Beyond Tutoring: Opportunities for Intergenerational Mentorship at a Community Level

Ye Yuan
University of Minnesota
Minneapolis, MN, USA
yuan0191@umn.edu

Svetlana Yarosh
University of Minnesota
Minneapolis, MN, USA
lana@umn.edu

ABSTRACT

Community intergenerational mentorship offers an opportunity to address older adults' social isolation while providing valuable one-on-one or small group learning experiences for elementary school students. Current organizations that support this kind of engagement focus on in-person visits that place the burden of logistics and transportation on the older adult. However, as older adults become less independent while aging, coming to schools in person becomes more challenging. We present a qualitative analysis of current intergenerational mentorship practices to understand opportunities for technology to expand access to this experience. We highlight elements critical for building successful mentorship: the importance of relationship building between older adults and children during mentoring activities, the skills mentors acquired to carry out mentoring activities, and support needed from teachers and schools. We contribute a rich description of current intergenerational mentorship practices and provide insights for opportunities for novel HCI technologies in this context.

CCS CONCEPTS

• CCS → Human-centered computing → Human computer interaction (HCI) → **Empirical studies in HCI**

KEYWORDS

Intergenerational mentorship; intergenerational communication; children; older adults; mentoring; tutoring; community

ACM Reference format:
Ye Yuan, and Svetlana Yarosh. 2019. Beyond Tutoring: Opportunities for Intergenerational Mentorship at a Community Level. In *2019 CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019), May 4–9, 2019, Glasgow, Scotland, UK.* ACM, New York, NY, USA. 14 pages. https://doi.org/10.1145/3290605.3300679

CHI 2019, May 4-9, 2019, Glasgow, Scotland, UK.

ACM ISBN 978-1-4503-5970-2/19/05...$15.00.
DOI: https://doi.org/10.1145/3290605.3300679

1 INTRODUCTION

Intergenerational mentoring is an important social cognitive strategy that leverages resources from older adults to provide support for children and adolescents who are at risk [41,49]. There are many intergenerational mentoring programs in United States. *Across Age* [1] provides an intergenerational mentoring intervention across the country, focusing on substance use prevention among at-risk middle school youth. *Experience Corps*[2] is also a country-wide program which focuses more on providing reading tutoring for children. Local communities often organize such programs as well. *Power of One*[3] is a Seattle-based intergenerational program facilitated by the local senior center, connecting seniors with children from public schools. Through these and other intergenerational mentoring programs, older adults connect and establish relationships with children and adolescents. For the young participants, these programs provide benefits including improving their academic performance, supporting their social development, and preventing substance use and delinquent behaviors [42,50]. For older adults, these programs often improve their sense of self value, and decrease their feelings of social isolation [14]. However, despite their effectiveness, access to these programs may be limited due to organizational and logistical challenges.

In our investigation, we focus on a school-based intergenerational mentoring program known as *DARTS Learning Buddies*. Through this program, older adults provide weekly one-on-one or small group academic tutoring for elementary school students (though, the impact of this connection may go beyond just academic tutoring). However, traveling to program sites can be

[1] Across Ages website: https://youth.gov/content/across-ages
[2] Experience Corps website: https://www.aarp.org/experience-corps/
[3] Power of One website: https://powerofonevolunteers.wordpress.com/

burdensome for older adults as they age, limiting or even preventing them from taking advantage of these social connection opportunities. To identify opportunities to extend access to this and similar programs, we conducted a qualitative investigation of current intergenerational mentorship practices at three mentoring sites, including participatory observations and selective interviews with four volunteers, ten students, and three teachers, to answer the following research questions:

(RQ1a) Who are the stakeholders in intergenerational mentorship interventions?

(RQ1b) What are their specific needs, priorities, and strategies involved in current intergenerational mentorship practices?

(RQ2) What are the design opportunities for systems to support and expand access to current intergenerational mentorship practices?

In the following sections of these paper, we begin by summarizing prior literatures on technologies for older adults' social connectedness, for children's social connectedness, and for supporting mentorship programs. We describe the context of our investigation, our methods, participants, and settings. In the results section, we discuss themes emerged from analysis, around current intergenerational mentorship practices. We close this paper by drawing implications from our findings, and for designing systems that support the intergenerational mentoring activities and intergenerational connection.

2 RELATED WORK

We highlight previous work in technologies for older adults' and children's social connectedness, as well as technologies for supporting mentoring activities.

2.1 Technologies for Older Adults' Social Connectedness

Prior work in HCI has sought to address many social challenges older adults face when communicating with their friends and family members during the aging process. For older adults living independently, systems like video conferencing and social networking sites make connecting with friends and families easier [23,32], which helps reduce the sense of loneliness and improve the quality of life for older adults [44]. In addition, awareness systems provide family members with older adults' daily status, to help them stay in touch with their families over distance [29,30].

Despite the fact that older adults perceive technologies (e.g., email, video chat, social media etc.) as essential means for their social connectedness [18,32], barriers still exist, especially in the context of communicating with younger generations. In contrast to younger generations' quick adoption of new tools and preference over using multiple advanced technologies, older generations often prefer simpler and fewer communication media [36]. This barrier could potentially limit older adults' ability to connect with others [9,28]. To overcome these barriers, researchers have both investigated the challenges older adults have with new technologies [4,35], and designed systems addressing these specific challenges in older adults' social communication [9,24].

Although most literature in HCI focus on technologies for older adults' social connectedness within families and friends, a few researchers investigate this topic in broader social settings. Hiyama et al. noticed the social opportunities older adults lost after retiring, and developed a collaboration platform that let the elderly contribute their professional expertise, and maintain their connection with the surrounding community [17]. Aiming to increase seniors' participation in community center activities and improve their well-being, Lee et al. defined design opportunities for communication technologies to facilitate the offline community center programs, and strengthen their connection with their communities [25]. Similarly, our work focuses on understanding older adults' social connectedness in community settings as well. However, instead of finding technological opportunities that focuses on increasing their participation in current in-person activities, we hope to benefit and empower a wider range of older adults by leveraging technology to bring the connection opportunities to them.

2.2 Technologies for Children's Social Connectedness

The HCI community has studied how current technologies support children's social relationships as well as new systems that better facilitate children's communication with their surroundings. Technologies like social media serve as vital means for children to maintain connections with their friends [2,3]. Messaging tools specifically help increase their sense of connection with friends and increase their sense of connectedness [31]. Besides in the context of friendship, technology-mediated communication facilitates children's relationship with their family members as well: supporting information exchange in family routines [1,7,16], strengthening familial connections by supplementing the face-to-face

communication [8,37], and maintaining relationships when family members are distributed geographically [38,40].

Researchers have found that children face a variety of challenges when communicating with family members via traditional technologies [2,44]. And the concept of shared context becomes especially important when children communicate with geographically-separated family members. To address these challenges, various systems have been explored to create a shared context and activities to better support children connect with family members from a distance: a system with a shared space to support communication [48]; online games that help family members connect through the same activity [22]; storytelling systems that improve the quality of time spent between family members when communicating over distance [33]. When comparing feedback and effectiveness on systems that support different shared activity for children, Follmer et al. found that storytelling provided a more structured framework for communicating with children, and such a system was preferred by families participating in the evaluation [12]. While prior literature focuses on children's connectedness with family members through the lens of technology-mediated shared activities, we intend to better support children's connectedness at a community level by investigating and gaining insights of an existing intergenerational activity.

