Applying the Computer Science Capital Framework to Understand Factors Facilitating Children's Decision to Participate in Code Clubs

Tina Vrieler
Department of Information Technology, Uppsala University
Sweden
tina.vrieler@it.uu.se

Abstract

Despite the increasing participation of children in code clubs, there remains a significant gap in our understanding of the factors that drive children's motivation to join these clubs. Identifying factors is critical, as gaining insights into early involvement in computing is crucial for comprehending early computing participation processes and elucidating the factors hindering or fostering children's interest in computing. Therefore, this study explores the influence of social, cultural, and behavioral factors on children's decision to participate in code clubs, utilizing the Computer Science Capital (CSC) conceptual framework for data collection and analysis, providing an opportunity to examine and refine the CSC model empirically. Through a deductive qualitative analysis of 17 semi-structured interviews with children, some of which included a parent present during the interview, it was found that a prominent factor driving most children to participate in code clubs was their social capital, with family and friends playing a significant role. Another influential factor was the children's keen interest in computer games; specifically, creativity, financial gains, and problem-solving were mentioned. While access to a supportive social network and an interest in computer games can encourage children to join code clubs, these same factors can create inequalities for children lacking such support or interest. The findings further reveal that the children's decision to join a code club is complex and multifaceted, encompassing an interplay of capitals. Although the results from the study generally support the CSC model, the analysis of findings has helped refine our understanding of the functions of the capitals and their interplay. The paper concludes by discussing valuable implications for educators in non-formal and formal settings.

CCS Concepts

• **Social and professional topics → Informal education**; **Computing education**.

Keywords

Computer Science capital, Bourdieu, code club, children, social capital, cultural capital, non-formal computing education, broadening participation

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1 Introduction

Every day, thousands of children worldwide learn to program in different code club constellations. The potential of these code clubs to empower young people with digital skills suitable for the 21st century has been recognized by researchers [49, 67]. However, as other researchers have noted, access to code clubs might not be as equitable as it seems. Scholars have questioned whether code clubs contribute to attracting more diverse groups of learners to computing [37, 55]. A study by Corneliussen and Priøtz [24] found that code clubs mainly attract children already interested in computing. Despite the increasing participation of children in code clubs, there remains a significant gap in our understanding of the factors that drive children's interest in joining these clubs [37]. Identifying these factors holds critical importance, as they can serve as valuable insights for practitioners and educators, enabling them to design more effective outreach activities and educational experiences in non-formal computing education.

Furthermore, gaining insights into early involvement in computing is crucial for comprehending early computing participation processes and elucidating the factors hindering or fostering children's interest in computing. Given these considerations, this study explores the social, cultural, and behavioral determinants influencing children's participation in code clubs. The conceptual model of Computer Science Capital (CSC) [79] was adopted for data collection and analysis, providing an opportunity to empirically examine and refine the CSC model (the words *conceptual model* and *framework* are used interchangeably in this article). Consequently, the research questions of this study are:

- How do computer science-related capitals facilitate children's decision to participate in code clubs?
- How can the CSC conceptual model be refined based on the interview evidence?

2 Why Do Children Attend Code Clubs?

To date, few studies have examined children's viewpoints and perspectives concerning their decision to devote their free time to learning computing in a code club. Most studies in informal computing education have focused on investigating the impact of computing outreach activities on children's computer science (CS) related perceptions and attitudes [46, 56], interest development [38, 54, 68], self-efficacy [21] and skills development [33, 59, 62].

Our interview study [77] with summer coding camp instructors revealed that the instructors thought the children wanted to learn to program for various reasons, including curiosity about programming and digital design, interest in computer games, social reasons, and encouragement from caregivers. This is in line with the findings from Corneliussen and Priøtz [24, p.103], who found that children joined code clubs "to have fun" and to "learn about computers". The authors also found that code clubs offer an alternative for children not interested in sports, allowing them to find like-minded friends. Lakanen and Kärkkäinen [56] found that interest in computer games is one of the primary motivators for children to participate in code clubs. In contrast, the study by Denner [27] found technological curiosity to be the strongest predictor of girls' interest in learning about computing.

Evidence suggests that many children who participate in computing education in non-formal settings have an already-established interest in technology and computing; participation in code clubs is, therefore, a way for the children to develop this current interest [24, 56]. Several studies have found that children's interest in computing has often been developed and/or supported by key people in their surroundings, such as family and friends [27, 56, 78]. A prerequisite for children to participate in computing-related activities in their spare time is support from their family, as they depend on their caregivers' approval for participation [56, 69]. Overall, these studies suggest that positive experiences with computers, curiosity, community, and social support are essential factors contributing to children joining code clubs. Since family support plays a particularly central role in the children's opportunity to participate in informal coding activities, the next section of the literature review will address this in more detail.

2.1 The Role of Family in Children's Code Club Engagement

Various studies have investigated the link between children's leisure activity preferences and family factors (see e.g., [5, 20, 57, 69]). Evidence indicates that children's caregivers play a crucial role in shaping children's aspirations and consumption of leisure activities [6, 75]. Young children's choices of free-time activities are particularly influenced by their families compared to older children [64]. Sociological scholars have found that caregivers can influence their children's knowledge and skills (i.e. cultural capital, which will be described in Section 3) by enrolling them in various activities [52]. These activities can, in turn, produce advantages or privileges for the children. By being aware of the types of knowledge and skills that have high exchange values in society (e.g. status and income), caregivers can support their children in acquiring these competencies even though they do not necessarily possess them. It is important to note that the transmission of privileges from a caregiver to a child is not always a part of the caregiver's strategic decision to develop the child's capital. In fact, the endowment of cultural capital is often carried out instinctively and subliminally; it is something one simply does [11, 12]. Considering that programming skills are one of the most sought-after abilities in Sweden [35] and Europe generally [23], cultivating children's interest in programming through leisure activities could be a way for caregivers to encourage their children to develop a skill that could lead to gainful employment in the future. This does not imply that caregivers must possess computing-related knowledge or skills. Studies have shown that caregivers' support can take various forms, such as mediating the relevance of computing, early access, emotional support, career guidance, and self-efficacy. [27, 65]

Other important factors influencing children's preference for leisure-time activity are family education, class belonging and gendered expectations [31, 42, 75]. A study by DiSalvo et al. [29] found that socioeconomically disadvantaged families did not find many of the existing online free computing educational resources for their children simply because they did not know the correct search terms. This is an example of how caregivers' lack of education and relevant knowledge and skills (i.e., cultural capital) negatively affected their children's opportunity to learn about computing.

