# From Access to Affirmation: How Technology Exposure and Family Support Shape Confidence in Computer Science

A Study among Young Adults in Germany

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*Abstract*— **The high demand for computer scientists makes it crucial to understand the career decisions of young adults. This study examines how technology experience shapes young adults' perceived competence in computer science, which is a key factor in career decisions. A novel framework was developed to structure technology experience. This framework guided the quantitative analysis of data from over 800 young people in Germany. Special emphasis was placed on gender differences within this context of digitization adoption. The results show that while a gender gap in technology exposure exists, this disadvantage is compounded by a more significant disparity in the social support they receive at home. Family support emerges as a critical predictor of self-concept, yet it is marked by a stark gender gap: young men receive consistent encouragement for their technical abilities, while young women report significantly less support, often facing neutrality or even doubt. Therefore, fostering a diverse tech pipeline requires a holistic strategy that extends beyond the classroom, engaging with families to dismantle gendered stereotypes and build a supportive foundation for a wider and more diverse talent pool. Taken together, the study contributes a multidimensional framework of technology experience and shows that understanding gender disparities in computer science self-concept requires looking beyond access to the context in which technology use is embedded.**

***Keywords: technology experience; family support; computer science self-concept; young adults; gender gap.***

## I. Introduction

Past research suggests that technology exposure has a measurable, though modest, influence on career-related beliefs. In particular, greater access to technology and more frequent use have been linked to young adults' confidence in their competence and their perceived ability to succeed in Computer Science (CS) [1]. Such access likely fosters baseline familiarity and comfort with technology. However, the study indicates that frequent exposure is not the sole factor driving the CS self-concept, particularly for young women. A person's self-concept in a particular field such as math, science or CS is typically shaped by past experiences, feedback, the immediate environment, and social comparisons [2], [3]. Crucially, this self-concept acts as a gatekeeper: without it, a person is unlikely to develop a genuine interest or consider a career in that field [2].

Since an individual's history with technology is a pivotal determinant of this self-concept, this study deconstructs that history. While previous research, particularly within school contexts, has examined how mere availability and use of Information and Communication Technology (ICT) affect students' confidence and competence in using technology or its impact on math and science achievement (e.g., [4], [5], [6]), this study takes it a step further. It investigates how the multidimensional nature of the technology experience, ranging from broad quantitative exposure to the **situational context** in which technology exposure occurs (such as in school or at home), relates to their CS self-concept. Building on this framework of multidimensional technology experience, the present study expands the analysis in two primary directions. First, it continues to examine how technology exposure relates to CS self-concept. Second, it introduces an in-depth analysis of one of the most critical situational contexts: the family. Specifically, it investigates how social-environmental feedback within the family—namely, parental encouragement for a CS career and expressed confidence in their child's CS-specific talent—influences a young adult's confidence and career perceptions in the field.

The confidence shaped by these factors is what ultimately drives a young adult's decision to enter and persist in a CS educational path. This educational pipeline is critically important, as the labor market continues to face a widening workforce gap. In recent decades, there has been a high demand for well-trained ICT specialists, and industry has complained about a shortage of skilled workers. Although advances in Artificial Intelligence (AI) raise questions about how automation will impact ICT jobs and the ongoing need for professionals, recent studies [7] predict continued strong demand for professionals skilled in both developing and using ICT and AI systems.

However, the extensive re- and upskilling required to meet this demand will only be successful if a broader demographic develops a genuine interest in CS. In this regard, a large gender gap exists. Despite the importance of ICT roles, women continue to be significantly underrepresented. In 2023, only 19.4% of ICT specialists in the EU were women, compared to 80.6% men [8]. The numbers are similar around the world. According to the Global Gender Gap 2024 report published by the World

Economic Forum, only 28.2% of the positions in Science, Technology, Engineering, and Mathematics (STEM) worldwide are held by women, in contrast to 47.3% in non-STEM positions [9, p. 49]. This inequality is further amplified by the fact that women are more likely to hold a position with less influence and status, and consequently a lower salary [10]. This gender disparity poses several problems, including the loss of diverse perspectives that are vital for innovation.

