



# "Money shouldn't be money!" : An Examination of Financial Literacy and Technology for Children Through Co-Design

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## ABSTRACT

Financial literacy is the use of knowledge, skills, and behaviors around managing financial resources. Despite its importance, less is known from a Human Computer Interaction (HCI) and child-computer interaction perspective about what financial literacy means for youth, especially the role of digital technologies. We examine children's perspectives of financial literacy and digital technologies through a study of nine participatory design sessions with children (ages 7 – 11) centered around ideating, evaluating, and designing technologies for children's finances. Our co-design findings demonstrate that children's relationship to money can be quite complex in the digital world. Empirically, we report three inductive themes that demonstrate the role that technology plays in children's financial literacy. Theoretically, we argue the need for child-computer interaction research to engage more in financial literacy for children. Finally, we reflect on co-designing for financial literacy, technology, and children.

## CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction (HCI)**; • **HCI design and evaluation methods**; • **User models**;

## KEYWORDS

Child-computer interaction, participatory design, financial literacy, children's perceptions

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## 1 INTRODUCTION

Financial conditions can be taxing concerns for people, and as financial choices become more complex, increasing consumer financial literacy has become a public policy issue in the US [60]. Financial literacy is the combination of knowledge, skills, and behaviors that support people's financial decisions and management of resources for financial well-being [1, 39, 40, 56, 75]. Lower financial literacy is correlated with negative financial behaviors, such as predatory debt [50], higher borrowing rates [47], and home foreclosures [27].

Researchers have made arguments for children and adolescents to be exposed earlier to financial literacy education (e.g., [2, 31, 36, 44, 81]). A Pew Research Center [74] study in 2022 found that seven-in-ten Americans think young adults are facing more challenges than the prior generation. Young people are taking on more student debt [4], face an affordable housing crisis [78], and have a harder time saving financial resources for the future [45]. While there are calls for national policies to address these economic issues in young people, several researchers make arguments for the early development of financial literacy in youth, even starting in pre-K [36].

Educators and policy makers are considering early financial literacy exposure to youth, but we know little about how to support children's development of these literacies in current times. Financial literacy is different now for children than for prior generations, in part, due to technological innovations. First, financial markets are changing due to digital technologies. Cryptocurrency, non-fungible tokens (NFTs), online banking, digital wallets, and other technology upheavals can influence how youth think about finances. In 2021, Pew Research [62] found that for American adults who have invested in cryptocurrency, the largest age group are between ages 18 – 29 (31% compared to 21% for ages 30 – 49, and 8% for ages 50 – 64). There are even concerns that cryptocurrencies and NFTs are being marketed directly to children [35]. Second, children are now being exposed to financial markets through home technologies. Digital games with microtransactions, online shopping, and the transition from cash to credit cards are aspects of financial change through digital technologies. Overall, a rapidly changing landscape

for financial literacy, often mediated by youth and technology — are reasons for Human Computer Interaction (HCI) researchers to consider the role of design and technology in how children perceive and interact with money in the digital world.

We argue that HCI and child-computer interaction researchers need to consider the connection between children’s financial literacy and technology usage. For instance, Pina et al. [63], Roldan et al. [71], and Yip et al. [92] demonstrated that families are often dependent on children’s understandings of technology as it pertains to finances. In our review of HCI and child-computer interaction studies (*CHI, IDC, International Journal of Child-Computer Interaction*, etc.) we only found a small set of studies pertaining to children’s financial literacy and technology. Despite rapid shifts in technology around finances (both directly and indirectly affecting children), we do not have guidelines for design in our HCI community. For this study, we ask the following research questions: **RQ1**: What do children (ages 7 - 11) in a co-design setting consider important about finances as it relates to technology? How do children in a co-design setting make sense of the complex world of technology and financial literacy? **RQ2**: What design principles and guidelines can be derived from a co-design setting with children about the consideration of technology and financial literacy for children?

To understand how children conceptualized financial literacy and its relationship to technology, we conducted nine participatory design (PD) sessions [91] with children (ages 7 - 11) on co-designing technologies for financial literacy. Through the PD method of Cooperative Inquiry [20, 91], we utilized adult-child design partnerships to dive deep into how children understood financial literacy and technologies. We used different co-design activities for each session to elicit how children conceptualized ideas about financial literacy and technologies. We contribute to the discussion on children, financial literacy, and technology in three ways. Empirically, we report three inductive themes that demonstrate the role that technology plays in children’s financial literacy. Theoretically, we pursue the argument for a need in child-computer interaction research to engage more in financial literacy for children. Finally, we make reflections on co-designing for financial literacy, technology, and children.

## 2 LITERATURE REVIEW

### 2.1 Definitions of financial literacy

Education researchers observe that people engage in foundational literacies, such as reading, writing, numeracy, and general cognitive abilities (e.g., executive function) [68]. From this foundation, there are expansions to specific types of literacy, such as digital literacy, media literacy, information literacy, health literacy, etc. As a specific concept, financial literacy takes on two dimensions: 1) understanding and knowledge of finances, and 2) behavior towards finances [39]. A systematic review by Hung et al. [39] notes that many conceptual definitions of financial literacy exist, but the definition comes together as a) specific form of knowledge around financial matters; b) the ability and skills to apply financial knowledge to a variety of situations; c) how people perceive knowledge around finances; d) whether people have good behavior around finances; and e) what kinds of financial experiences they have. Despite some consensus, Hung et al. argue that researchers need to

make clear distinctions between financial literacy and financial attitudes (e.g., self-reports, personal preferences, opinions on finances) and financial education (e.g., the processes by which people improve their financial skills and knowledge). From this definition, Hung et al. [39] created a conceptual model in which financial knowledge affects the skills, behavior, and perceived knowledge of the person, but at the same time, behavior reciprocates and influences knowledge, skills, and perceived knowledge.

Alsemgeest’s [1] review on financial education notes a contention of whether financial literacy education leads to effective financial behaviors. Alsemgeest’s argument for financial literacy is that consumer financial decisions have great personal and societal consequences. Big and small decisions can have negative consequences when people are poorly informed about finances. For instance, in the US, predatory lending and high-level debt have increased [14]. Financial adversity can lead to great emotional toil, hardship, and psychological issues [21, 67]. In the modern digital world, advanced technologies, and market innovations (e.g., cryptocurrency, day-trading) have made the financial world more complex and sophisticated. Learning about financial literacy matters, as prior studies show. For example, that those that plan for retirement accumulate more retirement income [66].

However, numerous challenges exist when only considering individuals’ financial literacy. First, consumers are individuals, with their own irrational tendencies around finances [13]. People have personal and emotional triggers that can be unpredictable around finances [42], with biases in decision-making [48]. Teaching financial literacy in a systematic and prescribed way is not always effective [1]. There is also an unclear relationship between financial knowledge and behavior (i.e., causal, correlational, or both). Research has not shown if financial education leads to better financial behaviors [1]. Focusing on an individual’s financial literacy may put blame on the individual, when in fact, we are living in times of global systemic financial crisis [25]. Financial planning is hard and requires a lot of general knowledge (e.g., numeracy, executive function) that financial literacy or education itself cannot address. These complex challenges and tensions underscore the importance of designing supports for developing financial literacy, which arise from the mental models and realities that children face. Given the rapidly changing social, cultural, and technological environment that children experience today, updating our understanding of their ways of understanding financial literacy becomes vital.

### 2.2 Children and youth and financial literacy

While financial literacy is a difficult topic for people, there is a consensus among researchers that financial literacy and education programs for young children matters [2, 30, 36, 77, 81]. For example, the *Programme for International Student Assessment (PISA)* exam is a worldwide study intended to evaluate the educational systems of countries by looking at the performance of 15-year-old students in reading, writing, science, and mathematics. PISA has an optional financial literacy assessment section. The assessment found that youth in some wealthier countries (e.g., US, Portugal, Spain, Russia, Italy) scored average or slightly below the OECD score (505) [61], which suggests that merely living in a wealthier country does not appear to have a strong relationship with higher financial literacy

scores. Amagir et al.'s [2] review on financial literacy programs for children and adolescents found that school-based financial education programs can support positive financial knowledge and attitudes. However, studies that assess the effects of financial education behavior in the long term are scarce.

The Brookings Institute [44] conducted a large-scale review of US-based youth financial education programs. The result of the review was inconclusive on what policies and programs are effective in promoting positive financial behaviors in the long-term. The report found that many parts of the US do not have financial literacy requirements in schools or weak mandates for a comprehensive education. The conclusion noted that programs often consider financial literacy as just presenting information. The report suggests that designers and policy makers need to consider financial literacy as "a dynamic construct, with the acquisition of financial skills and behavior built upon crucial foundational skills and shaped over time by experience and opportunity." For HCI researchers, this means attempting to consider how technologies can connect time, space, experience, and opportunities for children to think about their financial literacy in the long run.