Caregivers' expectations of their children and what is appropriate for them to do is another critical factor in understanding children's engagement in a spare-time activity [57]. An influential study by Margolis and Fisher [61] found that caregivers' gendered expectations affected girls' and boys' access to computers. Playing and tinkering with a computer was not considered interesting for girls. Therefore, girls did not get the same opportunities from their caregivers to explore computers to the same extent as boys. Learning programming in code clubs is a gendered activity, as the majority of children participating in code clubs are boys [1, 24, 55, 71, 78]. With this in mind, it can prove challenging for caregivers to move away from gender stereotypes and involve their daughters in an all-male environment, even when their daughters show interest in computing [71].

The above studies provide essential insights into caregivers' powerful role in influencing their children's participation in code clubs. The studies show a need to consider the children's social environment, including the people and the norms in that environment. Since the CSC framework focuses on these aspects, it is suitable for examining the factors that affect children's decision to participate in code clubs.

3 Conceptual Framework: Computer Science Capital

The Computer Science Capital (CSC) framework [79] builds on Bourdieu's theoretical concept of capital [12] and Archer et al.'s research on science capital [4]. Bourdieu argues that a person's preference of all kinds across diverse practices is not coincidental but is developed through upbringing, education, and socialization [12]. These accumulated social experiences in a person's life determine their unique composition of what Bourdieu calls capitals, contributing to a person developing a *"taste"* for various activities and objects.

Bourdieu identified four types of capital: 1) cultural (dispositions, skills, preferences, degrees, and access to cultural goods); 2) social (connection to other people that can facilitate the advancement of other capitals); 3) economic (access to financial resources); and 4) symbolic (social and cultural capital that are considered valuable by people belonging to a specific group) [12–14, 72]. Together, these

Table 1: The Computer Science Capital Framework, including the three main categories of CS-related capitals and their subcategories. These CS-related capitals are symbolically valuable in the field of CS. Adapted from Vrieler and Salminen-Karlsson [79]

Main categories	Subcategories	Literature
1. CS-related social capital	A. Family support	Support from family members plays a crucial role in encouraging young people to aspire to pursue computing education or work (see, e.g., [7, 80]).
	B. Community support	Support from peers, friendship groups, teachers, and others beyond the closest family is essential for building CS-related cultural capital and identity of participation in computing (see, e.g., [19, 22, 81]).
	C. Access to role models	Role models help people identify with computing. Knowing a key person with computing-related interests can contribute to developing CS-related cultural capital, which, in turn, can encourage participation in the field (see, e.g., [17, 19, 43]).
2. CS-related cultural capital	A. Access to computing devices and software applications	A high level of self-efficacy in computing is often the result of positive previous computing experiences, perceived capabilities in computing, and personal involvement with computing (see, e.g., [9, 70, 80]). This can only be achieved with access to computing devices and software applications.
	B. Positive attitude towards CS	Prior studies have shown that people who held positive views of computing were more likely to consider participating in computing in the future (see, e.g., [9, 16, 82]).
	C. Perception of CS and its career opportunities aligned with intrinsic values	A person who understands the exchange value of computing skills/degree/knowledge and how these can contribute to reaching personal goals is more motivated to engage in computing (see, e.g., [9, 16, 39, 58]).
	D. Computer experience and self-efficacy	Early familiarization with computers and prior experiences with computers positively affect a person's self-efficacy levels, which, in turn, can influence their intention to participate in computing (see, e.g., [2, 10])
3. CS-related behaviors and practices	A. Consumption of CS-related media	Exposure to media that contains significant elements of computing or technology can make participation in computing more attractive (see, e.g., [44, 56, 78]).
	B. Participation in informal learning of CS	Positive experiences with computing outside the classroom can support the development of CS-related cultural and social capital and influence young people to participate in computing (see, e.g., [2, 10]).

four forms of capital influence a person's decision to enter a social setting and contribute to them feeling a sense of belonging (or not) in a field. Broady [14, p.11] summarizes Bourdieu's definition of a field as *"a system of relations between positions occupied by people and institutions that contend for something they have in common"*.

Since every field has its norms, values, beliefs, and expectations, Archer and colleagues saw the need to extend Bourdieu's framework to understand what forms of capital are valued in science [4]. The authors called this symbolic capital in science *"science capital"* and found that it affects all children's aspirations and participation in science [4]. Archer et al. [4] also found that access to science capital is gendered and classed, where those possessing low science capital tend to be female and come from socially less advantaged backgrounds. Although the science capital framework proved valuable for understanding the reproduction of inequalities in science participation, it also has limitations. A noteworthy drawback of the science capital framework is that it does not consider what capitals are symbolically valuable in diverse scientific fields. This is why the work of CSC is relevant for this study.

Vrieler and Salminen-Karlsson developed the CSC framework to help educators better grasp the symbolically valuable forms of capital that can facilitate a person's possibility to participate fully in computing education [79]. Table 1 provides a summary of the CSC conceptual framework, including a brief presentation of some of the research that supports the construction of the framework.