2.3 Supporting Mentorship with Technology

Mentoring is an important social cognitive strategy used in many fields: youth support, academic support, and career development. Researchers have focused on studying the outcome of mentoring on proteges, and overall, mentoring is an effective intervention that benefits proteges' attitudes and behaviors across different fields [11,26] .When examining the effectiveness of youth mentoring in terms of proteges' outcomes (on their behaviors and attitudes), researchers found the quality of relationship between mentors and proteges especially affects the outcomes on youth [10].

Given the benefits of mentoring programs, researchers have explored how technologies can be used to support mentoring activities, especially in educational settings. These investigations focused on leveraging technologies to provide more resource to facilitate mentoring activities in classrooms: a tangible mentor for pre-K math education [21], a conversational multimedia virtual tutor for K-5 science education [45], computer based reading tutors for ESL study [46], and social media based virtual mentor for computer science students [15]. Among building virtual tutors/mentors to provide students with more educational resources, robots are one of the popular formats for virtual tutors/mentors in providing small group learning experiences for students [19,34]

Despite the increasing popularity of using robots in educational settings, Kennedy et al. found that compared to social robots, humans were better at picking up social cues and being more socially adaptive when interacting with children, which helped them outperform robots when measuring academic outcomes [20]. Gibson et al. discussed the importance of face-to-face interactions in sustaining relationships between mentors and proteges in tele-mentoring programs, and how these relationships affect proteges' academic performance [13]. Both investigations discussed the importance of social interactions in mentorship activities, and both focused on how social interactions and relationships with mentors affect proteges' academic outcomes. Our work, on the other hand, intends to investigate the relationship aspect of mentorship programs and understand the connections built between mentors and proteges through mentoring activities.

3 METHODS

In this section, we describe the context of our investigation, our participants, setting, with details of our multi-method approach, and data analysis process.

3.1 Context of Investigation: DARTS Learning Buddies

We partnered with a non-profit organization, DARTS[4], which fosters community health by providing a network of information and resources to help people remain connected to one another. DARTS approached us, interested in exploring how technologies could help expand access to their resources, especially for older adults. One of their services, the Learning Buddies program, specifically aims to connect older adults with students in grades K-5. The program currently has connections with schools in three different counties, where they can place volunteers for working with students.

Based on volunteers' preferences for location and subject, as well as the volunteering needs specified by teachers, the Learning Buddies program matches

[4] DARTS website: https://darts1.org/

Table 1. Teacher-Volunteer-Student groups in this study (each row captures one group), including the gender, ages, years of teaching experience, grade, and subject. We bold the participants whom we have observed or interviewed.

School	Teacher (Gender, Grade, Subject, Yrs. of Teaching Exp.)	Volunteer (Gender, Age)	Students (Gender, Age)
S1	**T1 (F, 1st Grade, Reading and Writing, 2)**	**V1 (F, 76)**	**S1 (M, 7)**
			S2 (F, 7)
			S3 (F, 7)
			S4 (M, 7)
S2	**T2 (F, 1st Grade, Reading, 5)**	**V2 (F, 84)**	**S5 (M, 7)**
			S6 (M, 7)
			S7 (F, 7)
S3	**T3 (M, 2nd Grade, Math, 30)**	**V3 (M, 71)**	**S8 (M, 8)**
			S9 (M, 8)
			S10 (M, 8)
	T4 (F, 3rd Grade, Reading)	**V4 (F, 71)**	S11
			S12
			S13
			S14
			S15
			S16

volunteers with schools and teachers at the beginning of each school year. Volunteers physically attend sessions at their designated schools every week during school hours from October to May, to work with students on reading, math, or science. These sessions happen during the class time, usually in common areas outside students' classrooms, e.g., the school library.

The Learning Buddies program provides orientation and training sessions for volunteers before they start volunteering, as well as workshops on teaching reading, math, or any other mentoring-related topics during the school year. The program holds a celebration event at the end of each school year, inviting all volunteers and teachers involved in the program to gather and connect with each other.

3.2 Participants and Setting

We received principal and administration permissions to work with four elementary schools in the West St. Paul-Mendota Heights-Eagan school district. With the contact information provided by DARTS, we reached out to all older adults (11 in total) who were volunteering at these four schools during the year 2017-2018. Once volunteer participants were confirmed, we contacted students and teachers whom the volunteers worked with. Because this study took place in educational settings, parental consent was waived by our university's IRB. Nonetheless, informational flyers for parents were provided to teachers for distribution; and we required students' verbal assent at the beginning of each study session.

A total of 4 volunteers from 3 schools was recruited to participate in our study (which constitutes 36% of older adults volunteering at these four schools). Three volunteers were recruited for both participant observations and interview parts of the study, and 1 volunteer only for the interview study (3 females, 1 male, *M = 75.5 years old*, *SD = 6.14)*. Ten students (3 females, 7 males, *M = 7.3 years old*, *SD = 0.48*) and three teachers (2 females, 1 male, *M = 12.33 years of teaching experience*, *SD = 15.37*) whom these volunteers worked with, participated in the observation part of our study, and one teacher was recruited for the interview to help interpret some of our observations. Table 1 provides participants' information and their relations with each other in these volunteer-student-teacher groups. We had more significant engagement with the first three volunteer-teacher-student groups but recruited one addition participants at the third school to help confirm that we had achieved data saturation and were seeing the same mentoring practices and approaches recur.

The observation sessions took place inside schools during regular school hours. Volunteers and students worked together often at the desks in the common spaces next to the classrooms. Interviews with volunteers and teacher happened either inside schools, in the classrooms or libraries after class time, or in the local coffee shops.

3.3 Multi-Method Approach and Data Gathered

We chose to pursue a multi-method approach, combining participant observation with semi-structured interviews. With this approach, we could understand participants' actual in-situ behaviors during their activities, as well as relying on the interviews to help interpret the reasoning, opinions, and other invisible aspects behind their behaviors.

3.3.1 Participant Observations. There were two phases of the observation study: **1)** 4 informal participant observation sessions with the volunteering community for understanding the structure of intergenerational mentoring activities and identifying potential stakeholders involved in the program; **2)** eight focused observation sessions with three volunteers, for understanding the communication and relationship practices between stakeholders in the mentoring program. Each observation session lasted 1-2 hours and involved volunteers working with students either one-on-one or in small group (maximum group size 3). We asked open-ended questions at the end of the sessions, to better understand the reasoning behind some actions we observed and to get students' perspectives on intergenerational mentorship. We took hand-written field notes during observations sessions and collected worksheets and handouts volunteers used during the sessions as supplemental materials.