Overall, while research indicates that financial literacy and education programs are important for youth, less information exists on how to design for such programs. There is consensus from researchers that financial literacy programs for younger children (pre-K to 3) need much stronger consideration [36]. However, there are number of challenges that exist in creating designs for younger children around financial literacy. First, researchers need to consider children's cognitive development (e.g., numeracy, executive functioning, Piagetian conceptual change, maturation [36]) and how it fits with financial literacy.

Second, because financial skills acquired in childhood are often instilled by caregivers, considerations of family are important for youth. Children do not interact independently with financial institutions and markets; therefore, the design of programs or products needs to consider children's experiences with caregivers as intermediaries. Van Campenhout [84] notes that caregivers and families socialize children in the financial process. Caregivers play the most prominent role in a child's life, especially with financial socialization. This socialization includes environmental influences in the family, learning processes, and parents as sources of financial information.

Third, while general cognition and literacy are important for finances [36], young children do not often have prior knowledge about direct financial concepts (e.g., trading, exchange, taxes) and these specific concepts may need to be directly taught to them. Therefore, designs must be attractive to both caregivers and teachers for any adoption to occur. Designs need to consider how to start financial education early with children and their families, be highly customizable for children's development, and help caregivers introduce financial concepts.

### 2.3 Technology on financial literacy for children and youth

While researchers highlight that early financial literacy considerations are important, our study's review indicates that there is little research in the HCI and child-computer interaction space in this

area. Commercially, there are digital games that support learning about finances [43], children's personalized debit cards [37], budget apps for children [80], and videos for children on financial literacy [57]. Sari et al. [73] developed a financial literacy storybook for early childhood using augmented reality. Digital games are perhaps the most prevalent technologies for children and financial literacy. Tanja and Alesja [79] developed digital games for promoting financial literacy in youth. Liu et al. [54] created games and online virtual worlds for teenagers using *Second Life*. Rasco et al. [69] developed *FinCraft*, an open-source gaming platform to enhance financial literacy in teens. Others have utilized *Scratch* programming [26] to create a game to teach financial literacy concepts to children. Digital quizzes are also found in the children design space. Sladjana and Ziakou [94] conducted research on the *European Money Quiz*, a digital learning initiative to understand children's understanding of finances. Despite the research on digital designs for financial literacy for children and adolescents, many of these designs do not follow some of the financial learning principles outlined in this review. For instance, none of these designs have considerations of parental involvement and support of financial behavior and knowledge in the long term.

Finally, many of these design studies do not utilize established principles of participatory design [19] and co-design [20, 91] to consider what children know and need. The most prominent paper our research could find on children, co-design, and financial literacy was by Halloluwa et al. [31] and their case study of co-design activities with primary school children in Sri Lanka. The researchers aimed to design mobile applications to engage primary school students in financial literacy topics. The researchers engaged in three co-design workshops around Bags of Stuff (low-tech prototyping with arts and crafts), storyboarding, and using sticky notes for critique.

In our review, we could not find any papers from the *CHI*, *Interaction Design and Children* (IDC), and *International Journal of Child-Computer Interaction* venues on financial literacy. Zimmerman et al.'s [95] work in *ACM Design of Interactive Systems (DIS)* conducted a study asking if parents should play a role in teaching their teens' financial literacy. They conducted a literature review, competitive analysis of current digital tools, and interviewed parents and teens. They found that there is interest in digital tools that allow parents to educate their teens. We assert that more studies like Zimmerman et al. [95] need to be conducted in the HCI youth space. Therefore, our study builds off the Halloluwa et al. [31] research to engage in multiple co-design activities with an established inter-generational co-design group of children (ages 7 – 11) and adults. Our goal in this paper is to demonstrate the role that co-design can play in understanding children's perceptions, knowledge, skills, and behaviors around financial literacy and digital technologies.

## 3 METHOD

For this study we followed the participatory design (PD) method of *Cooperative Inquiry* [20, 91]. PD is a user-centered design method that focuses on close collaborations and democratic ideas between designers and stakeholders. Cooperative Inquiry is a method of PD that emphasizes that design partnerships between children and adults can be done equally and equitably [20, 91].

**Table 1: Demographic characteristics of our child participants**

Name	Age	Gender	Ethnicity	Sessions
Melissa*	11	Female	White	1, 2
Kristin*	8	Female	White	7, 8
Matteo	9	Male	Hispanic	1, 2, 3, 4, 5, 6, 7, 9
Sierra	7	Female	Asian / Black	1, 2, 3, 4, 5, 7, 8, 9
Shiro#	10	Male	Asian / White	1, 2, 3, 9
Hideo#	7	Male	Asian / White	1, 2, 3, 8, 9
Caleb	10	Male	White	1, 2, 3, 4, 6, 8, 9
Jin&	11	Female	Asian / White	1, 2, 3, 4, 5, 6, 7, 9
Yoongi&	8	Female	Asian / White	1, 2, 3, 4, 5, 6, 7, 9
Haile	8	Male	Black	1, 2, 3, 4, 6, 7, 8, 9

The symbols \*, #, and & refer to children as siblings.

We chose PD and Cooperative Inquiry [20, 91] as our method for this study for three reasons. First, while prior research indicates that interviewing and surveying children is possible [34], the complex and abstract nature around finances can be difficult to elicit and interpret qualitative responses. Second, researchers in HCI and child-computer interaction have shown that PD techniques and workshops allow children to concretely express abstract ideas around complex topics due to the in-depth and rich engagement children are able to have. Finally, Cooperative Inquiry has shown robustly that children that already work closely in comfortable settings with adults can express their perceptions more assertively. Children in long-term co-design groups develop close relationships over time with adults and develop trust. The children are also knowledgeable on multiple PD techniques [85] and can therefore dive deeper into financial literacy rather than needing to teach children how to co-design. Overall, Cooperative Inquiry has shown to be a strong choice when needing to work with children to understand their perspective on complex topics like intelligent user interfaces [87, 88], cybersecurity and privacy [49, 59], creepy technologies [90], and online safety [7, 8, 15–17].

The PD sessions in this study focused on designing and eliciting responses from children around their ideas and perceptions of financial literacy. The study took place in the middle of the COVID-19 pandemic (Fall 2021 – Spring 2022). Due to lockdowns and COVID-19 preventative measures, we conducted nine 90-minute co-design sessions across the span of one year using online and hybrid co-design techniques [51].

### 3.1 Participants

An intergenerational co-design group of children (ages 7 – 11) and adult design researchers (undergraduates, masters students, and an investigator) participated in nine co-design sessions. Our team is called *KidsTeam UW* (a pseudonym, all child and adult names are also pseudonyms, Table 1). Child members have participated in KidsTeam UW for the past 1 – 4 years. We obtained all appropriate parental consent and child assent. All research conducted was approved by our university’s Institutional Review Board for ethics and safety. In each of the co-design sessions, between four to six adult facilitators acted as design partners. The adults developed relationships with the children, supported facilitation of the sessions,

designed with the children, and helped to generate and interpret ideas around financial literacy technologies for children.

### 3.2 Design sessions

Each design session (DS1 – 9) in *KidsTeam UW* was conducted mostly online [51], except for the eighth session (DS8), which we did as a hybrid local and online session. The design sessions mostly followed the same pattern. The first 10 minutes of the session (*snack and arrival time*) started with some light chit-chat and games to build relationships. The next 15 minutes (*circle time*) focused on introductions to the session and a “Question of the Day” that helped to prime the children’s thinking around the session. The next 45 minutes (*design time*) were spent on a design activity for us to understand children’s engagements around finances. During design time, children and adults were split into “breakout” rooms of around two children and two adults to work together. The last 15 minutes (*discussion time*) allowed each group to share their design ideas and bring together all the thoughts for everyone to discuss.

We conducted nine design sessions (Table 2), with the early sessions to center broadly on children’s thoughts around finance itself (DS1), and then later to focus specifically on financial issues like credit cards (DS2), parental permission around finances (DS3 – DS4), children’s perceptions of current financial literacy apps (DS5), children redesigning a board game around finances (DS6), and how voice assistants could be integrated with finances (DS7). We concluded the sessions with children redesigning lessons on allowances and money responsibility (DS8) and saving, investing, and comparison shopping (DS9).