To address these disparities, it is necessary to understand young adults' decision-making process underlying career choices. Therefore, the analysis presented in this paper investigates gender disparities in young adults' technology experiences. To this end, data from a survey of more than 800 young adults conducted in Germany in 2024 is analyzed. Understanding these dynamics will help educators, policymakers, and industry leaders encourage a diverse range of young people, especially women, to pursue careers in CS.

The remainder of this paper is organized as follows. Section II presents the theoretical background and derives the research questions. Section III details the methodological approach, including the study design, sample characteristics, and limitations. Section IV presents the quantitative results regarding technology exposure and its relationship to self-concept. Section V analyzes how young adults perceive family support for both their CS-specific talents and a potential career in the field. Section VI discusses the implications of the findings. Finally, Section VII concludes the paper and outlines areas for future research.

## II. Theoretical Background

The following sections provide the theoretical basis for the core constructs used in this study. First, key dimensions of technology experience are defined, covering both quantitative aspects such as access and frequency of use, and the contextual and interactional dimensions of engagement with ICT. Subsequently, the construct of the ability self-concept is introduced, which is essential for explaining how specific technology experiences can foster or hinder the development of confidence and interest in CS.

### A. *Technology Exposure of Young Adults*

Exploring the aspect of **technology exposure** requires understanding that it encompasses a wide array of experiences and opportunities through which individuals encounter and interact with ICT. Technology exposure can be conceptualized through a set of behavior- and experience-based indicators that show how much and how often people interact with technology or are exposed to it. These include the amount of time spent using technology, how many times it is used before a person feels comfortable with it, the frequency of technology use, participation in ICT-related trainings, and the context in which technology is used, for instance at work and at home [11]. They also include access-related aspects such as owning ICT devices. The exposure of young adults to technology has been examined in a number of studies from a variety of perspectives. Figure 1 provides an overview of these different perspectives.

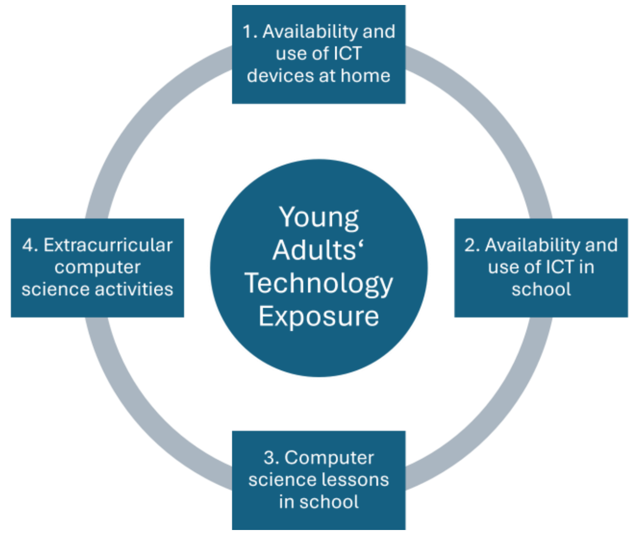



Figure 1. Technology exposure of young adults, Source: own depiction.

Apart from the term "technology exposure", the terms "technology experience" and "technology use" are also commonly used [11], as well as "ICT use" [4].

*1) Availability and use of ICT devices at home:* Access to digital devices such as computers, tablets, smartphones, game consoles and even Virtual Reality (VR) glasses at home allows young people to explore technology on their own. The presence of ICT devices can encourage experimentation and the development of digital literacy from an early age [12]. Note that, in addition to "classical" ICT devices such as personal computers, laptops, tablets, and smartphones, new devices have entered children's rooms. Programmable robot toys, in particular, offer playful and exploratory entry points into coding and computational thinking [13]. Therefore, engagement with hardware no longer necessarily involves assembling a personal desktop computer; it also includes hands-on activities such as constructing educational robots by connecting wheels, sensors, and actuators, or building simple electronic circuits.