3.3.2 Semi-Structured Interviews. We used semi-structured interviews to understand volunteers' and teachers' needs and priorities in intergenerational mentoring activities and to further interpret our findings from the participant observations. The semi-structured approach allowed us to incorporate insights from observations and follow up with discussions on those insights. Each interview lasted 30-40 minutes. At the beginning of volunteers' interviews, we used background information questionnaires and volunteering motivation scale [51] to collect their demographics information (age, years of volunteering experience, occupation status, etc.), and their attitudes towards volunteering. We then asked questions about their experience volunteering in the mentoring program, their communication practices during mentoring, and their relationships with students, teachers, and school. For teachers, we asked about their experience working with volunteers, how they facilitated the mentoring activity, their general feedback towards the volunteering program. Interviews were audio recorded; both interview recordings and observation field notes were transcribed for analysis.

3.4 Analysis

We employed a qualitative, data-driven approach, following the guidance from Grounded Theory Method [27]. The lead author converted all data to textual format (e.g., transcribing interview recordings, typing up hand-written field notes) and conducted open coding of all the notes and interview transcripts. This process generating over 800 open codes and 5 additional memo documents chronicling early emerging themes and ideas. Both authors worked together to apply affinity mapping to all open codes: organizing open codes into groups and identifying the relationship between codes to extract axial codes. After affinity mapping, the authors met to discuss and refine categories and themes that emerged from axial codes. We describe these categories and themes in the Results section.

4 RESULTS

In this section, we describe the communication practices and relationship practices between volunteers and students during mentoring activities. We further discuss about volunteers' motivations for mentorship programs, and how they gained identities as mentors through participating in the program. Finally, we describe the interactions communication and interactions between volunteers and teachers and highlight the importance of teachers' support for successful mentorships.

4.1 Academic Tutoring Practices between Volunteers and Students

4.1.1 Negotiating Students' Interests and Attention. Volunteers engaged students in mentoring activities by relating to their interests. In 6 out of 8 sessions we observed, both V1 and V2 started the mentoring sessions by letting students decide which book they wanted to read. Similarly, V3 let students choose where they wanted to sit in the library when they were working on problem sets. In one session with S5, V2 suggested one book for him to read, as V2 remembered they both found the book interesting in the past. While reading stories, students verbally expressed becoming fascinated with certain plot, illustration, a song the character sings, or couldn't wait to know what would happen next in the story. During the sessions with S1, S5 and S7, we saw them stop reading and flip through the pages quickly to see the full story, turn over to the previous pages to sing the song in the story again, or discuss the illustrations that caught their interests. Both V1 and V2 let students take time and interact with the book content they were interested in. Volunteers also engaged students by asking content-

related questions that required students actively thinking. For example, V2 asked S5 to reflect on the reading content with the question ***"what is [the character]'s problem presented in the story?"*** and followed up with the question ***"what suggestion do you have for [the character]?"*** To make sure students were following their explanations, V3 continually asked questions as they were unpacking the solution together. Sometimes we observed students struggling during the mentoring activities or losing patience. While S7 was reading a difficult book during one session, V2 noticed she was struggling with pronouncing words and appeared increasingly frustrated with the book. Instead of correcting her on every single word, V2 let several words slip through to make sure S7 can finish reading the book.

4.1.2 Behavior Management and Compliance. During the mentoring activities, volunteers not only needed to negotiate students' interests and attentions in the activities, they often also needed to manage students' behavior. In half of the mentoring sessions we observed, volunteers had to use different strategies to persuade children to cooperate with the mentoring activities. For example, S1 didn't want to read at all when V1 and S1 started the mentoring session. In response, V1 made a contract with S1 and promised that they would take turns to read the book. Students were more difficult to manage if they were working in small groups. Compared to volunteers who worked with students one-on-one, V3 had to utilize more strategies to manage students' behavior and had to employ these more frequently in order to keep the activity going during the sessions we observed. At the beginning of the sessions, V3 addressed his expectations towards students' behaviors (***"I want you to be particularly good, okay?"***) and at the end of the sessions, he asked students to reflect on how to best spend time during the mentoring sessions. When we discussed volunteers' challenges, all four volunteers talked about compliance problems. V1 acknowledged that behavior issues were problems they had to deal with when working with elementary school students. Frequently, such problems created potential obstacles for volunteers to mentor students. Both V2 and V3 shared experiences about working with difficult students who they couldn't convince to participate in the activities at all. After communicating with teachers on these difficulties, they stopped working with these students during their volunteering time.

4.1.3 Encouraging Academic Growth. Volunteers used different strategies to stimulate students' academic growth. One type of strategies they used was to introduce challenging activities for students. In observation sessions, both V1 and V2 encouraged S4, S5, S7 to read longer or new books that were slightly above their reading level. When we asked how volunteers picked books with students, V1 described:

> ***I always let them pick the first book, and then, I will try and look at the books in their book box, and see if there's something new, or something, that might be a little bit more challenging (V1).***

Because the books that students could choose from did not update every time, in one session with S4, she noticed that S4 was one page ahead when reading (*i.e.,* had memorize the book content). When S4 picked the second book to read, V1 made sure it was a book that they had not read before. Volunteers also devised activities to cultivate independent thinking. In one session, V3 chose to let students collaborate on solving problems by themselves and observed how they work on the problem without providing instructions. In this way, V3 pushed students forward in problem solving by making the activity format more challenging for students.

Progress tracking was another strategy that volunteers used to foster students' academic growth. Carefully tracking their progress in mentoring activities, volunteers provided students with detailed feedback on how much they accomplished and improved throughout the school year. Often students' progress was communicated in conversational format. At the end of the mentoring session that we observed with V3, students started a conversation between them and volunteers on how many advanced math problems they had completed this year, as a recap of the year's progress. V4 used a teacher-provided paper-based visual progress-tracking system, which quantified students' reading goals with numbers of words they read per minute and chart these numbers on paper. According to her description, students were delighted to see how many words they improved after they had read the content repeatedly.

4.2 Beyond Academic Tutoring: Importance of Relationship-Building

Volunteers not only worked with students on academic content, they also established personal connections with students through the mentoring program. Often, volunteers intentionally sought to build relationships with students by incorporating social activities into mentoring sessions. In all mentoring sessions we observed,

volunteers started the session by engaging students in social chat about their personal or school life, for example, asking about student's plan for summer, their field trip experience from the previous week, or talking about students' upcoming birthdays. In 2 mentoring sessions (out of 8), students initiated conversations about their families without volunteers asking. When asked about volunteers' relationship practices with students, 3 out 4 volunteers said they spent more time to trying to get to know the students at the beginning of the year when first starting to work together. Volunteers usually stayed with the same group of students throughout the school year (usually 3-6 students from the same class, students switch off to work with volunteers one-on-one during each mentoring session). In V2's previous mentoring experience, she asked questions about students' favorite things and hobbies. With this information, she prepared small gifts (movie themed stickers) that the students would enjoy as rewards during mentoring activities. In V3's case, he kept track of all students' birthday and sent them birthday cards for celebration. We observed volunteers and students finding ways to establish closure to their connection at the end of school year. In V2's last mentoring session, S7 brought thank you notes and a class photo for V2, and they read through the notes to commemorate the time spent together, before reading books from the class. V3 and V4 also echoed this idea in the interview, namely using the last session with students to bring a closure to their year-long mentorships.