### 3.3 Data analysis

We approached this study through inductive methods [22]. We began with an inductive analysis of a total of approximately 540 minutes of online video of the co-design sessions. We had two reviewers of the video data: a primary and secondary reviewer. For each co-design session (DS1 – DS9), the primary reviewer watched the videos, created analytic memos, and transcribed the portions of the co-design sessions that were pertinent to the study. Analytic memos allowed us to review the videos and make our own reflective data and observation [10, 70]. Next, a secondary reviewer looked over the initial analytic memos from the primary reviewer and the

**Table 2: Design Sessions**

Session	Session Overview and Goals	Design Activities Description
DS1 - online	Asking children what they think about learning about money and finances.	We asked children to list 10 questions they had about money and had them draw out technologies that are going to help children learn more about money.
DS2 - online	Having children co-design what they think a credit card should look like for kids	We had children list 10 questions they had about credit cards and had them design their own credit cards.
DS3 - online	How do children ask for permission to buy things online?	We asked children five questions around parental permission and money: what children ask permission for; what children think about asking; what's hard about asking; what's their parents' reaction; and do the children have strategies to get their parents to say yes. We also had them draw a scenario in which children asked for permission about money and purchasing online.
DS4 - online	How would children like to ask for permission to buy things online?	We gave children three tasks: 1) pick a physical item to buy; 2) pick a digital item to buy; and 3) create an app for children to ask their parents' permission for purchasing physical and digital items. We provided children Google Slides and images to help them create their purchasing app.
DS5 - online	What do children think about current financial literacy apps and online games?	We asked children to engage in Line Judging ([85]) to review six apps and games around finances for children: <i>Rooster Money</i> (children's banking app); <i>Bankaroo</i> (children's budgeting app); <i>BusyKid</i> (children's debit card); <i>FamZoo</i> (a site that helps parents teach children good money habits); <i>Star Banks</i> (educational minigame about money); <i>The Game of Life</i> (traditional board game / digital game to simulate growing up and using money).
DS6 - online	Asking children to redesign The Game of Life to understand what they think about finances	We took screenshots from The Game of Life (digital edition) and had the children draw out what they envisioned to make the game better around finances.
DS7 - online	Asking kids to consider how voice assistants could be used for financial literacy	We had the children create a script that would simulate a scenario in which an AI-based voice assistant to help children with their money.
DS8 - hybrid	Using lessons we found online and asking children to make the lessons better (allowances and spending, money responsibility)	We gave screenshots of two lesson plans for grades 3 – 6 on money and had the children redesign the lessons on allowances and spending, and financial responsibility. We used printouts, markers, and sticky notes in this session.
DS9 - online	Using lessons we found online, and asking children to make the lessons better (Saving and investing; comparison shopping)	We gave screenshots of two lesson plans for grades 3 – 6 on money and had the children redesign the lessons on saving, investing, and comparison shopping). We used printouts, markers, and sticky notes in this session.

video data and added their own reflections and observations to the document. Once we completed the analytic memos, we began an inductive coding process.

First, we created a codebook based on our initial development of the analytic memos. We created initial codes, such as how children spent their money, how children used technology to handle money, what questions children had about money, experiences asking their parents' permission, and what positive and negative thoughts children had about money. Over the course of five discussions with the co-authors of this paper, we organized our initial codebook into larger themes. Next, the primary reviewer of the analytic memos began the coding process using the initial codebook. Over the next two group discussions, we updated the codebook to reflect this initial coding process. Once the primary reviewers completed the first round of coding, the secondary reviewers reviewed the codes and

determined points in which they disagreed. We conducted inter-rater reliability through qualitative negotiations and discussions about the disagreements [58]. We went through the disagreements about coding processes and made sure our group came to a consensus. Through axial coding [46], we developed three overarching inductive themes around financial literacy: the modality of money, independence vs. parental supervision, and how children learn about money in the digital age.

#### 4 FINDINGS

We present our findings in three major themes with subthemes: (1) the modality of money; (2) independence and parental supervision around money in its digital form; and (3) how children learn about money in the digital age. We present descriptions of co-design sessions and direct quotes from the children as qualitative evidence

for these themes. For each section, we conclude with a summary analysis of the importance of the theme as it relates to technology and money for children.

#### 4.1 The modality of money

**Physical vs. digital.** Children in our co-design sessions had questions about what money exactly was (modality), especially concerning physical vs. digital currency. In DS1, Hideo noted that “money shouldn’t be money because money is literally paper”. He later noted in DS1 that money is also metal coins because the actual worth of the coins is in the metal. Meanwhile, Melissa also explained that money is the value of something. Both children had an understanding that the physical form of money does not necessarily tie into what its value is. Kristin (DS7, DS8) also wanted to know why other countries had different money. Some children in DS1 asked at what point is video game money the same thing real money.

Children had questions about the relationship between physical money, credit cards, and digital access. In DS2, Matteo wondered about the physicality of money (storage). Hideo had notions that digital money is different from physical money. In DS2 Matteo asked, “how do they store money inside a credit card?” Hideo tried to explain, “it’s just digital money. . . . You can go to a bank and then like show them your credit card and then you can like get money. . . .” Matteo responded, “But I mean, like how is there like money inside a plastic card? That’s what I mean.” Matteo later wondered about what you are allowed to buy with a credit card. Hideo explained that you cannot buy things on Amazon.com with physical cash. Some children had concerns about the transition from cash to digital credit only.

**Unfamiliar digital money concepts.** Children also had thoughts about unfamiliar technology concepts around finances. For instance, in DS1 Matteo said that cryptocurrency was just “online money”, but that he had heard “bad stuff” about it. Hideo did not know what cryptocurrency was, but had heard of Bitcoin and Dogecoin, even explaining to us that Dogecoin was set up as a joke. In later conversations (DS8), Caleb and Kristin try to compare Bitcoin to the concept of foreign currencies. Kristin responded that she did not understand cryptocurrencies herself, but that she thought children should know more about them.

**Summary analysis.** From our examination, we posit children now have a different material relationship with what they think money is. From our co-design sessions, we observe children developing a mental model of what they think money is based on different sources, such as credit cards, digital currency (both real and imaginary), changing store policies against physical cash, storage of currency in digital gift cards, and murmurs of cryptocurrency in the backdrop. We argue it is important to understand this material relationship with money because, as the world becomes more digital, children’s experiences with finances are becoming more diverse. Our co-design sessions demonstrate that children are possibly conflating concepts. Children asked if video game money is the same as real money, if cryptocurrency is just another form of digital money that they can spend, and why money is limited in the real world when there are unlimited amounts of money in fictional video game worlds.

#### 4.2 Independence and parental supervision around money in its digital form

**Parental supervision.** Some co-design partners thought that children still needed some form of parental supervision for technology and finances. In DS2, we asked children to design their own credit cards. Melissa and Yoongi put parental supervision features into her credit card app. Sabina noted, “Okay, it (her design) says it has parent supervision, it’s connected to the app. I wanted it to be able to change the color of the credit cards through the app. And monitoring of money how it’s used and where it’s used.”

**Parental control of technology.** For some children, just because they have money does not mean they can go directly online to make purchases. Matteo (DS3) explained that just because he wanted to buy a cash dispenser gun on Amazon.com did not mean he could do it. His mother was in control of the credit card for Amazon.com. Children also talked about how their parents would not let them order food online because the food would be uneaten and wasted. Sierra expressed that apps and digital games required permission from parents, especially as they controlled the technology. Matteo added (DS3) that even if the apps and games are free, he must still ask permission and his parents will enforce a time limit. Hideo noted that if he asks to make a purchase on the Microsoft Xbox or Nintendo Switch, his parents must unlock the device with a password.

**A need for digital literacies around money.** We posit that while there are affordances in online and digital commerce, children require an updated set of literacies beyond just asking their parents for permission. Children need to develop heightened awareness of how designs like in-app purchases and subscription models manipulate their customers to make the sticky sale; and similarly, how these designs are root issues for needing parental supervision routines in the absence of any other support mechanisms. However, children need to navigate these digital realities with their parents beyond a sale or no-sale binary, and perhaps with more cooperative learning opportunities for families to experience alternatives together. For example, children in KidsTeam UW critiqued Apple iOS “Ask to Buy” feature in which children can ask permission for parents to purchase apps in the App Store. The children expressed that while “Ask to Buy” is a simple transaction of yes or no, asking parents for financial permission is complex and emotional. This design contradicts prior research on children’s financial literacy suggesting that designs should provide opportunities for parents to participate in teaching financial knowledge and skills [32, 81, 83], financial socialization in families and schools [25, 26, 83], numeracy development [32], and direct experiences with money [25].

During DS4, Sierra said that her parents must give her approval to buy something, which is hard because a lot of the items she wants require parental approval. In the design of new technologies for permissions (DS5), children developed apps that helped them plan out how to convince their parents towards financial purchases. One group discussed a potential app that provides children strategies for how to ask their parents’ permission for finances. Another group worked on parents putting “money limits” on what is fine to ask for. Shiro wanted a “persuasion app” that could be used to tell him what to say in a situation to ask his parents for permission around money (DS3). Jin created an app to allow other siblings to “+1” any request

of parents that they agreed with. As designers, we might consider that as children and families work through what is allowed or not allowed in purchases, they could develop new literacies around digital commerce that helps children make more sense of the kinds of manipulations that exist around commerce and digital purchases.

**A need for supervision around digital purchases.** Children had ideas around how technology influences their confidence levels and attitudes around money. In KidsTeam UW, children had different perceptions of what they thought was mature behavior around finances for children with technology. For instance, Jin was surprised that children could even have access to a child's version of a debit card (DS5), "You know, like, kids, what's a seven-year-old is going to do with 20 bucks (on a debit card). They're gonna spend it on toys." Jin has a perception of herself as older (age 12) and more responsible with money than children who are younger than her. Caleb (DS8) also agreed that credit cards would be too risky for children, and that children's debit cards are better.