The category *CS-related cultural capital* encompasses a person's experiences and the dispositions of their mind and body (also referred to as habitus/embodied capital [12]) in relation to computing (Table 1: 2B, 2C, and 2D). It also encompasses their access to computing-related objects (Table 1: 2A). The category *CS-related social capital* pertains to an individual's access to social support of various kinds in computing. One of the key advantages of social capital is that it can be converted into other forms of capital [12]. The category *CS-related behaviors and practices* highlights an individual's computing-related habits, consumption, and behaviors that can contribute to creating computing aspirations. Note that in the original paper by Vrieler and Salminen-Karlsson [79], community support also included support from caregivers. In this paper, community support pertains to non-family members' support to clarify the distinction between family and community support.

The CSC conceptual model postulates that the more CS-related capital a person has, the more likely they will participate in computing education. For example, some children may be able to utilize their CS-related knowledge, contacts, and dispositions in a way that allows them to enter and feel comfortable in the code club learning setting. Other children who do not have the right kinds of CS-related capitals might not see code club activities as something for them. Identifying the capitals that matter for participation in computing education enables us to recognize privileges better and change the structuring context (e.g., pedagogical practices) so that it can support the learning and engagement of all children. The CSC framework thus helps to understand the factors that affect children's decision to participate in code clubs by focusing on the variation in the children's CS-related resources, attitudes, behaviors, social contacts, and relationships. For more details on the CSC framework, see Vrieler and Salminen-Karlsson [79].

4 Method: Deductive Qualitative Analysis

Deductive qualitative analysis (DQA) is a theory-guided approach that can be used to empirically test, develop, revise, and/or refute a theory [40, 41]. DQA does not undermine the importance of examining evidence in the data to find new or contradicting concepts (i.e., inductive approach). This process is called negative case analysis [41]. The purpose of this approach is to develop a more inclusive theory that reflects the data and accounts for greater diversity in the phenomenon under study. The research design, including the stages of data analysis, followed the four key steps within DQA: 1) generating sensitizing constructs from the guiding theory, 2) collecting the purposive sample, 3) coding and analysis, and 4) concept development.

4.1 Step One: Generating sensitizing constructs

Gilgun's [40, p.743] notion of sensitizing constructs can be described as *"ideas with which researchers begin their inquiries and that alert researchers to what might be important in the topics of interest"*. The sensitizing constructs in this study are the CSC model's subcategories (see Table 1). The interview instrument is derived from the author's interpretation of the sensitizing constructs, and these concepts also guided the data analysis process (i.e., the deductive approach).

4.2 Step Two: Sample collection

The author searched online for code clubs and contacted several with information about the study. The only inclusion criterion for the code clubs was that the club had to regularly teach computing-related concepts to children (under age 18) outside of school. Three code clubs (all located in two of the largest cities in Sweden) were willing to help with data collection. The other code clubs contacted never replied or replied that their code club was no longer active. All three collaborating code clubs had weekly programming activities for children, focusing mainly on game programming. The collaborating code clubs distributed the informed consent to the caregivers of the children who participated in the code clubs. However, the code club providers did not keep track of the number of informed consents handed to caregivers, making it impossible to know the exact number of children reached by the information about the study. The informed consent contained a detailed description of the purpose of the study and how the interview would be conducted. The informed consent clarified that participation was voluntary and that the data would be confidential. Therefore, all names throughout the paper are pseudonyms. Before data collection, the Swedish Ethics Review Authority approved the research project (#2023-03293-02). Consent was taken in writing from the children and their caregivers before the interview began.

In total, 17 children (6 girls and 11 boys) agreed to participate in the study. The study included children ranging in age from 10 to 17 years old. The broad age range was chosen deliberately because the primary focus of the research was not on developmental differences across ages but rather on the general impact of sociocultural and behavioral factors on children's decisions to participate in code clubs. By including children of various ages, the study aimed to capture diverse experiences and perspectives that transcend specific age groups. The children's ages are mentioned in parentheses throughout Section 5 Results.

One sibling pair was in the sample, and the siblings were interviewed separately. In 9 out of 17 interviews, the children's caregivers contributed to the interviews. Other studies have successfully combined interviews with children individually and with their caregivers present (see, e.g., [30, 45, 73]). Reflections concerning caregivers' involvement in the interviews are discussed in Section 4.5. The author conducted all semi-structured interviews [28] online. It made sense to do online interviews since online communication had become commonplace during the pandemic. In addition, the goal was to ensure that participation in the study was as convenient, flexible, and unobtrusive as possible for the children and their families; therefore, online interviews were considered the best option. The interviews were conducted between October 2022 and January 2024 and ranged between 25 – 40 minutes. Only the audio from the interviews was recorded. The interviews were transcribed and analyzed soon after they took place.

4.3 Step Three: Coding and analysis

The first phase of the data analysis process consisted of reading the interview transcript thoroughly and coding the transcripts deductively by looking at evidence in the data that supported the sensitizing constructs (i.e., the subcategories of the CSC model). During the coding process, memos were taken to capture all analytical reflections related to the research questions. The second phase of the data analysis process focused on inductive analysis through open coding and analysis of negative cases. In other words, this phase involved deliberately searching for instances in the data that added to, contradicted, or undermined the initial analysis [40]. Once all the interviews were coded, the researcher revisited the coded data to ensure no concepts or negative cases were overlooked. Throughout both phases of the analysis, the researcher endeavored to remain receptive to new or divergent evidence from the initial analysis.

4.4 Step Four: Concept Development

Data were analyzed sequentially throughout the analysis to test whether the empirical data fit the CSC framework. Careful consideration was paid to analyzing the data for exceptional cases, contributing to refining the CSC conceptual model. The result is an enhanced appreciation of the interplay between sensitizing constructs and which constructs are more prominent for children's participation in code clubs.

4.5 Reflexivity and Trustworthiness

Reflexivity is critical to the DQA research approach, as it enhances the research results' transparency, rigor, and trustworthiness [40]. Since this study concerns the identification of children's CS-related capitals, which is mainly accrued out of the children's interactions with their immediate family, it seemed sensible to allow the caregivers to supplement their children's stories during the interviews. Therefore, at the beginning of each interview, the caregivers were informed that they could stay in the vicinity if they wanted to listen to the interview, and they could also complement their children's accounts as they saw fit. In addition, caregivers can help children feel safer in an interview [18], providing another rationale for keeping the caregivers close by.