The content of mentoring activities provided rich context and opportunities for relationship building between volunteers and students. Reading was especially a good activity in fostering practices around social connections. In all 6 reading sessions we observed, volunteers prompted students with personal sharing questions based on story content. For example, S1 shared stories about his pets when V1 and S1 were reading a book about dogs. Similarly, S7 brought up topics about her parents when reading a family story book. In the interview, V4 also discussed how reading content can provide interesting topics on which volunteers could invite students to share their related personal experience:

> ***we talked a little bit about that (personal sharing), especially, depending on the story, it was like "do you have any brother or sisters?" Or "do you have any pets?" It is whatever story is about, leads me talking a little bit about themselves (V4).***

With the context provided by academic activities, volunteers were able to start more personal sharing conversations, and hence strengthen their connections with students.

Different types of connections might influence volunteers' relationships with students, especially when volunteers were working with a small group of students. When asked about other connections volunteers had with students, both V3 and V4 mentioned other ways that they were broadly part of the same community. For example, V4's grandchild attended the same school and was in the same grade as the students with whom she worked. As a result, the students already knew the volunteer when she started volunteering. This shared connection provided a good foundation for the volunteer when she started building relationships with the students. However, some mentors sought to minimize the perception of unfairness if they were mentoring multiple students and had additional connections with some of them. For example, V3 worked with a group of three students whom he didn't know before the start of the year. He suggested that a student with whom he had connected in a different program work with a different volunteer to make sure that everybody in his group felt like they were starting on a level playing field in terms of establishing their relationship.

4.3 Gaining an Identity as a Mentor

Volunteers brought other aspects of their life into the mentoring program which helped them become better mentors: their interests, professional skills, and dedication to support the community. When asked about volunteers' motivation for participating in the mentoring program, 3 out of 4 volunteers explicitly said that their interests and passions led them to volunteer for the Learning Buddies program. Before retirement, V2 worked in the education field, and ***"loved being involved in education.***" V3's interest in helping with math led him to connect with the current teacher and his student mentees. Volunteers also brought their professional experience and skills into mentoring activities, which helped them build confidence working as mentors. When asked about strategies used to explain math problems to students, V3, who had been working in engineering, said:

Table 2. Average agreements for volunteering motivation statements (1=strongly disagree; 5 = strongly agree), ordered from most to least highly rated

Statements	Average Response (N = 4)
I wanted to interact with others.	5
Volunteering creates a better society.	5
I wanted to do something worthwhile.	5
I wanted to put something back in the community.	5
I have more free time than I used to have.	4.25
I wanted to develop relationships with others.	4
I wanted to work with different people.	3.25
A relative or a friend is involved in Learning Buddies program.	3
I wanted to gain some practical experience.	2.5
My friend/family were also volunteering.	2.5
Most people in my community volunteer.	2.5
Being a volunteer with [the mentoring program] is considered prestigious.	2
I am expected to volunteer.	1.25

> ***I don't have any doubt that if they were to listen to me that we would learn stuff… I believe I have a knack for unpacking and asking the questions that opens up what the problem means (V3).***

Besides the volunteers' professional background, the soft skills they obtained from their working experience made interacting with students easier:

> ***…my background is in nursing. So, I am a good communicator and I am very good with kids, so I don't really have any problems talking to the kids or asking them questions or maintaining boundaries or whatever (V4).***

When asked about their motivation to volunteer for this mentoring program, all volunteers responded that they were motivated by the wish to interact with children and reiterated their dedication to support their community. As V4 said, ***"I always felt like I would enjoy and have something to give kids. I always felt that way."*** These motivations were also reflected in the volunteering motivation scales (Table 2), where all volunteers selected "strongly agree" for the statements "volunteering creates a better society," "I wanted to do something worthwhile," and "I wanted to put something back in the community."

While participating in the mentoring program, volunteers wanted to strengthen their mentoring skills and connect with other mentors in their volunteering communities. Even with these professional skills, some volunteers still expressed their lack of confidence regarding teaching specific subjects (e.g., writing or math), and the concern of working with younger children in the interviews. Three out of 4 volunteers mentioned that workshops led by the mentoring program provided them with strategies for working with students:

> ***…they have these experts coming in and they tell you about new methods of teaching. I have learned a lot. And they give you the tools, when you go back to work with your kids, you have those tools to know how to communicate better (V4).***

V3 also described an incident where the workshop pushed him to think further about the ways in which they could incorporate new learning strategies into his mentoring sessions. Overall, these workshops strengthened volunteers' capacity and confidence working as mentors.

Being part of the mentoring program helped volunteers strengthen their existing connections with their social network and connect with other mentors in their volunteering communities. When asked how they started volunteering for this program, half of the volunteers we interviewed were recruited by their neighbors and friends who were already part of this mentoring program. This mentoring program also facilitated a community of fostering new connections with other mentors, as V2 described in the interview "***you made friends in the group… when we were together like that we made friendships.***" Similarly, V4 shared about her experience participating in events with other mentors, where they shared mentoring stories and connected with each other.

Volunteers' identity as mentors was not only shared in their volunteering communities, but with larger communities as well. In one observation session with V2,

one of the school staff commented about ***"students love to read with [V2]"***. Volunteers' mentor identity was also recognized outside the mentoring program as well. In the interview with T1, she mentioned that when V1 volunteered in other school activities during the summer, she also worked with some of the students she had mentored during the school year. In this case, V1 brought her mentor identity to other contexts within the community.

4.4 Teachers' Role in Mentorship Success

While our original study plan was to focus on just the students and volunteers, through our participant observations, it quickly became apparent that teachers played an important role in facilitating this mentoring program. Because this mentoring activity is part of the class agenda, teachers served as supervisors of this activity who matched students with volunteers, decided on the types of activities to work on (e.g., reading, writing, vocabularies, etc.), assigned special tasks when needed, and facilitated the logistics of mentoring activities. Volunteers and teachers communicated frequently about the mentoring program. In all sessions we observed, volunteers and teachers checked in verbally either at the beginning of their committed volunteering time, or at the end of the time block. During these check-ins, volunteers often got updates about students' schedule. For example, if students would go on field trip the next week and volunteers need not to come. Volunteers also communicated with teachers on students' performance during mentoring sessions, discussed problems they faced, and reported the progress students made. Teachers were able to provide volunteers with insights about students during these check-ins (e.g., this student just moved to a higher reading level, hence you might expect to provide more help with reading). Without these verbal check-ins, volunteers might not be able to follow up with the class schedule or might show up at a mentoring session where students were busy taking a test.

In addition to verbal communication with volunteers, different teachers used different written rubrics to support volunteers. Some teachers have well-structured framework for volunteers to track students' progress, which provided guidance on how they were supposed to mentor the students:

> ***For each child I have a graph that we fill out, the words they read. And there is a page I put notes on what they did or did not accomplish (V4).***

More commonly, teachers used the current class frameworks for tracking mentoring progress. V1 utilized the progress tracking forms from the class to track and inform the teacher about students' performance during the mentoring sessions. When teachers didn't have any external system to facilitate the mentoring activities, they usually coordinate with volunteers in decision-making during the mentoring activities. For example, T2 asked the class who wanted to read with the volunteer and based on the feedback, assigned the interested students to the volunteer at the beginning of a mentoring session.