**Summary analysis.** Based on these sessions, we believe children's relationship with monetary independence and supervision is now based on their digital relationships with money. For instance, teaching children about money is not just about traditional financial literacies, such as numeracy, delayed gratification executive function, financial concepts, or budgeting. What is unique about commerce in digital environments is that children (and their families) need a different lens on how digital marketing and sales mechanisms work. Take for example, free digital games and in-app purchases, a business model that maximizes a larger quantity of views and interactions on the game because it's offered for "free". Freemium games have manipulations designed for children to believe they need or want digital purchases. While KidsTeam UW children wanted different ways to negotiate with their parents about downloading free games or getting in-app purchases, the children in our sessions did not mention knowing about these market manipulations. We believe families may also have a less critical eye, and only focus on supervision and gatekeeping mechanisms for purchases. The question of parental supervision and children's developing independence has the potential to focus more on how families can learn together around these heightened situations.

### 4.3 How children learn about money in the digital age

**Social interactions.** Although children need to develop financial skills and abilities, KidsTeam UW children discouraged homework style organizational skills embedded in digital design. Jin (DS8) noted that children do not like charts and worksheets that help them organize their finances. Technologies that use charts and worksheets do not account for the reality of how children interact and spend money. Children also explained that technology designs that try to help them develop the ability to compare prices does not consider their inability to go to every store to compare the prices. Hideo (DS8) explained that for comparison shopping, "instead of having good stuff, you (the technology) must have the essentials." Maria (adult) asked if children would go around to different grocery stores and compare each price, to which Hideo said no. Hideo tried to remember the prices after looking at them but felt that people only go to a different store if the item is not there.

Unsurprisingly the main social influence in which the children of KidsTeam UW learned about digital finances was through their parents [26, 32, 83, 93]. Children also mentioned that they learned about money simply by watching their parents' financial interactions online, mostly when his parents buy things online. Matteo said he learned about money as he started earning small amounts and spending it through online shopping on Amazon.com with his parents. Children also talked about learning about finances from their friends. In DS1, Tom (adult) joined in a conversation and asked children about payments using Venmo and PayPal. Melissa explained some children she knew used that and have that, but she personally does not. She said she knows about digital payments since some friends talk about it.

**Digital technologies.** KidsTeam UW children did refer to children's apps they used to spend and save money (e.g., digital debit cards). Caleb referred to BusyKid (<https://busykid.com>) as a way his parents structure his spending digitally. Children also talked about the work they did to earn money. For Hideo (DS3), he would do chores and record them on an app called Mellow (<https://mellowmoney.com>). Chore amounts would be converted to points that he could spend online. At the same time, children are also using digital tools designed for adults. In DS5, Yoongi recalled, "Just use like Google Pay or something." Jon (adult) was surprised by her response about Google Pay, and Yoongi justified, "Yeah, whatever it's called. My sister has it. . . And like you can set limits on it."

Melissa said that video games are an easier medium to learn and process financial information. For example, Hideo noted that he does not have a bank account, but in Minecraft there is a mini game called Hipixel SkyBlock (SkyBlock), with a digital bank. In SkyBlock, the money increases the longer you keep your funds in the bank. Similarly, children in KidsTeam UW talked much about Animal Crossing and how they better understood rent and mortgages (DS9). Hideo and Melissa noted that the "bells" (game currency) in Nintendo's Animal Crossing do not mean anything in real life. However, Hideo noted there could be a transitional point where the bells mean money to somebody. Haile added that Nintendo does convert cash into a point system to spend on games. Some children had a poor perception of digital games teaching them financial lessons.

During DS5, Jin had strong opinions on digital games and finances: "I've got a lot to say about this one. This is the game. Kids, they're gonna be focused on the game, not the financial learning. They're gonna forget it overnight, and then they're gonna come back and be like, What the heck is this? What is this stupid game? It's just Candy Crush." Jin explained that children are just distracted by digital games, and not the main goal of how to be fiscally responsible. Children also learned about finances through video games through in-game purchases in Fortnite (DS3), in which they must constantly ask their parents for permission.

**Summary analysis.** Through co-design, KidsTeam UW children discussed two forms of learning about digital finances. First, children learned from direct instruction, such as parent modeling how to use Amazon.com, parents giving permission to make digital purchases, and children using specific financial apps (Apple Pay, Google Pay, Venmo, BusyKid). Children in KidsTeam UW reacted poorly to the specific forms of direct instruction, such as online

budgeting lessons and specific edutainment video games about finances. Most importantly, KidsTeam UW children brought up a second form of learning, that is, the hidden curriculum [3] of digital finances, the amorphous collection of implicit, unspoken, and unwritten social and cultural messages around digital finances. These ways of learning about digital money are embedded in subtle ways such as fictional currency in video games, side conversations with parents about digital money, and watching friends use new forms of digital payments. In the hidden curriculum, there are also digital literacy skills and critical awareness that some children may be picking up subtly. Whether specific explicit or implicit hidden curriculum, we argue children in the digital age face new challenges, whether it is helping children navigate wisely around digital advertising, deceptive dark patterns, and digital misinformation around money that leads to their parents. Even helping children be aware of the modality of money becomes important, given that physical money is fading away, and children are literally not able to touch what money is anymore on a regular basis.

## 5 DISCUSSION

We outline our discussion in three parts: (1) the need for research in child-computer interaction and digital finances; (2) methodology issues in co-design with children around digital finances; and (3) implications for design.

### 5.1 The need for child-computer interaction and digital finances

Our co-design findings demonstrate that children's relationship to money can be quite complex in the digital world. Children are faced with figuring out what money means in a world that transitions to less physical interactions with money (e.g., cash). Children also have multiple means of access to money through digital means, such as digital debit cards for children, access to online shopping, in-app purchases, and the use of adult-designed finance tools (e.g., *Google Pay*, *Apple Pay*). As such, teaching children about money is not only about traditional financial literacy skills, such as budgeting and savings [30], numeracy [36], financial concepts [2, 30] and executive function [36]. Such traditional skills and education development in children currently have little to say about the material relationships children have with digital forms and access to money. In addition, because children's access to finances are digital, deceptive financial designs exist that target children online, such as financial mis/disinformation for children [38], deceptive dark patterns trying to get children to spend more [93], online advertisements targeting children [12], financial aid scams [38], and online influencers [18]. The findings of this co-design experience show that children struggle with three tensions around digital finances that child-computer interaction researchers can take a note of.

*Tension 1: What is money?* One contribution of our research findings shows that children's mental models of digital money are expanding and becoming more diverse. Understanding money and its digital forms is not just about content knowledge, such as understanding how a digital debit card works or knowing how to transfer money from one digital account to another. The overarching issue we have noticed is children's conflation about the different forms of digital assets that exist. Children in this study

mixed digital payments, video game currency, in-app purchasing, and even cryptocurrency together into a single concept of money in its digital form. Since children may not be accessing money in its physical form as much, the concept of money in digital form can be harder to grasp. For instance, learning sciences research work in embodied cognition notes the importance of physical manipulation, sensorimotor feedback, gestural interfaces, and direct manipulation as ways for children to learn [11]. With less embodied interactions with physical cash, the concept of money becomes more abstract for people. For example, as society transitions to the cashless society, scholars in business note that a new form of digital competence needs to take place, one that helps people understand the flow of money without physical movement of cash but using digital credit and debit cards and online payments [72]. We believe child-computer interaction researchers and designers can think about work that could help children understand digital payment systems through embodiment or other theories of learning.

*Tension 2: What are children's needs for financial independence vs. family supervision?* A second contribution of our findings reveals a tension around independence and supervision in children's digital finances. Children in this study mostly talked about the gatekeeping mechanism their parents and families have around digital purchases. However, we know very little about how designs in child-computer interaction can help families learn together, especially as safety, privacy, scams, dark patterns, and other pitfalls exist in digital finances. For instance, child development scholars note the importance of children and parents to negotiate risk, safety, and danger together [72]. To consider negotiations between children and families around digital finances, it is important for designers to think about how to transition children from thinking about their relationships to digital tools and finance as gatekeeping, and instead towards financial independence. The notion of risk and safety is fluid, contingent, and contextual, with perceptions of temporal changes, behaviors, and responsibility. Child-computer interaction researchers interested in digital finances can learn from online safety and privacy researchers that study child-family negotiations. For instance, Ghosh et al.'s [29] work in *Circle of Trust* highlights how transitions from adolescent regulation of online safety can be designed around negotiation. Similarly, a trust development design perspective could take place within families and children.

*Tension 3: How do children learn about digital finances?* Finally, the third contribution of our findings notes the tension in children in learning about digital finances, from direct instruction to implicit learning from the hidden curriculum [3]. Children in the digital age engage in a multiplicity of different ways to learn about digital finances. There is a ripe opportunity to re-design experiences that children have with currency, purchases, and financial literacy in general – through the digital interactions they have with apps and games for example – that perhaps scaffold different learning processes. Some interactions might directly instruct children on key aspects of financial literacy. For example, during the process of making a purchase, perhaps apps might scaffold children to reflect on key considerations. Other interactions could be designed to expand children's access to hidden curriculum experiences, by perhaps making them aware of other children and family strategies

around finances, connecting children safely with other peers for social modeling, or facilitating generative parent-child conversations around key issues.