All caregivers who participated in the study responded to questions regarding how they came to learn about the existence of the code club in which their child participated. The degree of caregiver involvement during these interviews fluctuated based on their perception of their children's ability to comprehend and express themselves effectively. Some caregivers were more eager to contribute to the interviews, while others preferred minimal involvement. In essence, caregivers had the autonomy to determine the extent of their participation. The interview with Knut was the only interview in which both caregivers were involved.

It is pertinent to point out that caregivers' involvement in the interviews was never perceived as dominating or negatively affecting the interview with the children. In all the interviews, it was perceived that the caregivers took a step back, allowing the children space to express themselves. The children could also assert themselves by disagreeing with or questioning their caregivers' statements. Often, the caregivers assisted the researcher by clarifying an interview question to their child. Insights into these experiences would have been impossible to gain if the child had been interviewed alone [36]. Since most children were young, having caregivers supporting them in expressing their views was helpful.

Nevertheless, it is essential to point out that caregiver involvement in the interviews made it impossible to know what the children would have said if their caregivers had been absent. The potential influence of other people (the caregivers and the researcher, as in this case) on the children is known as participant bias or response bias [15]. There is a risk that the children responded to the interview questions in ways they thought the researcher or their caregivers desired. This would hurt the validity of the research findings. However, research shows that participant bias is more likely for questions relating to sensitive topics [28]. Since this study did not cover sensitive questions (sensitive is defined here according to the Swedish Privacy Protection Authority; see [8] for details), the risk of participant bias is less. In several instances, caregivers' presence helped prevent participant bias by complementing the children's stories to allow the researcher to understand the phenomenon being discussed better.

Moreover, every child is developmentally different. Some were very verbal, and others lacked the linguistic capabilities to present their thoughts fully and tended to respond to the interview questions in a monosyllabic manner. In such cases, having caregivers act as proxies proved valuable as it allowed the researcher to gain insights into the children's experiences that would have been inaccessible otherwise [36]. For these reasons, it was perceived that the involvement of caregivers was enriching, rather than restricting, the understanding of the children's social environment and their participation in code clubs.

4.6 Positionality Statement

The author of this study is committed to fostering inclusivity and critical engagement within computing education. The author has studied non-formal computing education for several years but has never been directly involved in code club activities. The author visited all three code clubs in the study at least once and established rapport with the code club educators. While the code club providers demonstrated interest in the research outcomes, there was no discernible attempt to influence the researcher's findings. The author was welcome to visit the code clubs when they wished and was welcome to hand the informed consent to any participating child or parent. To mitigate potential bias from these visits, the researcher conscientiously recorded any preconceptions or assumptions about the clubs and their participants, ensuring these were set aside during data analysis.

5 Results

The results have been categorized into three primary sections: *CS-related social capital, CS-related behaviors and practices*, and *CS-related Cultural Capital*, based on the conceptual framework. The subcategories *perception of CS and its career opportunities aligned with intrinsic values* and *positive attitudes towards CS* have been merged, as the interview answers related to perceptions and attitudes towards computing were so closely intertwined that separating them would be illogical.

5.1 CS-related Social Capital

5.1.1 Family Support: Parents and Siblings. This category delves into the role of the family in transmitting their value related to computing to their children, thereby paving the way for the children's involvement in code clubs. Six children, namely Anna (11), Tilde (11), Milly (10), Rashid (12), Vera (11), and Pontus (11), were introduced to programming and/or the concept of code club by someone in their family. In other words, the initiative to participate in a code club came from a family member instead of the children. For four of the children who were introduced to programming by a family member, it was the fathers in the family who possessed coding expertise, either as active developers (as in the case of Anna, 11, Tilde, 11, and Milly, 10) or with experience as developers (as in the case with Rashid, 12).

Pontus (11) was the only child in the sample whose mother was the one who knew how to program. Pontus's father explained that Pontus's mother introduced Pontus to programming and later located the code club for Pontus to participate in: *"Pontus' mother knew the organizer of the code club from work (. . .), and we knew Pontus was interested in learning to code (. . .) so we asked him if he wanted to participate and he said yes"*. As for Vera (11), none of her family members possessed programming knowledge, but her mother was the one who suggested that Vera should try programming to *"see if she liked it"* (Vera's mother).

The interviews also revealed that the children who lived in a household where a caregiver possessed programming knowledge were introduced to programming through collaborative programming experiences with their caregiver. Anna (11) learned programming from her father, explaining: *"My father is a programmer, so I thought I might want to be a programmer too"*. For Tilde (11), learning programming with her father created positive learning experiences and made her want to participate in a code club: *"I like to program with my dad. He suggested that we could program a candy machine, and I thought it sounded fun. I have not been able to stop since. He would [at first] tell me what to do, and then I could do it myself"*. Milly (10) thought programming *"was fine"*, but it was not until she started programming with her father that her programming interest *"lit up"*.

Of the 17 children interviewed, only Albin (10) was inspired by a sibling to participate in a code club. Albin was only one year younger than his sister Freja (11) and could join her in many spare-time activities. For example, an activity that the siblings enjoyed doing together was playing World of Warcraft. Albin (10) started going to the code club because Freja was going there and because he liked the theme of game programming: *"It seemed fun to create games using your own ideas"*.

5.1.2 Community support: Friends and Teachers. Four of the children interviewed, namely Elias (15), Samuel (11), Vidar (11), and Noah (10), developed an interest in programming primarily as a result of peer influence. Elias (15) started programming after a friend showed him the creative possibilities of Arduino: *"A friend of mine told me about Arduino. He said: 'You can program it to make lights blink, for example.' Then I was reminded. I think I was seven or eight years old, something like that, when my father bought an Arduino but never really managed to program it. And then I thought I should go home and look at that. And I did, and I stuck with it and just kept going"*.