Despite this regular communication between volunteers and teachers, certain aspects of the mentoring program were missing from these communications and brought challenges for volunteers. Even though there were regular check-ins between teachers and volunteers, teachers did not always communicate their expectation explicitly, which sometimes caused challenges for the less experienced volunteers:

> ***I am not sure what my job is, we talked about it earlier. The advanced stuff and is it okay if they want to count with their fingers for example. I think it is okay to let them do that, as long as he is applying it to, the more advanced stuff... but I am not sure about that. So, there's a little bit lack of clarity about what I am up to, what I am supposed to be up to (V3).***

Although teachers sometimes did not explicitly address their expectations, most volunteers were still able to figure out what the students needed by themselves. Even though V3 struggled with unclear communication, he did set up goals for students to achieve. Similarly, V1 was able to pick up on students' needs during the mentoring process. Teachers were aware of the utility of communicating students' needs explicitly and were willing to clarify their expectations to volunteers.

Frequent communications between volunteers and teachers helped volunteers better working with students, but these communications could become burdens for teachers and for volunteers as well. Teachers often prioritized facilitating class and broader student needs over facilitating the mentoring program. When asked about communicating with volunteers, even though T1 understood that more communications with volunteers would be helpful, she didn't want to spend her personal time emailing volunteers. In addition, she also felt it difficult to respond to mentors' needs during the class:

> ***The hard thing is that they (volunteers) are here like during really busy time, so it is not a great time to ask a question at the moment. That didn't happen with [V1], but I have had other volunteers and they were like trying to ask me question in the middle of teaching or in the middle of the small group … I can't field these questions right now (T1).***

For volunteers, it is similarly burdensome if they were expected to communicate with teachers after their committed volunteering hours. V3 admitted that even though knowing the class content ahead would be useful for him when planning the mentoring session, he couldn't see him spending time at home familiarizing himself with the content.

Good relationships between volunteers and teachers allow volunteers to better facilitate students' and teachers' needs. Throughout the school year, all volunteers stayed with the same teacher and the same class. In the following year, they often stayed with the same group unless teachers changed the volunteering needs for their class. V2 has volunteered with the same teacher for 9 years, and "they become very good buddies over these years and talked about things all the time." V4 described her relationship with T4:

> ***And it has been nice working with the same teacher for the last two years. Cause you get to know her. And she knows me. She can feel free to ask me to do extra things if she needs to be (V4).***

As V4 pointed out, her relationship with T4 helped her be more active during mentoring activities.

5 DISCUSSION

We begin by reflecting explicitly on how our results address the research questions. We discuss system design considerations following opportunities we identified for support and expand access to intergenerational mentorship programs. We conclude with limitations and future research directions revealed by our investigation.

5.1 Summary of Results

RQ1a & RQ1b: Who are the stakeholders in intergenerational mentorship interventions? What are their specific needs, priorities, and strategies involved in current intergenerational mentorship practices? Besides volunteers (mentors) and students (mentees), our results identified teachers as stakeholders for intergenerational mentoring programs and highlighted the important role teachers play in mentoring programs' success. All stakeholders have different needs and interpersonal priorities when participating in the mentoring program. For volunteers, they wanted to establish relationships with students, and further connect with the larger community through the program. Students also wanted relationships with older adults, but they wanted relationships to grow beyond the scope of academic tutoring. Teachers perceived the mentoring program as opportunities to provide students with positive adults' relationship, and individual help for students' growth. One of the takeaways of our work is that for all of the stakeholders, the program went "beyond tutoring"—it was about establishing and growing meaningful relationships across generations.

RQ2: What are the design opportunities for systems to support and expand access to current intergenerational mentorship practices? Based on results, we identify opportunities for systems to support and expand access to current intergenerational mentoring program in three areas:

1) Lower Barriers for Mentors: although the mentoring program is valuable and provides benefits for mentors, there are also logistical challenges, skills, and knowledge needed for volunteers to work with students. These requirements can be challenging for volunteers to participating in mentoring programs, resulting in smaller number of qualified potential participants.

2) Nurture Meaningful Relationships: students wanted more connections with older adults beyond classwork, however, the current model of mentoring programs doesn't support mentoring outside of this context. Hence there are opportunities supporting relationship building beyond the dedicated mentoring sessions for students.

3) Increase Facilitator's Capacity: the current structure of intergenerational mentoring programs required teachers' time and attention to facilitate these activities. Because teachers' time and attention are constrained given their regular responsibilities, the number of relationship pairs they can support for the mentoring programs is limited. With the right technology, however, their capacity may be increased.

In the following section, we provide more details about implications for designing systems that address these three opportunities.

5.2 Design Implications

5.2.1 Lower Barriers for Mentors. Volunteers needed many skills and knowledge to work successfully as mentors in

intergenerational mentoring programs. For example, the subject matter skill V3 owned to guide students through math problem solving process, or communication skill V4 had for working with students. With non-cooperative students, volunteers also needed to have the knowledge on how to manage students' behaviors. Besides these skills and knowledge required for working with students, the current mentoring program structure needed volunteers to drive to schools to participate in person and on-site. Even though the intergenerational mentoring program provides many benefits for older adults, these requirements can become barriers for them to joining in the mentoring program and hence lose this opportunity for social connections.

There are opportunities for technologies to potentially lower these barriers for older adults by sharing their mentoring responsibilities to support volunteers during sessions. When a system helps activities to be more structured, it can help parents run the activity and improve the quality of activity, as previous work in intergenerational family communication found [12]. Raffle et al. also had a built-in character in their intergenerational storytelling system, that could act as a listener to engage children in the activity and provided instructions to children that involved the grandparents in similar roles [33]. In the context of intergenerational mentoring, systems can use similar strategies to support volunteers as mentors, by providing a scaffold for the mentoring activity that guide volunteers during mentoring or introducing a third party that can share mentoring responsibilities with volunteers. Technologies can also lower the barriers for older adults to participate in intergenerational mentoring programs by supporting mentoring activities in various formats, e.g., remote mentoring sessions facilitated by video-conferencing systems.

5.2.2 Nurture Meaningful Relationships. Connecting beyond classwork was an important part in the relationships building process between volunteers and students. However, the current model of combining mentoring activities with class agenda didn't support this aspect. The current format of intergenerational mentoring program put many constrains to connections between volunteers and students: fixed time for mentoring sessions, limited types of activities and connections. Although the current format of intergenerational mentoring program supported the relationship building between volunteers and students by providing shared context (e.g. book reading) during mentoring activities, it also limited opportunities they could otherwise have to strengthen their relationships. To address the need for relationship building between volunteers and teachers, technologies should support format of connections beyond classwork, outside the dedicated mentoring time, for nurturing meaningful relationships between volunteers and students.