In addition to the availability of ICT devices at home, the type of usage is often differentiated, according to whether it is used for leisure, e.g., the use of social media or gaming, or for schoolwork activities [4]. Analyses of the impact of leisure activities on interest in CS have highlighted gaming in particular. Recent studies confirmed previous research that playing games on computers, game consoles or mobile devices increases interest in CS [14], [15], [16]. In addition, more active engagement with games includes experimenting with mods, level editors, or in-game scripting.

To better understand the context, conditions, and support mechanisms that shape children's ICT use at home, Bonanati and Buhl describe four aspects characterizing a digital home learning environment [17]: stimulation, instruction, interactions, and modeling. Stimulation refers to the availability of and the access to ICT devices at home in general and as children's individual devices. Instruction encompasses the activities and strategies that parents utilize to support their children in using ICT. Interactions describe shared ICT activities in which parents and children use ICT together. One example is searching for information online to plan a family event. Finally, modeling refers to parents' own attitudes toward ICT use, for example, whether they deem it as beneficial for their children to be familiar with ICT.

*2) Availability and use of ICT in school:* During the Covid-19 pandemic, distance learning was supported by video conferences and digital learning materials such as learning apps. This period accelerated the adoption of ICT in schools and highlighted the importance of digital tools for both teaching and learning. In many education systems, the pandemic, alongside longer-term digitalization efforts, prompted sustained investment in digital infrastructure and the availability of ICT in schools.

Students of all ages are learning basic ICT skills, such as ten-finger typing, internet search, interacting with the user interfaces of generative AI ("AI chatbots"), and using software applications, for instance for creating presentations or using spreadsheet and calculation software, and learning management systems. Sometimes, technology is integrated into different subjects, which helps students recognize the relevance of ICT across diverse fields. In these contexts, ICT may be used both by teachers, for example, to demonstrate concepts or model procedures, and by students themselves in an active and creative way. For example, students use their smartphones in music class to create a short commercial, adding background music that they either record themselves or select from provided audio files.

The extent to which ICT is used as a tool for learning—such as using educational software, engaging in interactive learning experiences via websites and mobile apps, or utilizing online resources—can have a significant impact on students' familiarity with technology [5].

*3) CS lessons in school:* In many countries, in-school offerings of CS education have been established during the last years. Formal education in CS, including hands-on experiences such as programming or working with robots, can foster students' interest in the field [6]. Such lessons can provide foundational knowledge and inspire confidence in students' abilities to pursue further study or work in this field.

However, the frequency and the level of detail of the CS lessons often varies [18]. In Germany, for example, there are considerable differences between the federal states as the annual "computer science monitor" published by the German Informatics Society reveals. It ranges from a very limited offer of CS lessons in some types of schools or in some grades, sometimes only on a voluntary basis, to several compulsory CS lessons in all types of schools [19]. Moreover, CS curricula differ between the German federal states [19]. To ensure a coherent and high-quality framework for CS education across Germany, the German Informatics Society has developed detailed recommendations and guideline for CS education. An example is the *Educational Standards for the Subject of Computer Science in Lower Secondary Education* published in 2025 [20]. A core consideration is that CS education should not focus on operating applications or devices, but on understanding fundamental concepts of how information and data are represented, processed, and transformed by machines [21]. Rather than merely "doing something with digital media", learners should be enabled to develop digital applications themselves and to creatively modify existing ones. This requires the ability to model problems and to realize solutions through implementation. The goal is to empower learners to not only use ICT, but also to actively shape digital systems.