Samuel (11) and Vidar (11) were introduced to Scratch programming by a friend and, from then on, started experimenting with programming at home: *"A good friend of mine showed me what programming was. It was Scratch. He told me there was a book called 'programming from Scratch' and when we found the book, or if we borrowed it, then we saw what it was. Then we started to program and understand a little bit what programming was"* (Samuel, 11). *"I think I was in the second grade when my friend Henrik showed me a program called Scratch, and I started programming. After a while, I made my first game with gravity and such"* (Vidar, 11). Noah (10) explained that he started attending the code club because his two closest friends participated. According to Noah (10), besides spending time with his friends, learning programming seemed *"exciting and cool"*, yet another reason he wanted to attend the code club.

Lucy (17) was the only child interviewed who was encouraged by her teacher to participate in a code club. Lucy (17) was 14 when she started going to the code club. Before that, she had never experimented with programming and did not know anyone who could program. Lucy (17) explained that she always had a favorable view of computing. When her science and technology teacher (who was also one of the organizers of the code club) asked the girls in his class if they wanted to learn programming, Lucy (17) decided to join the club immediately: *"It [programming] has always been something that I think is very cool. Then [the teacher] also said you could participate in a programming competition. There was something called First Global, and then you could go abroad. They had competed in Mexico, Dubai, and several other parts of the world to represent Sweden, and I thought it sounded great fun! So, it was for those reasons that I wanted to start [at the code club]"*.

5.1.3 Access to Role Models. Most of the children interviewed (11 out of 17) lacked personal acquaintances with adults possessing programming knowledge. Those who had exposure to adults with programming skills were those whose caregivers possessed the knowledge. Regarding the interview question concerning role models, it was observed that most children had difficulty responding to it, even when prompted with indirect questions. Most children had not previously contemplated whom they admired or the reasons behind such admiration. However, there were exceptions, such as Milly (10) and Anna (11), who considered becoming engineers like their fathers, or Samuel (11), who wanted to be like Einstein because *"he was intelligent"*.

The slightly older participants, Lucy (17) and Elias (15), were able to provide more comprehensive accounts of their role models and the rationales underpinning their admiration. For Lucy (17), her mother and Ada Lovelace were the primary role models: *"I look up to my mother a lot, but I don't want to work with what she does, but I would like to be as successful as her. Then there are historical women I look up to. The project I'm involved in is named after her: Ada Lovelace. She wrote the first algorithm, and she was the first programmer"*. As for Elias (15), his role models were people doing *"cool"* engineering things: *"I am a big fan of Mark Rober; he builds things on YouTube. Then, of course, there is Elon Musk; he is also doing really cool things, in my opinion"*.

5.2 CS-related Cultural Capital

5.2.1 Access to Computing Devices and Software Applications. Most children (15 out of 17) had access to their own or shared computer or iPad. Many children also had access to computing-related toys, books, and games in their homes. The games that were often mentioned were Minecraft and Lego Boost. Some children, such as Anna (11), had access to several programming-related resources: *"Anna used to play with Lego Boost that we bought for her as a gift. We have tried Swift and Scratch programming (. . .) But now I bought a course at Code Monkey [for Anna] where the [programming] tasks are easier, and she is doing well there"* (Anna's father). Similarly, Pontus (11) received many technology and programming-related gifts from his parents: *"Five years ago, [Pontus] got Lego Boost, and two years ago he got Nintendo Labo where he could build controls from cardboard, and he could do like Scratch programming on Nintendo Switch"* (Pontus father). Samuel (11) received programming toys from his technology-interested parents and grandfather: *"I got a small set of programming kits from my grandpa. There was a circuit board with two, three buttons and some holes where you can plug in the wires"*.

5.2.2 Positive Attitudes towards CS, and Perception of CS and its Career Opportunities Aligned with Intrinsic Values. The children were asked what they would like to work with as adults. Only five children did not know what they would like to work with in the future. The other 12 children had a profession in mind, and they all mentioned computer programmer as one of the desired professions. Another common profession mentioned by the children was engineering.

The children were asked if they thought programming was necessary for society and young people in general. The prevailing perception among the children interviewed (12 out of 17) was that programming was vital for young people to learn. The most common rationale behind this perspective was the growing reliance on technology in contemporary society. Consequently, it was believed that it was essential to gain competence in programming. For example, Tilde (11) stated: *"There are many things that need to be programmed like solar cells and cars. Almost all technologies need to be programmed"*.

Considerations of future employment prospects drove another prevalent motivation: *"Programmer is one of the most sought-after jobs right now. If you want a job in the future, then it is good to study programming"* (Vidar, 11). *"I don't know what I want to work with when I grow up, so I think it is important to learn a bit about everything"* (Rashid, 12). For a subset of children, the appeal of programming was closely tied to recreational interests and amusement: *"It's more because it's fun to learn to program, then you can program games and other things"* (Pontus, 11). Samuel (11) thought that young people should learn programming so that they can *"have more people to get help from"*. For Oscar (10) and Lucy (17), programming was perceived as *"exciting"* and *"cool"*, contributing to them wanting to participate in a code club.

In contrast, only five of the interviewed children believed that programming was not an essential skill for young people. Milly (10) stated: *"No, I don't think it's important [to learn programming]. I don't think you need to know how to program an app alone"*. Vera (11) expressed uncertainty about the significance of programming for young individuals, stating: *"Maybe I don't think it's important for children, but maybe when you are older"*. Amin (12) thought learning programming was only crucial if *"it makes you happy"*.

