

Designing for Collaborative Discoveries and Conversations: Families Together Outside

Heather Toomey Zimmerman, haz2@psu.edu
Lucy R. McClain
Penn State University

Our research project examined families' interactions with each other and the outdoors in order to develop materials for families that would spark playful scientific explorations on nature trails. Our goal is to understand how to support people as they engage in questioning and explanation-building (see Allen & Gutwill, 2009) in the life sciences. A conceptual framework based on informal learning research and sociocultural theory situates our project. Thinking and learning in everyday life is often guided by family interactions in a process called guided participation (Rogoff, 2003). Guided participation occurs in informal settings when family members mutually support each others' sense making (Callanan & Jipson, 2002; Crowley & Jacobs, 2002; Palmquist & Crowley, 2007; Zimmerman, McClain & Crowl, 2013). We build on research (e.g., Eberbach & Crowley, 2005; Rowe & Kisiel, 2012; Zimmerman & McClain, 2012) that asserts that guided participation allows children and parents to connect new biological knowledge outdoors to shared family experiences and other forms of prior knowledge.

Participants in our study were families attending nature walk programs on a wheelchair and stroller accessible Americans with Disabilities Act compliant trail outdoors. Families were ethnographically shadowed as they interacted together, with a subgroup of families videotaped for deeper analyses (Derry et al, 2010). Collective case studies (Stake, 1995) were created through video-based analyses of learning processes found in families' interactions.

Across the families in our study, more prolonged exploration of natural objects occurred when a child initiated a 'discovery,' rather than a naturalist or a parent. Our findings showed that when families used scientific tools to support observations, these investigations were tied to families' goals to identify the discovered animals, plants, fungi, and abiotic elements. Correct identifications of species most often required a complex coordination of tools, scientific representations, and families' conversations and social interactions. Two common interaction patterns emerged from the video analyses: (a) discovery first, followed by tool and representation use second and (b) selection of a tool and representation first followed by trying to find an object to identify. Implications were drawn on designs that support family learning processes, including the need for materials that can be flexibly used by families within forms of social interaction.

Facilitating Collaborative Observational Practice During Family Activity

Catherine Eberbach, catherine.eberbach@gse.rutgers.edu
Rutgers University

A central challenge of scientific observational practice is to reach agreements about what an individual sees with what others see (Daston, 2008). To address this challenge, scientists have forged cultural tools—language, equipment, and disciplinary systems of knowledge and practice—that enable the collaborative construction of shared vision (Goodwin, 1994). Yet little is understood about how people begin to participate in these scientific observational practices (Eberbach & Crowley, 2009). This study explores how parent knowledge and use of conversational strategies mediated joint attention, knowledge sharing, and collaborative agreements during an observational activity.

79 parent-child pairs that included children aged 6-10 observed and talked about pollination during a visit to a botanical garden. Families were organized by parent knowledge of pollination and randomly assigned to treatment or control groups for parent conversational strategies. To help parents elaborate upon children's observations, parents in the treatment groups received instruction in the use of particular conversational strategies (e.g., asking *wh*-questions, focusing talk on children's expressed interests). Family interactions were videotaped, coded, and analyzed. Statistical analyses revealed that a simple training protocol significantly modified how parents interacted with their children. Case study analyses suggested that parents' use of the *wh*-questions strategy facilitated participation, clarification, and focusing attention. In turn, these questions evoked elaborative parent-child talk and extended shared noticing of phenomena. Parents' use of the focus talk strategy shifted how parents actively managed children's attention in ways that also enabled collaborative observations and knowledge sharing, but from the perspective of the child.

This study expands our knowledge of how families collaboratively practice science together in

community settings. "Designing" for parent conversational strategies can support interactions between parents and children in ways that foster collaborative observational practices and knowledge sharing. One way to frame these findings is to think about the use of parent conversational strategies as transportable tools that can be applied across learning contexts to support joint attention and talk in ways that help parents and children to collaboratively see the same things during observations.