Prior literatures highlight the potential of asynchronous communication technologies to foster deeper communication and strengthen connections between distributed family members. For example, Bentley and Chowdhury built a located-based audio/video sharing app, which triggered further conversations between family members based on the story they shared [6]. Awareness system like a digital portrait of family members with their status can also help distributed family members feel connected remotely and initiate further connections through other media and forms [29]. We can leverage similar systems to support diverse but lightweight forms of connections outside mentoring sessions and help build meaning relationships between volunteers and students in intergenerational mentoring context. For example, considering a scenario where students may be nervous before taking a math test, an asynchronous communication system would allow volunteers to signal their support and hence strengthen their relationships. Although we expect these communication technologies to be low-touch, asynchronous interactions without requiring significant effort or time from volunteers and students, it is important to analyze cost-benefit trade-offs while evaluating such technologies, for example, using the ABCCT questionnaire [47] or the User Burden scale [39].

When designing communication systems in this context, technology designers should remain vigilant against replacing face-to-face interaction with mediated interaction. Mediated communications should only be considered under the situation where face-to-face interaction cannot happen.

5.2.3 Increase Facilitators' Capacity. The organization of intergenerational mentoring programs required teachers' time in communicating with volunteers and facilitating the mentoring activities to make intergenerational mentoring programs viable in schools. However, teachers were often busy with teaching and managing classes and did not have much capacity for intergenerational mentoring programs. T1 described in the interview that she wanted to better facilitate intergenerational mentoring activities, because she could see how valuable these activities are for students. But she also did not have much

time to do so as her time was already occupied by managing the class. Technologies should better support teachers' role as facilitators in intergenerational mentoring, lessen their burdens for facilitating each volunteer-student pair, and increase their capacity of mentoring sessions they can facilitate.

Researchers have investigated similar problems in the area of grandparents and grandchildren communicating over distance, where they found parents were vital in facilitating the communication between them (e.g., initiate and end the communication session) [33,43]. Considering the challenge parents face in facilitating intergenerational communication, researchers often adopt a children-friendly interface design with their systems, to lessen the burdens parents have during the communication sessions. In the intergenerational mentoring context, technologies can support volunteers' independence during mentoring and leverage support from the community when necessary, rather than relying on teachers for help (e.g., tele-connecting with other mentors from the volunteering community for help). Systems design can also increase teachers' capacity by integrating the facilitating process into existing technology infrastructure teachers are using in the classroom, to make the facilitating process more convenient for teachers. It is important to demonstrate lowering the teachers' facilitation costs first, before attempting to extend access to additional volunteers (e.g., supporting mentoring activities in remote format).

5.3 Limitations and Future Work

Because we focused on school-based intergenerational mentoring program with one particular community, our results are based on a limited group of stakeholders from one specific context. Other contexts of intergenerational mentoring programs or other communities might have different sets of insights on how technologies can support intergenerational mentoring intervention in different scenarios. For example, mentees might have different technology need to support in community-based programs with less emphasis on academic work. Mentorship programs that are structured outside of the school context may also have different sets of constraints and opportunities. Future work investigating other contexts of intergenerational mentoring programs can further supplement design implications for systems to support intergenerational mentoring programs.

Although we represented all stakeholders' voices in our investigation, our findings emphasize the volunteers' perspective more because of our access to different groups of stakeholders. Future investigation can focus on further the understanding of intergenerational mentoring practices from students' and teachers' perspectives.

6 CONCLUSIONS

Even though students are the target population for community intergenerational mentorship programs, older adults also benefit greatly from this experience as their participation reduces their sense of social isolation and gives them opportunities to give back to the community. We carried out a qualitative investigation that combines participant observations and interviews to identify opportunities to maximize access and effectiveness of such intergenerational mentorship opportunities. We found that while the context of interaction between the children and elders was around academic tutoring, there were significant other factors that were necessary for the success of the program. We identified three critical elements: relationship building between older adults and children during mentoring activities, the skills and identity mentors acquired to carry out mentoring activities, and support needed from teachers and schools. Through an ethnographic field investigation, this paper contributes a rich description of current intergenerational mentorship practices and insights for opportunities for novel HCI technologies in this context.

ACKNOWLEDGMENTS

We would like to express our sincere thanks to School District 197 (West St. Paul-Mendota Heights-Eagan Area Schools) and DARTS for their support throughout this work; Carrie Hilger and Erin Walloch for facilitating the communications with schools and volunteers. We would also like to thank Weijia Zheng for her feedback and support while writing this paper. This work was funded by the NSF grant (1651575).

REFERENCES

[1] Muhammad Haziq Lim Abdullah, Cara Wilson, and Margot Brereton. 2016. MyCalendar: Supporting Families to Communicate with Their Child on the Autism Spectrum. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction* (OzCHI '16), 613–617. DOI:https://doi.org/10.1145/3010915.3011000

[2] Denise E. Agosto and June Abbas. 2010. High School Seniors' Social Network and Other ICT Use Preferences and Concerns. In *Proceedings of the 73rd ASIS&T Annual Meeting on Navigating Streams in an Information Ecosystem - Volume 47* (ASIS&T '10), 65:1–65:10. Retrieved October 29, 2017 from http://dl.acm.org/citation.cfm?id=1920331.1920426

[3] Tracy Packiam Alloway, John Horton, Ross G. Alloway, and Clare Dawson. 2013. Social networking sites and cognitive abilities: Do they make you smarter? *Computers & Education* 63, Supplement C (April 2013), 10–16. DOI:https://doi.org/10.1016/j.compedu.2012.10.030

[4] M. Báez, F. Ibarra, I. K. Far, M. Ferron, and F. Casati. 2016. Online Group-Exercises for Older Adults of Different Physical Abilities. In *2016 International Conference on Collaboration Technologies and Systems (CTS)*, 524–533. DOI:https://doi.org/10.1109/CTS.2016.0098

[5] Rafael Ballagas, Joseph "Jofish" Kaye, Morgan Ames, Janet Go, and Hayes Raffle. 2009. Family Communication: Phone Conversations with Children. In *Proceedings of the 8th International Conference on Interaction Design and Children* (IDC '09), 321–324. DOI:https://doi.org/10.1145/1551788.1551874

[6] Frank R. Bentley and Sujoy Kumar Chowdhury. 2010. Serendipitous Family Stories: Using Findings from a Study on Family Communication to Share Family History. In *Proceedings of the 12th ACM International Conference Adjunct Papers on Ubiquitous Computing - Adjunct* (UbiComp '10 Adjunct), 359–360. DOI:https://doi.org/10.1145/1864431.1864435

[7] Meng-Ying Chan, Yi-Hsuan Lin, Long-Fei Lin, Ting-Wei Lin, Wei-Che Hsu, Chia-yu Chang, Rui Liu, Ko-Yu Chang, Min-hua Lin, and Jane Yung-jen Hsu. 2017. WAKEY: Assisting Parent-child Communication for Better Morning Routines. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (CSCW '17), 2287–2299. DOI:https://doi.org/10.1145/2998181.2998233

[8] Yi-Fan Chen and James E. Katz. 2009. Extending Family to School Life: College Students' Use of the Mobile Phone. *Int. J. Hum.-Comput. Stud.* 67, 2 (February 2009), 179–191. DOI:https://doi.org/10.1016/j.ijhcs.2008.09.002