5.2.3 Computer Experience and Self-efficacy. All of the children in the sample had experience using computers before participating in the code club. When the children were asked about programming experiences before code club participation, most (14 out of 17) indicated they had engaged in some programming activities at home or school, with Scratch being the most commonly mentioned programming language. The most common activities the children mentioned doing in front of computers were playing games and watching streamed content (more about this in Section 5.3). To assess the children's self-efficacy, they were asked if they considered themselves *"good"* with computers. Most children (12 out of 17) responded positively, stating they were good or okay with computers. However, five children expressed uncertainty in answering this question, highlighting the need to improve and clarify the interview question. For instance, Knut (13) mentioned that his proficiency *"depended on the programming language"*. At the same time, Lucy (17) felt that she was *"very good at programming"* but not with every aspect of computers.

5.3 CS-related Behaviors and Practices

5.3.1 Consumption of CS-related media: Computer Games. For five of the interviewed children, namely Thor (10), Amin (12), Oscar (10), Freja (11), and Knut (13), their interest in programming was primarily instigated by their fascination with various facets of game development. These game-related facets included: 1) creativity (i.e., the potential to craft new games), 2) financial gains (i.e., the possibility of generating income by selling created games), and 3) problem-solving (i.e., solving programming challenges in a game). For Oscar (10), the possibility of making money and creating new games was equally important: *"I think it's fun that I will be the first in the world to play a game because I created it. I also think it's cool* *that you can make so much money [from selling games] in such a short time"*.

On the other hand, for Knut (13), the problem-solving aspect of games was the primary motivator to learn programming: *"It all started with Knut playing Minecraft, and there's a stone called Redstone, which is the basic idea of programming. Knut built systems there without learning anything from anyone else. He taught himself and borrowed books from school to learn"* (Knut's father). This excerpt from the interview illustrates the value Amin (12) placed on the creative part of game development, which facilitated his decision to join a code club: *"I like to play computer games with my friends but also alone, so when my mom told me about learning to program in a code club, I thought: 'fun to be able to create something on my own'. To let my creativity flow and make my dream game"*. Similarly, Freja (11) expressed her appreciation for the autonomy and creativity afforded by the theme of game programming in a code club: *"I like that you can create exactly what you want in a game and see the games others create"*.

5.3.2 Participation in Informal Learning of CS: YouTube. The children were asked about their media habits and what they do on their computers in their spare time. Besides playing computer games, watching YouTube videos was the most common activity mentioned by the children. While none of the children directly attributed their interest in joining code clubs to content found on YouTube, 7 out of 17 children interviewed mentioned that YouTube facilitated their ability to engage in self-directed learning of programming at home. In other words, these children referenced YouTube as their primary resource for acquiring programming-related knowledge before and after enrolling in a code club. For instance, Tilde (11) explained that she watched YouTube *"to get inspiration on what to program"*. Vidar (11), an aspiring engineer, recounted his penchant for using YouTube to delve into electronics and computing, stating: *"When I watch YouTube, I like to learn about engineering and programming. I like to build crazy electronic projects that don't blow up the house!"*. Elias (15) also noted that, before his involvement in the code club, he extensively relied on YouTube as his primary source for augmenting his programming expertise, remarking: *"It's crazy that everything I've learned about programming is from YouTube. I also searched for things on Google"*. In contrast to these accounts, one child, Rashid (12), thought he did not learn anything about programming on YouTube. He explained: *"I don't think you learn that much [since you] just copy the code. It's fun to do [but you] don't learn anything"*.

6 Discussion and Implications

This section discusses the findings and their implications in the context of extant literature. Although the results generally support the current CSC framework, the analysis helped refine the model, providing a better understanding of how various factors influenced children's decisions to participate in code clubs. While the discussion focuses on the sociocultural factors facilitating children's decision to participate in code clubs, it is essential to emphasize that children are not passive products of socialization by others. Children have the agency to resist socialization, negotiate and renegotiate computing-related expectations and norms with the people around them, and impact others and society.

6.1 Refining the Understanding of CS-related Social Capital

The CSC conceptual model maintains that support from close family members plays a crucial role in children's participation and aspirations in computing [79]. This study revealed that family support can manifest in various forms, such as a parent teaching a child programming and discovering its potential or as a source of inspiration for siblings to begin exploring computing. Another essential form of support, according to the CSC model, is from the community, which could include peers and teachers. Being part of a community containing people with computing-related interests can strengthen a child's sense of belonging and increase their access to CS-related resources [79]. This study's findings confirm that family and community support, particularly parents and friends, significantly facilitate capital for the children's decision to participate in code clubs. Of the 17 children interviewed, 12 were inspired, encouraged, or introduced to programming, with the prospect of joining a code club through connections within their social network. This result aligns with previous studies showing that relationships with friends and family are essential for young people to engage in computing [2, 56, 60, 61, 77].

This finding has implications for computing educators operating within non-formal contexts. Firstly, the constitution of people in a child's social network (i.e., CS-related social capital) may influence their access to code clubs since participation in code clubs is contingent on access to other resources, such as information about code clubs and knowledge about online programming resources, which can be obtained with the help of a knowledgeable other. Non-formal computing educators could extend their activities to venues where children naturally congregate to make code clubs more equitable and accessible. This approach would help level the playing field for children who do not have computing-interested individuals in their social networks. For instance, our study [76] showed that collaboration with schools and youth recreation centers could enhance access to computing for those children who might otherwise miss out on the opportunity to participate in code clubs.

The study's results also revealed teachers' potential influence on children's decisions to engage in code clubs. However, the CSC framework did not discuss the role of teachers as part of a child's community support. Including a discussion on the role of educators refines our understanding of how community support functions within a child's social environment. Teacher-student relationships can be one of the most critical forms of social capital for underrepresented students in computing [32, 60] and students with an emerging interest in computing [2, 51, 61, 74]. In this study, the underrepresented children are those without an interest in computer games and those lacking a social network of computing-interested people. Therefore, there are reasons to believe that teacher encouragement might be particularly valuable for these children. Prior studies found that teachers can significantly impact students' interest and self-perception of science by recognizing students' abilities, setting high expectations, and providing encouragement [48, 72]. The study's findings demonstrated that teachers could facilitate children's decision to participate in code clubs by, for example, informing students about the possibility of participating in code clubs and conveying the value and the exciting opportunities with computing.