*4) Extracurricular CS activities:* Participation in technology-related extracurricular activities, such as coding clubs, robotics teams, or technology competitions (e.g., hackathons) is another context in which teenagers and young adults can experience ICT. These activities often allow students to explore technology in very creative and applied ways [6]. Makerspaces, such as the one in the Amsterdam Public Library [22], illustrate how children can engage creatively with ICT by combining digital technologies with tinkering, for example by using 3D printers and taking part in coding and robotics workshops. Other formats have a more focused nature, with a stronger emphasis on CS and, at times, a competitive format. In Germany, for example, there are several nationwide competitions for school students, the "Bundesweite Informatikwettbewerbe", that aim to encourage engagement with CS and programming [23]. These competitions address different age groups and levels of experience. Not all of them include programming. The Informatik-Biber, for example, consists of short problem-solving tasks that foster computational thinking through everyday scenarios. Besides such competitions, students may also be exposed to online tech communities where people discuss technology trends, share projects, and exchange knowledge. These interactions not only provide informal learning opportunities but also help build a sense of belonging to the broader tech community.

### *B. Impacts of Young Adult Technology Exposure*

The effects of technology exposure on young adults have been analyzed from different perspectives.

*1) Impact on students' performance in science and math:* In the last fifteen years, many studies used the data from PISA (Programme for International Student Assessment), OECD's Programme for International Student Assessment, which assesses how well 15-year-olds can apply their knowledge and skills in reading, mathematics and science to real-world tasks. In particular, the effects of ICT use in classrooms for teaching and learning purposes as well as ICT availability at home on students' performance in math and science were analyzed for various countries [4], [24], [25], [26], [27]. However, none of these studies analyzed the impact on achievement in CS in particular, which is obvious for studies using PISA data, as PISA has historically only tested students' literacy in reading, mathematics, and science.

The review of a large number of studies in [4] shows mixed results on how ICT availability, use, and engagement affect students' math and science scores. To provide clarity, they compared the results of the four PISA surveys from 2009, 2012, 2015 and 2018. Results indicated that there was no meaningful positive link between student performance in math or science and their use of ICT, whether this usage occurred in school or outside of it, and whether it was tied to specific academic subjects or not [4]. However, students who had a more positive attitude toward ICT, felt confident using it, believed in its usefulness, and used it autonomously, consistently showed better performance in math and science. Similarly, [28] discusses the mixed results of ICT availability on students' academic achievements and examines this relationship in their study, too. In particular, gender differences are investigated. Apart from a direct effect, which was negative for male students and neutral for female students, the study has shown significant positive indirect effects via other variables such as the students' ability to master the use of ICT and their autonomy in using ICT. These aspects are discussed in the next paragraph.

*2) Impact on digital literacy:* Technology experience also influences comfort and competence with ICT. Starting in 2025, PISA will include a new assessment, the "Learning in the Digital World" test, which evaluates how well students can use computational tools to engage in an iterative process of building knowledge and tackling real-world problems [29]. Pre-tests of this test indicate that students who regularly use ICT across various subjects tend to perform better in solving the tasks [5]. Moreover, students who possess confidence in their ICT skills and show interest in ICT demonstrate higher performance levels on the test. Further studies investigate more specific aspects of students' ability to use ICT tools effectively. For instance, [30] examines how the usage of educational technology affects students' internet self-efficacy. While these studies focus on digital literacy, CS self-concept is about how confident students feel when it comes to engaging with CS tasks.

*3) Impact on career decisions in STEM:* Research has examined whether and how technology experience increases the sense of familiarity, confidence and interest in pursuing STEM subjects and, consequently, influences an informed career decision regarding a STEM career path. Among the different contexts of technology experience, these empirical studies often focus on STEM school lessons or STEM programs. An example is the impact analysis of a program for students about robotics design and production in the USA, which increased participants' career choice in STEM [31]. While many studies have examined the direct and indirect impact of multiple variables on STEM career choices of young adults (e.g., interest, self-efficacy, influence from family and friends) [18], less attention has been given to the role of ICT availability and use at home or during leisure time in career choice specifically in CS.