## 5.2 The value-laden issues of co-designing for financial literacy

In the US, there is an old saying, "Never talk about money, politics or religion at the dinner table." This study was an attempt at co-designing for a specific and sensitive topic around digital finances [28]. As child-computer interaction studies have so few studies on co-design and children's financial literacy [31], it is important for us to critically reflect on our process. Children's co-design of financial literacy involves value-laden issues that are a part of money, capitalism, and citizenship [5, 6]. Prior work on co-designing with youth has taken on sensitive topics such as privacy and security [16, 49], creepiness of technology [90], gender and sexuality [52], and online safety and cyberbullying [7, 8]. However, a contribution of this study demonstrates that personal finance and children's co-design can have some thorny issues to carefully consider in co-design.

Our stance positions co-design as a fruitful methodology for understanding and designing for children's financial literacy. Co-design has the potential for adults and children to think about how to be critical actors in the financial system [5, 41]. For instance, children in these co-design sessions had critical questions on why rich and poor individuals exist in society, why money is used, what exploitations occur with technology and finances, and the relationship between their emotions and money. We believe that co-designing with children around financial literacy and technology can help children articulate critical questions about themselves and their underlying assumptions around finances.

Some of the opinions of the children in these co-design sessions are also value-propositions [24] that some take as some form of personal truths. Children had opinions about what they considered wasteful uses of money, what they thought was good spending and saving, who should be able to spend money, the relationship between happiness and money, and financial inequities. Some children had binary perspectives of good rich and bad poor, good saving and bad wasting, and happy vs. unhappy with wealth gains. Some children in the co-design session also recognized that their peers did have more (or less) financial resources than they did, which introduced some level of awkwardness.

Overall, considerations of design for youth financial literacy from co-design need to be approached with sensitivity. Reflexively [86], we need to critically think about questions of how to approach values, co-design, technology, and finances for children. Do we create digital designs that help children accrue more money through a "neutral" perspective that still assumes and perpetuates invisible values? Do we create digital designs that help children and families learn about financial literacy, but also critically reflect on their own their values on money? How do we design wisely for financial literacy for children without exacerbating (if possible) greed, selfishness, and social inequities?

Recently, Smith et al. [76] coined the term "mindfulness for financial literacy" to refer to the need to support financial education

in dealing with issues of envy, greed, and other problems associated with humans and money. Mindfulness strategies for finances can include intention in creating goals, emotional regulation, and increasing mental and physical health. Lucey and Henning [55] created the idea of "compassionate financial literacy" which is the notion of integrating arts-based education with financial education to consider issues of social justice. As an alternative to traditional notions, compassionate financial literacy encourages financial learners to think about citizenship and develop a sense of worth beyond financial attachments. Whether mindfulness or compassion, we advocate for designers considering youth financial literacy work to set the stage with children earlier about values related to finances. Portions of our study could have better integrated these concepts, such as co-designing for selflessness and finances, donations, and reflection of financial and citizenship values. We do believe more work needs to be taken place in co-designing for children's financial literacy so that we can better understand the relationship with children, technology, values, and finances.

## 5.3 Design implications

We provide two design contributions for this work: designing for a family team perspective and integrating prior financial technologies into youth financial education programs. Current technological designs around youth and financial literacy focus on "piecemeal" concepts. Children's budgeting apps [80] emphasize how to gain financial skills and support positive financial behavior, but we do not know what actual knowledge children are developing around money (e.g., modality, digitalization of money) and how their perceptions and attitudes are affected (e.g., positive / negative views). In contrast, digital financial games [79] may help children develop actual knowledge around how finances work but may not help us understand how children's actual financial skills (e.g., organization skills), perceptions, and behaviors are affected. As financial literacy for children (and people) is developed over the course of years (or a lifetime), it can be difficult then to gauge how children's financial literacy develops without a bigger picture.

HCI researchers note the importance of technologies for wellness designed from a family team perspective [64]. Financial socialization is an important aspect of children's development in financial literacy [77, 84]. However, parental involvement in design is not well developed in financial education programs [84]. For instance, some parents have hesitation to participate in financial education programs due to skepticism, unfamiliarity, and lack of experience [9, 84]. We also observe the same need that financial socialization and parental involvement is not developed well in technology designs. We suggest moving away from isolated technology designs for children towards an approach that integrates parental trust and family learning opportunities in the aspects of financial literacy.

We can also consider the organization and evaluation possibilities for youth financial education programs. In a large-scale review of financial education programs for youth in the United States [44], few programs considered the integration of digital technologies. Most of the technologies in these programs are meant for digital online distribution of learning materials. Educators and learning designers can expand their thinking about how to evaluate and integrate digital technologies into financial education programs. For

instance, to determine the potential of new technologies in financial education, technologists could collect different piecemeal financial literacy technologies [23, 82] and evaluate how the technologies connect and influence children's actual financial knowledge, perceived knowledge, skills, behaviors, and trust development.

## 6 LIMITATIONS AND FUTURE WORK

We developed our themes with ten children and nine co-design sessions in a single geographic region in the Pacific Northwest, US. All the children have extensive experience with technology and co-design. Therefore, our findings and discussions are formative theoretical generalizations, not statistical generalizations [89]. Our work is guided by Lincoln and Guba's prioritization of information richness, rather than probabilistic sampling [53]. Future work in this area needs to determine how robust our themes are. Three groups of children are siblings, therefore, some of what they indicated in the co-design is influenced by their own home interactions and parents. Our intense work with children has positive aspects, such as children who are unafraid of sharing their opinions with adults, working well together, and having healthy disagreements.

At the same time, we have limitations such as being able to fully comprehend the perspectives of diverse populations and families (e.g., different SES groups, recent immigrants, etc.). We contend this research is not the end but a starting point for child-computer interaction researchers to consider more about financial literacy with children in the digital age. We also conducted this work alone with children. Future work could incorporate parental and educators' perspectives, experiences, and opinions to expand our knowledge on children's perceptions of money in the digital age. Future surveys, experimental studies, interviews, and other methods could be used to validate the themes and generate new understandings. Finally, additional work needs to also consider the role that culture, and other ecological factors have in influencing how children think about financial literacy and technologies.

## 7 CONCLUSION

By working closely with children through PD methods, we were able to better understand how technology relates to children's mental models about financial literacy, and how their experiences relate as a sociotechnical system across social, cultural, familial, and technological domains. The importance of continuing this area of research remains substantial. While financial literacy does play a large influence in people's financial situations, we note that global financial crises [25], inequity and privilege backgrounds [65], corruption [33], and systemic racism [32, 65] are also at the core of many financial issues beyond the individual. As Kentaro Toyama quotes [83], "we as a society fool ourselves into believing that the world's problems can be solved by enlightened consumerism." Instead, we believe that understanding and engaging with children's perceptions of financial literacy and technology helps us to consider designs that can start conversations around finances, demonstrate transparency in the financial sectors, and help families develop supportive dialogues and trust with each other.

## 8 SELECTION AND PARTICIPATION OF CHILDREN

Children who participated in our study were already engaged in KidsTeam UW. Recruitment for KidsTeam UW children involved using flyers, mailing lists, and snowball sampling. The team is open to children ages 6-11. All the parents and guardians of child participants in KidsTeam UW signed an assent (children) and consent (parents) form. We informed both parents and children about the aims of the study, safety risks, and confidentiality and privacy measures. During the consent process, we indicated both parents and children were free to withdraw at any time. Researchers acted as facilitators and watched for children to make sure they did not feel under any pressure to participate in the study activities. All research has been approved by our university's Institutional Review Board. All adult facilitators go through ethics and safety training for children at our institution. All children's data were anonymized for the analysis and stored on a secure server.