Access to role models is a construct within the category of CS-related social capital pertaining to a child's access to people interested in computing and who could help a child relate to and identify with computing [79]. In this study, most children (except those with a parent who knew how to program) were not acquainted with adults equipped with programming skills or who worked as IT professionals. Instead, their interest in joining code clubs appeared to be sparked by other factors. This discovery aligns with previous findings [69, 80], highlighting that a critical determinant of children's participation in code clubs is not necessarily having a mentor to teach them programming. Instead, what proves essential is the caregivers' positive attitude toward computing and their readiness to support their child's interests. Moreover, many children could not answer the question regarding who they look up to. Even when prompted indirectly, such as when discussing their career aspirations, many found it challenging to respond, most likely not because they did not have a role model but because they had never reflected on these topics. The children's lack of reflection concerning role models may be due to their age, making it difficult to appreciate how role models affect their decision to participate in code clubs. Regardless, the results suggest that, for most children, code club participation is not a matter of (consciously) emulating someone. This is not to say that role models are not essential, but there seem to be other factors that primarily motivate participation. This finding helps refine the understanding of how the construct *access to role models* facilitates children's decision to participate in code clubs.

6.2 Refining the Understanding of CS-related Cultural Capital

The CSC conceptual model stipulates that early exposure and access to computing-related resources are essential for individuals to develop self-efficacy and an interest in computing, making participation in computing more appealing [79]. Most of the children in this study had access to their own or shared computers or iPads, and many also had programming-related toys, books, and games at home. Access to science objects is seen as an indicator of a family's economic and cultural capital [5, 79]. In other words, families that value science will use their financial means to purchase science-related objects, such as toys and games, for their children. Hence, it seems that the children in the sample come from families that value computer science.

Most of the children in the sample had tried programming at home or school before joining a code club. This implies that most of the sample children knew about programming, and their interest and curiosity in computing had already been established. This would make code club participation a logical next step in their skill development. However, the results also showed that for a minority of children, code club participation was a way to test whether programming was something they enjoyed. Since these children's initial interest level might be lower, creating positive code club experiences could be particularly significant for these children for continued participation and reducing potential drop-out [76].

It is difficult to determine how much access to computing devices and previous experiences with programming played a role in the children's decision to participate in code clubs. As access to computing devices has become more ubiquitous in Swedish homes (75% of children ages 9-12, and 81% of children ages 13-16, had access to computers at home [3]), the construct *access to computing devices and software applications* has likely become less substantial to determine code club participation in the Swedish context. Experiences with programming and self-efficacy, however, might be more essential in the children's decision to join a code club. Regarding self-efficacy, most of the children interviewed felt they were *"good"* with computers. Research studies show that confidence in one's computer abilities is closely tied to previous experiences [9, 53], implying that the children in the sample had positive encounters with computers, contributing to the feeling of them being *"good"*. Considering that low computer confidence is one of the most significant obstacles to participation in CS [34], this finding could imply that code clubs mainly attract children with strong computer confidence.

According to the CSC framework [79], a part of a person's computing aspirations is a product of their understanding of the meaningfulness and usefulness of computing in their daily lives. Therefore, appreciating the exchange value of computing is a form of cultural capital. Unsurprisingly, many of the children in the sample wanted to become computer programmers or engineers as adults. This result aligns with the CSC framework as it maintains that individuals who engage in informal computing activities are more likely to hold higher aspirations in computer science. The prevailing perception about computing among the sample children was positive, meaning that the children thought computing skills were vital for young people to learn. When the children were asked why computing skills were necessary for young people, the children mentioned three reasons: (1) that it was an essential part of understanding contemporary society, (2) that having computing skills could lead to many job opportunities, and (3) because it was a fun thing to learn. These findings were expected and consistent with the CSC framework and previous studies. Earlier investigations have reported that most children participating in non-formal computing initiatives highly appreciate science, technology, and computers [24, 78].

Considering these results, an implication for code club educators, in terms of broadening participation, is to reflect on the composition of the code club participants. The results from this study indicate that code club participants constitute children with experience in programming, have high computer confidence, and come from families that value computer science. This is not wrong per se, but regarding inclusivity and equal access, it is worthwhile to consider who the code club activities attract. In other words, code club providers are encouraged to consider whether it is possible to say something about who the typical participant is. Do they share similar backgrounds, previous experiences, interests, desires, and social class? Are there groups of participants who are over- or underrepresented? Is the participant group biased in some way? By being conscious of these differences among the children participating in code clubs, educators can better support children with less computer experience to prevent them from feeling out of place among children with higher computer skills and confidence. One way to support these children is to apply pedagogies that encourage all children to develop computer self-efficacy, as this has been shown to help maintain students' interest in computing [9].

6.3 Refining the Understanding of CS-related Behaviors and Practices

The CSC conceptual model posits that individuals who consume CS-related media (e.g., playing computer games and watching content related to computing) are more likely to find computing attractive and exciting. In line with the CSC framework, a CS-related behavior that notably facilitated the children's decision to join code clubs was their interest in computer games. This finding was expected since the theme of most code clubs is game programming. Game programming is a popular context for learning in code clubs, and the creative aspects of games have been found motivating for children [56, 66]. However, a study of 992 learners [66] found that game programming did not make children who were not initially interested in computing *more* interested in computing (emphasis added).

An issue related to the application of games as a learning context is the strong association between gaming and masculinity. This means that, historically, computer games have been dominated by male game characters and expectations that most players are men [50, 63]. Although there is an increased awareness among those in the computer game industry to create games appealing to both male and female players, the latest statistics from The Swedish State's Media Council [3] showed that boys still play significantly more computer games than girls at all ages. This suggests that using only games as a context for learning programming might narrow the definition of what it means to engage and participate in code clubs. Therefore, code club participation might not be as appealing to girls, a factor educators in non-formal computing education need to consider.