Backpacks as Boundary Objects: Documenting How Families Appropriate Take-Home Science Backpacks

Carrie Tzou, ctzou@uwb.edu
Elyse Litvack
University of Washington Bothell

The goal of this research project was to design, implement, and study a science backpack program that connects elementary school science learning with science activities that can be done at home with families. Specifically, we designed mini science kits that contain simple materials, directions, and ideas for conducting scientific investigations at home that connect conceptually to science being learned at school. The backpacks served as *boundary objects* (Akkerman & Bakker, 2011) —as such, they potentially allow for science practice at home that is infused with rich and varied funds of knowledge present in the home. Research questions we asked were: (1) How did the backpacks as boundary objects get appropriated by the youth and their families at home?, (2) What roles do parents take on while engaged with the backpack activities and how do these roles position children as science learners?, and (3)What are implications from this study for designing boundary objects that cross from school to home (and vice versa)? As a theoretical framing, we used a modified version of cultural historical activity theory (CHAT) (e.g., Cole, 1996) which allowed us to understand how boundary objects can transform roles, division of labor, and mediating tools from one activity system (e.g., school) to another (e.g., home).

We placed digital cameras in the backpacks, and the videos made by families and youth were analyzed for the ways in family members took on various roles while engaging with science learning that subsequently positioned youth in certain ways and how youth and their families transformed (or did not transform) the science activities into new types of activities. We found three main types of appropriation of backpacks by youth and their families: (1) appropriating school roles in which traditional power relationships between "teacher" (usually an older sibling or parent) and "student" (the youth who checked out the backpack) were recreated, (2) hybrid appropriation, in which parents and youth share positions of power and expertise, and (3) repurposing appropriation, where the backpack activities were turned into occasions for youth to host "reality tv"-like episodes as they recorded themselves engaging in the activities. This study points to the need to design for multiple configurations of learning, with activities that suggest various roles that parents and youth can take on.

Intergenerational Play Around Video Games: A Context for Family Connection and Learning

Sinem Siyahhan, Sinem.Siyahhan@asu.edu
Arizona State University

Intergenerational play around video games provides unique opportunities for families to connect and learn together (Aarsand, 2007, Horst, 2009). At the same time, the nature of intergenerational play around video games varies across different families, with some parent-child interaction styles and patterns being more productive in supporting family connection and learning than others (Mitchell, 1985; Siyahhan, Barab, & Downton, 2009). Using the lens of a socio-cultural theoretical framework, this presentation reports on findings from the second iteration of a design-based research study that investigated the effectiveness of different game design elements in supporting collaborative intergenerational play experiences where parents and children reciprocally take on expert and novice roles and engage *mutual scaffolding* behaviors. To this end, 16 mother-child pairs (children ages 9 to 13) played through different science, language arts, and social games designed in Family Quest—a family game space created within Quest Atlantis, a three-dimensional educational gaming environment (www.QuestAtlantis.Org)—as part of a family program at different informal learning sites. Data sources include parent questionnaires, video recordings of parent-child gameplay, and semi-structured interviews with parents and children about their experiences playing together. This presentation will share findings on parent-child interactions around different game designs, and provide illuminative cases of collaborative intergenerational play experiences that support family connection and learning. Results from this study contribute to our understanding of the nature of computer-mediated communication and learning between parents and children, and how to design learning experiences for families in the context of video games that position parents and children as learning partners.

Tapping In: Latino Immigrant Families, Media and Learning at Home

Amber Levinson, amlevinson@stanford.edu
Stanford University

This poster shares design-relevant findings from a dissertation study that investigates how low-income Latino immigrant families with young children use broadcast and digital media. Media – on television, computers, mobile devices and other platforms – has become a substantial part of families' language and literacy environment but its role is little understood. Using a lens of joint media engagement (JME), the study looks at how both children and parents use media at home and the opportunities to design educational content for this population. In these families, multiple generations are learning a new language and media often constitutes the only presence of that language (English) within the home. The study takes a three-pronged approach that includes:

1) ethnographic case studies to provide rich and detailed data on this little-studied topic;
2) survey responses that are compared to a nationwide sample, and
3) an intervention wherein I distributed a tablet device (iPads) to each case family and documented the role it comes to play in family life and learning.

The case studies provide rich data regarding media practices and interests within families, while the intervention gives a glimpse of what opportunities and/or challenges a new technology can bring and how families take up these media tools. The poster will share both qualitative and quantitative results related to how participating families – who all have at least one child between the ages of five and seven and speak Spanish as their primary home language – use media for learning. The poster will also focus on how to identify within these findings potential design spaces for innovation.

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