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## REFERENCES

- [1] Liezel Alsemgeest. 2015. Arguments for and against financial literacy education: where to go from here? *International Journal of Consumer Studies* 39, 2 (2015), 155–161. DOI: <https://doi.org/10.1111/ijcs.12163>
- [2] Aisa Amagir, Wim Groot, Henriëtte Maassen van den Brink, and Arie Wilschut. 2018. A review of financial-literacy education programs for children and adolescents. *Citizenship, Social and Economics Education* 17, 1 (April 2018), 56–80. DOI: <https://doi.org/10.1177/2047173417719555>
- [3] Jean Anyon. 2017. Social class and the hidden curriculum of work. In *Childhood socialization*. Routledge, Oxfordshire, UK, 369–394.
- [4] Nikolaos Artavanis and Soumya Karra. 2020. Financial literacy and student debt. *The European Journal of Finance* 26, 4–5 (March 2020), 382–401. DOI: <https://doi.org/10.1080/1351847X.2019.1711435>
- [5] Chris Arthur. 2012. Consumers or critical citizens? Financial literacy education and freedom. *Critical Education* 3, 6 (2012). DOI: <https://doi.org/10.14288/ce.v3i6.182350>
- [6] Chris Arthur. 2012. Financial literacy education for citizens: What kind of responsibility, equality and engagement? *Citizenship, Social and Economics Education* 11, 3 (2012), 163–176. DOI: <https://doi.org/10.2304/csee.2012.11.3.163>
- [7] Karla Badillo-Urquiola, Zachary Shea, Zainab Agha, Irina Lediaeva, and Pamela Wisniewski. 2021. Conducting risky research with teens: co-designing for the ethical treatment and protection of adolescents. In *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW3, 2021, 1–46. <https://doi.org/10.1145/3432930>
- [8] Karla Badillo-Urquiola, Diva Smriti, Brenna McNally, Evan Golub, Elizabeth Bonsignore, and Pamela J. Wisniewski. 2019. Stranger danger! social media app features co-designed with children to keep them safe online. In *Proceedings of the 18th ACM International Conference on Interaction Design and Children*, 394–406. <https://doi.org/10.1145/3311927.3323133>
- [9] Neil Bhutta, Jesse Bricker, Andrew C. Chang, Lisa J. Dettling, Sarena Goodman, Joanne W. Hsu, Kevin B. Moore, Sarah Reber, Alice Henriques Volz, and Richard Windle. 2020. *Changes in U.S. Family Finances from 2016 to 2019: Evidence from the Survey of Consumer Finances*. Social Science Research Network, Rochester, NY. Retrieved September 14, 2022 from [https://papers.ssrn.com/abstract=\\$3716339](https://papers.ssrn.com/abstract=$3716339)
- [10] Melanie Birks, Ysanne Chapman, and Karen Francis. 2008. Memoing in qualitative research: Probing data and processes. *Journal of research in nursing* 13, 1 (2008), 68–75. DOI: <https://doi.org/10.1177/1744987107081254>
- [11] John B. Black, Ayelet Segal, Jonathan Vitale, and Cameron L. Fadjjo. 2012. Embodied cognition and learning environment design. In *Theoretical foundations of learning environments*. Routledge, Oxfordshire, UK, 198–223.
- [12] Sandra L. Calvert. 2008. Children as consumers: Advertising and marketing. *The future of children* 18, 1 (2008), 205–234. DOI: <https://doi.org/10.1353/foc.0.0001>
- [13] Bryan Caplan. 2000. Rational Irrationality: A Framework for the Neoclassical-Behavioral Debate. *Eastern Economic Journal* 26, 2 (2000), 191–211.
- [14] Carolyn Carter. 2022. Predatory Installment Lending in the States (2022). *National Consumer Law Center*. Retrieved January 18, 2023 from <https://www.nclc.org/>

- resources/predatory-installment-lending-in-the-states-2022/
- [15] Neeraj Chatlani, Zachary Shea, and Pamela Wisniewski. 2020. Teenovate: using intergenerational participatory design to teach students about adolescent online safety. In *Chatlani, Neeraj and Shea, Zachary and Wisniewski, Pamela, Teenovate: Using Intergenerational Participatory Design to Teach Students about Adolescent Online Safety (June 18, 2020). Teaching CCI Workshop of the 2020 ACM Interaction Design and Children Conference*. <http://dx.doi.org/10.2139/ssrn.3786322>
  - [16] Chhaya Chouhan, Christy M. LaPerriere, Zaina Aljallad, Jess Kropczynski, Heather Lipford, and Pamela J. Wisniewski. 2019. Co-designing for community oversight: Helping people make privacy and security decisions together. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–31. <https://doi.org/10.1145/3359248>
  - [17] Arianna Davis, Neeraj Chatlani, Karla Badillo-Urquiola, and Pamela Wisniewski. 2021. Teenovate-Using Participatory Action Research to Create a Sustainable Teen Program Designing Adolescent Online Safety Solutions. <http://dx.doi.org/10.2139/ssrn.3882835>
  - [18] Marijke De Veirman, Liselot Hudders, and Michelle R. Nelson. 2019. What is influencer marketing and how does it target children? A review and direction for future research. *Frontiers in psychology* 10, (2019), 2685. DOI: <https://doi.org/10.3389/fpsyg.2019.02685>
  - [19] B. DiSalvo, J Yip, E Bonsignore, and C. DiSalvo (Eds.). 2017. *Participatory design for learning - Perspectives from practice and research* (1st ed.). Routledge, Oxfordshire, UK.
  - [20] Allison Druin. 2002. The role of children in the design of new technology. *Behaviour and Information Technology* 21, 1 (2002), 1–25. DOI: <https://doi.org/10.1080/01449290110108659>
  - [21] Adriana Espinosa and Sasha Rudenstine. 2020. The contribution of financial well-being, social support, and trait emotional intelligence on psychological distress. *British Journal of Clinical Psychology* 59, 2 (2020), 224–240. DOI: <https://doi.org/10.1111/bjc.12242>
  - [22] Jennifer Fereday and Eimear Muir-Cochrane. 2006. Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International journal of qualitative methods* 5, 1 (2006), 80–92. DOI: <https://doi.org/10.1177/160940690600500107>
  - [23] B. Frańczek. 2016. Usage of internet technology in financial education and financial inclusion by students of economics universities. *International Journal of Economics and Management Engineering* 10, 9 (2016), 3209–3217. DOI: <https://doi.org/10.5281/zenodo.1127040>
  - [24] Batya Friedman. 1996. Value-sensitive design. *Interactions* 3, 6 (1996), 16–23. DOI: <https://doi.org/10.1145/242485.242493>
  - [25] Gerry Gallery and Natalie Gallery. 2010. Rethinking Financial Literacy in the Aftermath of the Global Financial Crisis. *Griffith Law Review* 19, 1 (January 2010), 30–50. DOI: <https://doi.org/10.1080/10854667.2010.10854667>
  - [26] Zurishaddai A. Garcia, Dave Francis, Amanda Christensen, Stacey S. MacArthur, Margie Memmott, and Paul A. Hill. 2017. The Money Mentors Program: Increasing Financial Literacy in Utah Youths. *The Journal of Extension* 55, 6 (2017).
  - [27] Kristopher Gerardi. 2010. Financial Literacy and Subprime Mortgage Delinquency: Evidence from a Survey Matched to Administrative Data. DIANE Publishing.
  - [28] Paul Gerrans and Douglas A. Hershey. 2017. Financial Adviser Anxiety, Financial Literacy, and Financial Advice Seeking. *Journal of Consumer Affairs* 51, 1 (2017), 54–90. DOI: <https://doi.org/10.1111/joca.12120>
  - [29] Arup Kumar Ghosh, Charles E. Hughes, and Pamela J. Wisniewski. 2020. Circle of trust: a new approach to mobile online safety for families. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–14. <https://doi.org/10.1145/3313831.3376747>
  - [30] Antonia Grohmann, Roy Kouwenberg, and Lukas Menkhoff. 2015. Childhood roots of financial literacy. *Journal of Economic Psychology* 51, (2015), 114–133. DOI: <https://doi.org/10.1016/j.joep.2015.09.002>