An approach to broaden the code club learning content could involve aligning computing activities with other areas of interest that children are already passionate about. By collaborating with educators from diverse extracurricular activities, computing can be introduced to enhance children's pursuits, and its relevance in various contexts can be demonstrated. Integrating computing seamlessly into other activities can broaden its appeal and enable code club providers to reach a more diverse audience of children. Another approach to widen participation is considering the children's multifaceted motivations to learn to program games. The children in this study mentioned creativity, financial gains, and problem-solving as enticing factors when learning game programming. This has implications for curriculum design in both formal and non-formal computing education. Besides technical content, computing education could include content related to, e.g., creativity and entrepreneurship, to attend to the children's identity and aspirations more holistically.

This study found that computing-related content on YouTube indirectly influenced the children's decision to join a code club, as it allowed them to explore, acquire, and further their knowledge. Since the nature of learning on YouTube is voluntary, independent, and based on intrinsic motivation to learn *"cool"* things [47], it is likely primarily children with a pre-existing interest in computing who interact with programming-related content. This result helps refine the understanding of how CS-related behaviors and practices can (indirectly) facilitate children's decision to join a code club. However, as Dawson [26] emphasized, mere exposure to YouTube or TV content related to CS does not guarantee learning. This does not imply that educators cannot recommend YouTube content to children or take inspiration from content creators to expand their and the children's perceptions of computing and its applications. YouTube content creators can also serve as role models for children. A good starting point for educators to navigate the YouTube landscape is following Knorr's guidelines (as cited in [47]). This includes: (1) Watch YouTube with the students, talk about what you saw, and ask questions; (2) Investigate the creator of the YouTube channel to establish whether they are a good role model; (3) Read the comments to establish if they are appropriate for the students; (4) Encourage/Recommend the students to subscribe to age-skill-appropriate channels, as it will allow for easier access to the content.

6.4 Limitations

This study included 17 interviews with children, a small sample size considering the number of children participating in code club activities in Sweden. Therefore, the results of this study must be approached with some caution. Since one researcher performed this study, the data analysis and the interpretations of the findings rely predominantly on the researcher's perspective and comprehension of the data. The involvement of multiple coders in the data analysis process could potentially yield different results, as coding and data interpretation are subject to individual perspectives and expertise. However, the researcher consistently shared their interpretations with the children and parents interviewed to enhance the study's credibility. This approach helped increase the validity of the findings by summarizing the interviewees' input and feedback.

Considering potential selection bias is essential, as participation in this study is based on consent from both caregivers and children. As with all studies involving children, caregiver consent is necessary since children cannot freely agree to participate in research [18, 25]. By consenting to a child's participation in this study, caregivers may feel, as Davies [25, p.91] puts it, *"that they are being studied, even if their direct involvement in the research is not sought"*. From this perspective, it could be that some caregivers feel uncomfortable letting their children participate in the study, thus leading to biased results.

Lastly, comprehending the intricate social, cultural, and behavioral factors influencing children's decision to participate in a code club constitutes a complex social process. By categorizing the children's social environment as CS-related capitals, there is a risk of oversimplification and potentially overlooking the numerous subtle factors and nuances contributing to their choices. Nevertheless, akin to all research endeavors, summarizing and highlighting key findings in the data remains essential [15], all while recognizing the limitations of the method and the multifaceted nature of the factors affecting children's desire to participate in code clubs.

7 Conclusion and Future Directions

The primary aim of this study was to investigate how sociocultural and behavioral factors facilitate children's decisions to join code clubs using the CSC conceptual model. The secondary aim was to refine the CSC conceptual model with empirical data. Both aims were achieved through deductive qualitative analysis of 17 interviews with children. The findings revealed that social capital and engagement in computer games were the primary capitals influencing the children's decision to participate in code clubs. These factors sparked the children's interest and curiosity towards programming. While many children initially became aware of code clubs through someone in their social network, a combination of factors influenced their decision to join. Specific cultural and social factors, such as bonding with friends or family, future employment opportunities, previous positive experiences with computing, and a positive perception of computing, also emerged as influential in their decision-making process. This supports the notion that social capital becomes valuable when converted into different forms of capital. It is important to note that although the factors leading to children joining code clubs are complex, mapping out this complexity provides valuable insights into their motivations. Understanding these motivations brings us closer to creating more inclusive code club initiatives.

Given the complexity of the factors involved in children's decision-making, it is challenging to determine the exact impact of each factor. Future research could focus on one type of capital, such as examining how social capital impacts children's engagement in computing. Lastly, it is essential to point out that while the study's findings largely support the CSC model, certain elements of the framework showed limited effectiveness for the selected sample. Specifically, aspects related to role models and access to computing devices had limited relevance to the study's context. Future studies need to carefully consider their specific context and sample characteristics when applying the CSC framework to ensure its applicability. Nevertheless, the study's results have helped refine the CSC conceptual model, enabling a deeper and clearer understanding of the interplay of constructs that facilitated young learners' decision to participate in code club activities.

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A Interview guide

Warm-up questions:

- What do you like to do in your spare time?
- How did you find the code club?
- How long have you participated in code club?

Questions related to CS-related Cultural Capital:

- Why did you want to participate in the code club?
- Did you program before starting the code club? What did you do?
- Do you think it is important to learn to program? Why?
- Do you think programming is important to society? Do you think that young people should learn to program?
- Do you have your own computer or access to a computer you can use whenever you want? What do you do in front of the computer?
- Do you think you are good with computers?
- Can you tell me about the technology gadgets you have at home? Do you usually use them?
- Who would it be cool to be like when you grow up? What would you like to work with as an adult?

Questions related to CS-related social capital:

- Do you know someone who can program or who works in an IT company? What do they do?
- Can someone help you with programming?
- Is there anybody you look up to/consider as role model?

Questions related to CS-related behaviors and practices:

- What do you do in front of the computer in your spare time?
- What content on TV, YouTube, etc., do you like to watch?