[9] Raymundo Cornejo, Nadir Weibel, Mónica Tentori, and Jesús Favela. 2015. Promoting Active Aging with a Paper-based SNS Application. In *Proceedings of the 9th International Conference on Pervasive Computing Technologies for Healthcare* (PervasiveHealth '15), 209–212. Retrieved October 29, 2017 from http://dl.acm.org/citation.cfm?id=2826165.2826196

[10] David L. DuBois, Bruce E. Holloway, Jeffrey C. Valentine, and Harris Cooper. Effectiveness of Mentoring Programs for Youth: A Meta-Analytic Review. *American Journal of Community Psychology* 30, 2 , 157–197. DOI:https://doi.org/10.1023/A:1014628810714

[11] Lillian T. Eby, Tammy D. Allen, Sarah C. Evans, Thomas Ng, and David L. DuBois. 2008. Does mentoring matter? A multidisciplinary meta-analysis comparing mentored and non-mentored individuals. *Journal of Vocational Behavior* 72, 2 (April 2008), 254–267. DOI:https://doi.org/10.1016/j.jvb.2007.04.005

[12] Sean Follmer, Hayes Raffle, Janet Go, Rafael Ballagas, and Hiroshi Ishii. 2010. Video Play: Playful Interactions in Video Conferencing for Long-distance Families with Young Children. In *Proceedings of the 9th International Conference on Interaction Design and Children* (IDC '10), 49–58. DOI:https://doi.org/10.1145/1810543.1810550

[13] Shanan Gibson, Dennis C. Neale, John M. Carroll, and Christina A. Van Metre. 1999. Mentoring in a School Environment. In *Proceedings of the 1999 Conference on Computer Support for Collaborative Learning* (CSCL '99). Retrieved April 4, 2018 from http://dl.acm.org/citation.cfm?id=1150240.1150261

[14] Thomas A. Glass, Marc Freedman, Michelle C. Carlson, Joel Hill, Kevin D. Frick, Nick Ialongo, Sylvia McGill, George W. Rebok, Teresa Seeman, James M. Tielsch, Barbara A. Wasik, Scott Zeger, and Linda P. Fried. 2004. Experience Corps: design of an intergenerational program to boost social capital and promote the health of an aging society. *J Urban Health* 81, 1 (March 2004), 94–105. DOI:https://doi.org/10.1093/jurban/jth096

[15] Lelia Hampton and Kinnis Gosha. 2018. Development of a Twitter Graduate School Virtual Mentor for HBCU Computer Science Students. In *Proceedings of the ACMSE 2018 Conference* (ACMSE '18), 42:1–42:2. DOI:https://doi.org/10.1145/3190645.3190714

[16] Eiji Hayashi, Martina Rau, Zhe Han Neo, Nastasha Tan, Sriram Ramasubramanian, and Eric Paulos. 2012. TimeBlocks: Mom, Can I Have Another Block of Time. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '12), 1713–1716. DOI:https://doi.org/10.1145/2207676.2208299

[17] Atsushi Hiyama, Masatomo Kobayashi, Hironobu Takagi, and Michitaka Hirose. 2014. Mosaic: Collaborative Ways for Older Adults to Use Their Expertise Through Information Technologies. *SIGACCESS Access. Comput.* 110 (September 2014), 26–33. DOI:https://doi.org/10.1145/2670962.2670966

[18] H. B. Jimison, K. A. Klein, and J. L. Marcoe. 2013. A socialization intervention in remote health coaching for older adults in the home. In *2013 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 7025–7028. DOI:https://doi.org/10.1109/EMBC.2013.6611175

[19] James Kennedy, Paul Baxter, Emmanuel Senft, and Tony Belpaeme. 2016. Social Robot Tutoring for Child Second Language Learning. In *The Eleventh ACM/IEEE International Conference on Human Robot Interaction* (HRI '16), 231–238. Retrieved July 4, 2018 from http://dl.acm.org/citation.cfm?id=2906831.2906873

[20] James Kennedy, Paul Baxter, Emmanuel Senft, and Tony Belpaeme. 2016. Heart vs Hard Drive: Children Learn More From a Human Tutor Than a Social Robot. In *The Eleventh ACM/IEEE International Conference on Human Robot Interaction* (HRI '16), 451–452. Retrieved July 4, 2018 from http://dl.acm.org/citation.cfm?id=2906831.2906922

[21] Madhur Khandelwal and Ali Mazalek. 2007. Teaching Table: A Tangible Mentor for Pre-k Math Education. In *Proceedings of the 1st International Conference on Tangible and Embedded Interaction* (TEI '07), 191–194. DOI:https://doi.org/10.1145/1226969.1227009

[22] Yong Ming Kow, Jing Wen, and Yunan Chen. 2012. Designing Online Games for Real-life Relationships: Examining QQ Farm in Intergenerational Play. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work* (CSCW '12), 613–616. DOI:https://doi.org/10.1145/2145204.2145297

[23] Giulio E. Lancioni, Mark F. O'Reilly, Nirbhay N. Singh, Jeff Sigafoos, Doretta Oliva, Gloria Alberti, and Russell Lang. 2011. Two adults with multiple disabilities use a computer-aided telephone system to make phone calls independently. *Research in Developmental Disabilities* 32, 6 (November 2011), 2330–2335. DOI:https://doi.org/10.1016/j.ridd.2011.07.033

[24] Je Seok Lee, Shuang Liang, Sangeun Park, and Chang Yan. 2015. Hi Grandpa!: A Communication Tool Connecting Grandparents and Grandchildren Living Apart. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct* (MobileHCI '15), 674–679. DOI:https://doi.org/10.1145/2786567.2793687

[25] Young S. Lee, Shirley Chaysinh, Santosh Basapur, Crysta J. Metcalf, and Hiren Mandalia. 2012. Active Aging in Community Centers and ICT Design Implications. In *Proceedings of the Designing Interactive Systems Conference* (DIS '12), 156–165. DOI:https://doi.org/10.1145/2317956.2317981

[26] Sharan Merriam. 1983. Mentors and Protégés: A Critical Review of the Literature , Mentors and Protégés: A Critical Review of the Literature. *Adult Education* 33, 3 (March 1983), 161–173. DOI:https://doi.org/10.1177/074171368303300304

[27] Michael Muller. 2014. Curiosity, Creativity, and Surprise as Analytic Tools: Grounded Theory Method. In *Ways of Knowing in HCI*. Springer, New York, NY, 25–48. DOI:https://doi.org/10.1007/978-1-4939-0378-8_2

[28] Diego Muñoz, Raymundo Cornejo, Sergio F. Ochoa, Jesús Favela, Francisco Gutierrez, and Mónica Tentori. 2013. Aligning Intergenerational Communication Patterns and Rhythms in the Age of Social Media. In *Proceedings of the 2013 Chilean Conference on Human - Computer Interaction* (ChileCHI '13), 66–71. DOI:https://doi.org/10.1145/2535597.2535607

[29] Elizabeth D. Mynatt, Jim Rowan, Sarah Craighill, and Annie Jacobs. 2001. Digital Family Portraits: Supporting Peace of Mind for Extended Family Members. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '01), 333–340. DOI:https://doi.org/10.1145/365024.365126

[30] Joseph Nesbitt and AnnMarie Thomas. 2010. Bridging the Digital Divide One Tweet at a Time: Twitter-enabled Devices for Family Communication. In *CHI '10 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '10), 3949–3954. DOI:https://doi.org/10.1145/1753846.1754084

[31] B. O'Dea and A. Campbell. 2011. Online social networking amongst teens: friend or foe? *Stud Health Technol Inform* 167, (2011), 133–138.