  - [31] Thilina Hallowuwa, Dhaval Vyas, Hakim Usoof, Pradeepa Bandara, Margot Brereton, and Priyantha Hewagamage. 2017. Designing for Financial Literacy: Co-design with Children in Rural Sri Lanka. In *Human-Computer Interaction - INTERACT 2017 (Lecture Notes in Computer Science)*, Springer International Publishing, Cham, 313–334. [https://doi.org/10.1007/978-3-319-67744-6\\_21](https://doi.org/10.1007/978-3-319-67744-6_21)
  - [32] Darrick Hamilton and William A. Darity. 2017. *The Political Economy of Education, Financial Literacy, and the Racial Wealth Gap*. Social Science Research Network, Rochester, NY. DOI: <https://doi.org/10.20955/r.2017.59-76>
  - [33] Harun Harun, Peter Graham, Haryono P. Kamase, and Monir Mir. 2021. A Critical Analysis of the Impacts of Financial Literacy and NPM on Village Funds Initiative in Indonesia. *International Journal of Public Administration* 44, 4 (March 2021), 336–345. DOI: <https://doi.org/10.1080/01900692.2020.1722165>
  - [34] Einar Heiervang and Robert Goodman. 2011. Advantages and limitations of web-based surveys: evidence from a child mental health survey. *Social Psychiatry and Psychiatric Epidemiology* 46, 1 (2011), 69–76. DOI: <https://doi.org/10.1007/s00127-009-0171-9>
  - [35] Amanda Hess (April 26, 2022). Does a Toddler Need an NFT? *The New York Times*. <https://www.nytimes.com/2022/04/26/arts/nft-zigazoo-qai-qai.html>
  - [36] Karen Holden, Charles Kalish, Laura Scheinholtz, Deanna Dietrich, and Beatriz Novak. 2009. Financial literacy programs targeted on pre-school children: Development and evaluation. *La Follette Working Papers*. Available at: <http://digital.library.wisc.edu/1793/36314>
  - [37] Cassidy Horton. 2022. The best debit cards for kids for 2022. Retrieved September 11, 2022 from <https://www.finder.com/debit-cards-for-kids>
  - [38] Philip N. Howard, Lisa-Maria Neudert, Nayana Prakash, and Steven Vosloo. 2021. Digital misinformation/disinformation and children. UNICEF. Retrieved February 20, 2021 from <https://www.unicef.org/globalinsight/stories/digital-misinformation-disinformation-and-children>
  - [39] Angela Hung, Andrew M. Parker, and Joanne Yoong. 2009. Defining and measuring financial literacy. *RAND Working Paper Series WR-708* (2009). DOI: <https://dx.doi.org/10.2139/ssrn.1498674>
  - [40] Sandra J. Huston. 2010. Measuring Financial Literacy. *Journal of Consumer Affairs* 44, 2 (2010), 296–316. DOI: <https://doi.org/10.1111/j.1745-6606.2010.01170.x>
  - [41] Moritz Hütten, Daniel Maman, Zeev Rosenhek, and Matthias Thiemann. 2018. Critical financial literacy: an agenda. *International Journal of Pluralism and Economics Education* 9, 3 (2018), 274–291. DOI: <https://doi.org/10.1504/IJPEE.2018.10013932>
  - [42] Yuwei Jiang, Zhansheng Chen, and Robert S. Wyer. 2014. Impact of money on emotional expression. *Journal of Experimental Social Psychology* 55, (November 2014), 228–233. DOI: <https://doi.org/10.1016/j.jesp.2014.07.013>
  - [43] Panu Kalmi and Tanja Sihvonen. 2021. Education or entertainment?: On the potential of games in financial education. In *The Routledge Handbook of Financial Literacy*. Routledge, London UK, 259–273.
  - [44] Matt Kasman, Benjamin Heuberger, and Ross A. Hammond. 2018. A review of large scale youth financial literacy education policies and programs. *The Brookings Institution*. Available at: [https://www.brookings.edu/wp-content/uploads/2018/10/ES\\_20181001\\_Financial-Literacy-Review.pdf](https://www.brookings.edu/wp-content/uploads/2018/10/ES_20181001_Financial-Literacy-Review.pdf)
  - [45] Matewos Kebede Navkihiran jit Dhalual Kaur and Jasmeendeep Kuar. 2015. Financial Literacy and Management of Personal Finance: A Review of Recent Literatures. *Research Journal of Finance and Accounting* 6, 13 (2015), 92.
  - [46] Judy Kendall. 1999. Axial Coding and the Grounded Theory Controversy. *Western Journal of Nursing Research* 21, 6 (December 1999), 743–757. DOI: <https://doi.org/10.1177/019394599902100603>
  - [47] Leora Klapper and Annamaria Lusardi. 2020. Financial literacy and financial resilience: Evidence from around the world. *Financial Management* 49, 3 (2020), 589–614. DOI: <https://doi.org/10.1111/fima.12283>
  - [48] Bilgehan Kubilay and Ali Bayraktaroglu. 2016. An Empirical Research on Investor Biases in Financial Decision-Making, Financial Risk Tolerance and Financial Personality. *International Journal of Financial Research* 7, 2 (February 2016), 171. DOI: <https://doi.org/10.5430/ijfr.v7n2p171>
  - [49] Priya Kumar, Jessica Vitak, Marshini Chetty, Tamara L. Clegg, Jonathan Yang, Brenna McNally, and Elizabeth Bonsignore. 2018. Co-designing online privacy-related games and stories with children. In *Proceedings of the 17th ACM conference on interaction design and children*, 67–79. <https://doi.org/10.1145/3202185.3202735>
  - [50] Jae Min Lee, Narang Park, and Wookjae Heo. 2019. Importance of Subjective Financial Knowledge and Perceived Credit Score in Payday Loan Use. *International Journal of Financial Studies* 7, 3 (September 2019), 53. DOI: <https://doi.org/10.3390/ijfs7030053>
  - [51] Kung Jin Lee, Wendy Roldan, Tian Qi Zhu, Harkiran Kaur Saluja, Sungmin Na, Britnie Chin, Yilin Zeng, Jin Ha Lee, and Jason Yip. 2021. The show must go on: A conceptual model of conducting synchronous participatory design with children online. In *Proceedings of the 2021 CHI conference on human factors in computing systems*, 1–16. DOI: <https://doi.org/10.1145/3411764.3445715>
  - [52] Calvin A. Liang, Katie Albertson, Florence Williams, David Inwards-Breland, Sean A. Munson, Julie A. Kientz, and Kym Ahrens. 2020. Designing an online sex education resource for gender-diverse youth. In *Proceedings of the Interaction Design and Children Conference (IDC '20)*, Association for Computing Machinery, New York, NY, US, 108–120. DOI: <https://doi.org/10.1145/3392063.3394404>
  - [53] Yvonna S. Lincoln and Egon G. Guba. 1985. *Naturalistic Inquiry*. SAGE, Newbury Park, CA, US.
  - [54] Chang Liu, Teresa Franklin, Roger Shelor, Sertac Ozercan, Jarrod Reuter, En Ye, and Scott Moriarty. 2011. A learning game for youth financial literacy education in the teen grid of second life three-dimensional virtual environment. *American Journal of Business Education* 4, 7 (2011), 1–18. DOI: <https://doi.org/10.19030/ajbe.v4i7.4670>
  - [55] Thomas A. Lucey and Mary Beth Henning. 2021. Toward critically compassionate financial literacy: How elementary preservice teachers view the standards. *Theory & Research in Social Education* 49, 1 (January 2021), 107–136. DOI: <https://doi.org/10.1080/00933104.2020.1859422>
  - [56] Annamaria Lusardi and Olivia S. Mitchell. 2011. Financial literacy around the world: an overview. *Journal of Pension Economics & Finance* 10, 4 (October 2011), 497–508. DOI: <https://doi.org/10.1017/S1474747211000448>
  - [57] Jessica Martel. 2022. Financial Literacy Videos for Kids. *Penny Pinchin' Mom*. Retrieved from <https://www.pennypinchinmom.com/financial-literacy-videos-kids/>.
  - [58] Nora McDonald, Sarita Schoenebeck, and Andrea Forte. 2019. Reliability and inter-rater reliability in qualitative research: Norms and guidelines for CSCW and HCI practice. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW

- (2019), 1–23. DOI: <https://doi.org/10.1145/3359174>
- [59] Brenna McNally, Priya Kumar, Chelsea Hordatt, Matthew Louis Mauriello, Shalmali Naik, Leyla Norooz, Alazandra Shorter, Evan Golub, and Allison Druin. 2018. Co-designing mobile online safety applications with children. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–9. DOI: <https://doi.org/10.1145/3173574.3174097>
- [60] Heather Morton. 2021. Financial Literacy 2021 Legislation. Retrieved September 11, 2022 from <https://www.ncsl.org/research/financial-services-and-commerce/financial-literacy-2021-legislation.aspx>.
- [61] OECD. Organisation for Economic Co-operation and Development (OECD). 2017. *PISA 2015 Results (Volume IV) Students' Financial Literacy*. Retrieved from <https://www.oecd.org/education/pisa-2015-results-volume-iv-9789264270282-en.htm>.
- [62] Andrew Perrin. 2021. 16% of Americans say they have ever invested in, traded or used cryptocurrency. *Pew Research Center*. Retrieved September 11, 2022 from <https://www.pewresearch.org/fact-tank/2021/11/11/16-of-americans-say-they-have-ever-invested-in-traded-or-used-cryptocurrency/>.
- [63] Laura R. Pina, Carmen Gonzalez, Carolina Nieto, Wendy Roldan, Edgar Onofre, and Jason C. Yip. 2018. How Latino Children in the U.S. Engage in Collaborative Online Information Problem Solving with their Families. In *Proceedings of the ACM Human-Computer Interaction 2*, CSCW (November 2018), 140:1-140:26. DOI: <https://doi.org/10.1145/3274409>
- [64] Laura R. Pina, Sang-Wha Sien, Teresa Ward, Jason C. Yip, Sean A. Munson, James Fogarty, and Julie A. Kientz. 2017. From Personal Informatics to Family Informatics: Understanding Family Practices around Health Monitoring. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*, Association for Computing Machinery, New York, NY, USA, 2300–2315. DOI: <https://doi.org/10.1145/2998181.2998362>
- [65] Laura Elizabeth Pinto and Eliabeth Coulson. 2011. Social Justice and the Gender Politics of Financial Literacy Education. *Journal of the Canadian Association for Curriculum Studies* 9, 2 (December 2011), 54–85.
- [66] James Poterba, Joshua Rauh, Steven Venti, and David Wise. 2007. Defined contribution plans, defined benefit plans, and the accumulation of retirement wealth. *Journal of Public Economics* 91, 10 (November 2007), 2062–2086. DOI: <https://doi.org/10.1016/j.jpubeco.2007.08.004>
- [67] Richard H. Price, Jin Nam Choi, and Amiram D. Vinokur. 2002. Links in the chain of adversity following job loss: How financial strain and loss of personal control lead to depression, impaired functioning, and poor health. *Journal of Occupational Health Psychology* 7, (2002), 302–312. DOI: <https://doi.org/10.1037/1076-8998.7.4.302>
- [68] David J. Purpura, Laura E. Hume, Darcey M. Sims, and Christopher J. Lonigan. 2011. Early literacy and early numeracy: The value of including early literacy skills in the prediction of numeracy development. *Journal of Experimental Child Psychology* 110, 4 (December 2011), 647–658. DOI: <https://doi.org/10.1016/j.jecp.2011.07.004>
- [69] Aldrich Rasco, Johnny Chan, Gabrielle Peko, and David Sundaram. 2020. Fincraft: immersive personalised persuasive serious games for financial literacy among young decision-makers. In *Proceedings of the 53rd Hawaii International Conference on System Sciences*, 32–41. DOI: <http://dx.doi.org/10.2139/ssrn.3675270>
- [70] Richard Rogers. 2018. Coding and writing analytic memos on qualitative data: A review of Johnny Saldaña's the coding for qualitative researchers. *The Qualitative Report* 23, 4 (2018), 889–893. DOI: <https://doi.org/10.46743/2160-3715/2018.3459>
- [71] Wendy Roldan, Paola Vanegas, Laura Pina, Carmen Gonzalez, and Jason Yip. 2019. The Role of Funds of Knowledge in Online Search and Brokering. (June 2019). Retrieved September 8, 2022 from <https://repository.isls.org/handle/1/4398>.
- [72] Mohammad Salman and Imran Saleem. 2017. Role of digital competence in cashless economy. *IOSR Journal of Business and Management* 19, 11 (2017), 49–53. DOI: [10.9790/487X-1911034953](https://doi.org/10.9790/487X-1911034953)
- [73] Ratna Candra Sari, Mimin Nur Aisyah, Sariyatul Ilyana, and Hardika Dwi Hermawan. 2022. Developing a Financial Literacy Storybook for Early Childhood in an Augmented Reality Context. *Contemporary Educational Technology* 14, 2 (February 2022), 18 pages. DOI: <https://doi.org/10.30935/cedtech/11734>
- [74] Stella Sechopoulos. 2022. Most in the U.S. say young adults today face more challenges than their parents' generation in some key areas. *Pew Research Center*. Retrieved September 11, 2022 from <https://www.pewresearch.org/fact-tank/2022/02/28/most-in-the-u-s-say-young-adults-today-face-more-challenges-than-their-parents-generation-in-some-key-areas/>.
- [75] Soyeon Shim, Jing J. Xiao, Bonnie L. Barber, and Angela C. Lyons. 2009. Pathways to life success: A conceptual model of financial well-being for young adults. *Journal of Applied Developmental Psychology* 30, 6 (2009), 708–723. DOI: <https://doi.org/10.1016/j.appdev.2009.02.003>
- [76] Thomas E. Smith, Kristin V. Richards, and Victoria M. Shelton. 2016. Mindfulness in financial literacy. *Journal of Human Behavior in the Social Environment* 26, 2 (February 2016), 154–161. DOI: <https://doi.org/10.1080/10911359.2015.1052914>
- [77] Sang-Hee Sohn, So-Hyun Joo, John E. Grable, Seonglim Lee, and Minjeung Kim. 2012. Adolescents' financial literacy: the role of financial socialization agents, financial experiences, and money attitudes in shaping financial literacy among South Korean youth. *Journal of Adolescence* 35, 4 (August 2012), 969–980. DOI: <https://doi.org/10.1016/j.adolescence.2012.02.002>
- [78] Connie Susilawati and Leh Roo Wong. 2014. Barriers to entering affordable home ownership for young people: A preliminary study from university students' perspectives. In *Proceedings of the 20th Annual Pacific Rim Real Estate Society Conference*, S. Bond (ed.). Pacific Rim Real Estate Society, New Zealand, 1–11. Retrieved September 8, 2022 from <https://eprints.qut.edu.au/83852/>.
- [79] Sihvonen Tanja and Serada Alesja. 2020. Play with Money The Role of Digital Games in Promoting Financial Literacy. Retrieved September 8, 2022 from <http://www.digra.org/digital-library/publications/play-with-money-the-role-of-digital-games-in-promoting-financial-literacy/>.
- [80] Mia Taylor. 2022. The 5 Best Allowance and Budgeting Apps for Kids. *Parents*. Retrieved September 11, 2022 from <https://www.parents.com/kids/responsibility/money-management/allowance-and-budgeting-apps-for-kids/>
- [81] Tali Te'eni-Harari. 2016. Financial literacy among children: the role of involvement in saving money. *Young Consumers* 17, 2 (January 2016), 197–208. DOI: <https://doi.org/10.1108/YC-01-2016-00579>
- [82] Chandan Kumar Tiwari, S. Gopalakrishnan, Davinder Kaur, and Abhinav Pal. 2020. Promoting Financial Literacy through Digital Platforms: A Systematic Review of Literature and Future Research Agenda. *Journal of General Management Research* 7, 2 (2020), 15–26.
- [83] Kentaro Toyama. 2015. *Geek Heresy: Rescuing Social Change from the Cult of Technology* (1<sup>st</sup>. ed.). PublicAffairs, New York, NY, US.
- [84] Geert Van Campenhout. 2015. Reevaluating the role of parents as financial socialization agents in youth financial literacy programs. *Journal of Consumer Affairs* 49, 1 (2015), 186–222. DOI: <https://doi.org/10.1111/joca.12064>
- [85] Greg Walsh, Elizabeth Foss, Jason Yip, and Allison Druin. 2013. FACIT PD: a framework for analysis and creation of intergenerational techniques for participatory design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*, Association for Computing Machinery, New York, NY, US, 2893–2902. DOI: <https://doi.org/10.1145/2470654.2481400>
- [86] Diane Watt. 2007. On Becoming a Qualitative Researcher: The Value of Reflexivity. *Qualitative Report* 12, 1 (March 2007), 82–101.
- [87] Julia Woodward, Feben Alemu, Natalia E. López Adames, Lisa Anthony, Jason C. Yip, and Jaime Ruiz. 2022. "It would be cool to get stamped by dinosaurs": Analyzing children's conceptual model of AR headsets through co-design. In *CHI Conference on Human Factors in Computing Systems*, 1–13. DOI: <https://doi.org/10.1145/3491102.3501979>
- [88] Julia Woodward, Zari McFadden, Nicole Shiver, Amir Ben-Hayon, Jason C. Yip, and Lisa Anthony. 2018. Using co-design to examine how children conceptualize intelligent interfaces. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–14. DOI: <https://doi.org/10.1145/3173574.3174149>
- [89] Robert K. Yin. 2013. Validity and generalization in future case study evaluations. *Evaluation* 19, 3 (July 2013), 321–332. DOI: <https://doi.org/10.1177/1356389013497081>
- [90] Jason C. Yip, Kiley Sobel, Xin Gao, Allison Marie Hishikawa, Alexis Lim, Laura Meng, Romaine Flor Ofiana, Justin Park, and Alexis Hiniker. 2019. Laughing is scary, but farting is cute: A conceptual model of children's perspectives of creepy technologies. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–15. DOI: <https://doi.org/10.1145/3290605.3300303>
- [91] Jason C. Yip, Kiley Sobel, Caroline Pitt, Kung Jin Lee, Sijin Chen, Kari Nasu, and Laura R. Pina. 2017. Examining Adult-Child Interactions in Intergenerational Participatory Design. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*, Association for Computing Machinery, New York, NY, US, 5742–5754. DOI: <https://doi.org/10.1145/3025453.3025787>
- [92] Jason Yip, Wendy Roldan, Carmen Gonzalez, Laura R. Pina, Maria Ruiz, and Paola Vanegas. 2022. Youth invisible work: the sociocultural and collaborative processes of online search and brokering between adolescents and English-language learning families. *Information and Learning Sciences* 123, 7/8 (January 2022), 330–350. DOI: <https://doi.org/10.1108/ILS-01-2022-0004>
- [93] José P. Zagal, Staffan Björk, and Chris Lewis. 2013. Dark patterns in the design of games. In *Foundations of Digital Games Conference (FDG 2013)*, May 14–17, Chania, Greece. [http://www.fdg2013.org/program/papers/paper06\\_zagal\\_et\\_al.pdf](http://www.fdg2013.org/program/papers/paper06_zagal_et_al.pdf)
- [94] Sophia Ziakou. 2020. Resilient Digital Financial Education for Youth – European Money Quiz Project. *FINIZ 2020 - People in the Focus of Process Automation* (2020), 131–136. DOI: <https://doi.org/10.15308/finiz-2020-131-136>
- [95] John Zimmerman, Jodi Forlizzi, Justin Finkenaur, Sarah Amick, Ji Young Ahn, Nanako Era, and Owen Tong. 2016. Teens, Parents, and Financial Literacy. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems (DIS '16)*, Association for Computing Machinery, New York, NY, USA, 312–322. DOI: <https://doi.org/10.1145/2901790.2901889>