[32] Anabel Quan-Haase, Guang Ying Mo, and Barry Wellman. 2017. Connected seniors: how older adults in East York exchange social support online and offline. *Information, Communication & Society* 20, 7 (July 2017), 967–983. DOI:https://doi.org/10.1080/1369118X.2017.1305428

[33] Hayes Raffle, Rafael Ballagas, Glenda Revelle, Hiroshi Horii, Sean Follmer, Janet Go, Emily Reardon, Koichi Mori, Joseph Kaye, and Mirjana Spasojevic. 2010. Family Story Play: Reading with Young Children (and Elmo) over a Distance. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10), 1583–1592. DOI:https://doi.org/10.1145/1753326.1753563

[34] Tiago Ribeiro, André Pereira, Amol Deshmukh, Ruth Aylett, and Ana Paiva. 2014. I'M the Mayor: A Robot Tutor in Enercities-2. In *Proceedings of the 2014 International Conference on Autonomous Agents and Multi-agent Systems* (AAMAS '14), 1675–1676. Retrieved July 5, 2018 from http://dl.acm.org/citation.cfm?id=2615731.2616120

[35] Rita L. Rosenthal. 2008. Older Computer-Literate Women: Their Motivations, Obstacles, and Paths to Success. *Educational Gerontology* 34, 7 (June 2008), 610–626. DOI:https://doi.org/10.1080/03601270801949427

[36] R. Sarki, J. Haeun, and Y. M. Kwon. 2015. Design and implementation of web-based elderly friendly tangible photo technique. In *2015 Tenth International Conference on Digital Information Management (ICDIM)*, 194–197. DOI:https://doi.org/10.1109/ICDIM.2015.7381863

[37] Jennifer Schon. 2014. "Dad Doesn't Text": Examining How Parents' Use of Information Communication Technologies Influences Satisfaction Among Emerging Adult Children. *Emerging Adulthood* 2, 4 (December 2014), 304–312. DOI:https://doi.org/10.1177/2167696814551786

[38] Ayşem R. Şenyürekli and Daniel F. Detzner. 2009. Communication Dynamics of the Transnational Family. *Marriage & Family Review* 45, 6–8 (August 2009), 807–824. DOI:https://doi.org/10.1080/01494920903224392

[39] Hyewon Suh, Nina Shahriaree, Eric B. Hekler, and Julie A. Kientz. 2016. Developing and Validating the User Burden Scale: A Tool for Assessing User Burden in Computing Systems. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (CHI '16), 3988–3999. DOI:https://doi.org/10.1145/2858036.2858448

[40] Kimberly Tee, A. J. Bernheim Brush, and Kori M. Inkpen. 2009. Exploring communication and sharing between extended families. *International Journal of Human-Computer Studies* 67, 2 (February 2009), 128–138. DOI:https://doi.org/10.1016/j.ijhcs.2008.09.007

[41] Timothy N. Thornton, Carole A. Craft, Linda L. Dahlberg, Barbara S. Lynch, and Katie Baer. 2000. *Best Practices of Youth Violence Prevention: A Sourcebook for Community Action.* Retrieved September 21, 2018 from https://eric.ed.gov/?id=ED457290

[42] Patrick Tolan, David Henry, Michael Schoeny, Arin Bass, Peter Lovegrove, and Emily Nichols. 2013. *Mentoring Interventions to Affect Juvenile Delinquency and Associated Problems: A Systematic Review. Campbell Systematic Reviews 2013:10.* Campbell Collaboration. Retrieved September 21, 2018 from https://eric.ed.gov/?id=ED557983

[43] René Vutborg, Jesper Kjeldskov, Sonja Pedell, and Frank Vetere. 2010. Family Storytelling for Grandparents and Grandchildren Living Apart. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries* (NordiCHI '10), 531–540. DOI:https://doi.org/10.1145/1868914.1868974

[44] Chong-Wen Wang, Cecilia L. W. Chan, Andy H. Y. Ho, and Zhifan Xiong. 2008. Social networks and health-related quality of life among Chinese older adults with vision impairment. *J Aging Health* 20, 7 (October 2008), 804–823. DOI:https://doi.org/10.1177/0898264308321083

[45] Wayne Ward, Ronald Cole, Daniel Bolaños, Cindy Buchenroth-Martin, Edward Svirsky, Sarel Van Vuuren, Timothy Weston, Jing Zheng, and Lee Becker. 2011. My Science Tutor: A Conversational Multimedia Virtual Tutor for Elementary School Science. *ACM Trans. Speech Lang. Process.* 7, 4 (August 2011), 18:1–18:29. DOI:https://doi.org/10.1145/1998384.1998392

[46] Frederick Weber and Kalika Bali. 2010. Enhancing ESL Education in India with a Reading Tutor That Listens. In *Proceedings of the First ACM Symposium on Computing for Development* (ACM DEV '10), 20:1–20:9. DOI:https://doi.org/10.1145/1926180.1926205

[47] Svetlana Yarosh, Panos Markopoulos, and Gregory D. Abowd. 2014. Towards a Questionnaire for Measuring Affective Benefits and Costs of Communication Technologies. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing* (CSCW '14), 84–96. DOI:https://doi.org/10.1145/2531602.2531634

[48] Svetlana Yarosh, Anthony Tang, Sanika Mokashi, and Gregory D. Abowd. 2013. "Almost Touching": Parent-child Remote Communication Using the Sharetable System. In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work* (CSCW '13), 181–192. DOI:https://doi.org/10.1145/2441776.2441798

[49] 2016. Hidden in Plain Sight: How Intergenerational Relationships Can Transform Our Future. *Stanford Center on Longevity.* Retrieved September 21, 2018 from http://longevity.stanford.edu/2016/06/01/hidden-in-plain-sight-how-intergenerational-relationships-can-transform-our-future/

[50] How Effective Are Mentoring Programs for Youth? A Systematic Assessment of the Evidence. *Association for Psychological Science.* Retrieved September 21, 2018 from https://www.psychologicalscience.org/publications/journals/pspi/mentoring.html

[51] Construct validity of the special event volunteer motivation scale for Greek volunteers: Leisure/Loisir: Vol 30, No 1. Retrieved September 18, 2018 from https://www.tandfonline.com/doi/abs/10.1080/14927713.2006.9651352?casa_token=tYFWKAFKwo8AAAAA:W30_m8GRNtjQxyUOX1WLrARmPRXSfxD7_sMfDerXpTQkL_rzzg_LnJA9xRHFb6shuykfjIuSbSgu