### *C. The Situational Context of Technology Exposure*

Analyzing young adults' technology exposure makes clear that it is a multi-faceted experience that happens in various situational contexts. This context can be systematically deconstructed by addressing three fundamental questions: **Where** does the exposure occur? **With whom** is the individual interacting? And **how** are they engaging with technology? These three questions provide the analytical pillars for the framework that underpins our study.

*1) Contextual Domains:* The first dimension of situational context, **Where**, refers to the distinct Contextual Domains that structure a young adult's life. These domains are more than just physical locations; they are spheres of activity governed by different norms, resources, and expectations, each with a predominant purpose. Based on the literature review in Section II.A, three primary domains for technology exposure can be distinguished: school, home, and extracurricular settings. School provides a formal, structured, and often curriculum-driven context for ICT use. The home, in contrast, is an informal environment where purposes are more varied, ranging from leisure and social connection to self-directed learning and instrumental tasks like homework. Extracurricular domains, such as maker spaces, coding clubs, competitions and hackathons, are typically voluntary, interest-driven, and project-based.

*2) Social Actors:* The second dimension, **With whom**, focuses on the influential social actors present in each contextual domain. At home, the primary social actors are family members. At school, they are teachers and peers. In extracurricular settings, they are often mentors and like-minded peers who form a community of practice. These mentors shape young adult's experience with technology by providing support, offering feedback (which can be supportive or critical), establishing norms, and acting as role models.

*3) Interaction Patterns:* By analyzing **how** individuals use ICT devices (see Section II.A), recurring interaction patterns emerge. Regardless of whether the setting is domestic or educational, these patterns can be grouped into the following five distinct clusters of ICT-related activities:

- Acquiring general ICT skills and basic digital literacy (e.g., basic system operation, internet and email use, file management), including the everyday use of digital devices
- Using software applications to accomplish specific tasks (e.g., office tools for word processing, spreadsheets, presentations, editing images or videos)
- Creating and developing computational artefacts, such as programs or websites
- Engaging with hardware systems (e.g., assembling or upgrading computers), including robots and simple electronic kits
- Engaging in digital gaming activities on PCs, game consoles and mobile devices

Table I operationalizes this situational framework. Informed by the literature review in the preceding section, it describes for each contextual domain (home, school and extracurricular context) the involved social actors and the predominant interaction patterns with ICT. The characterization of interaction with the respective social actors is further based on the analysis by [32].

TABLE I. A FRAMEWORK FOR ANALYZING TECHNOLOGY EXPOSURE CONTEXTS (SOURCE: OWN DEPICTION)

<table>
<tr><th rowspan="2">Dimension</th><th colspan="3">Contextual Domains (Where?)</th></tr>
<tr><th>Home Context</th><th>School Context</th><th>Extracurricular Context</th></tr>
<tr><td>Social Actors<br>(With whom?)</td><td>Family (parents, siblings, close relatives), friends (live, online)<br><br>Interactions are informal and affective:<br>• (+) Informal encouragement, emotional support, and instrumental help<br>• (-) Can be a source of conflict, apathy, or restriction (e.g., over screen time, type of use)</td><td>Teachers, peers<br><br>Interactions are formal and evaluative:<br>• (+) Structured, constructive feedback and formal instructions<br>• (-) Can be punitive, overly comparative, or create social pressure and exclusion among peers</td><td>Mentors, experts, like-minded peers<br><br>Interactions are collaborative and performance-driven<br>• (+) Fosters community through shared interest, mentoring, and specialized collaboration<br>• (-) Can be intensely competitive, leading to gatekeeping, exclusion, or imposter syndrome</td></tr>
<tr><td>Interaction Patterns<br>(How?)</td><td>Broad & Interest-Driven:<br><br>• High prevalence of digital gaming and using software applications for homework/leisure.<br>• Provides unstructured opportunities for self-initiated creation of artefacts (e.g., personal websites), hardware engagement (e.g., PC building), and informal acquisition of skills.</td><td>Prescribed & Task-Oriented:<br><br>• Strong focus on acquiring general ICT skills through formal instruction and using software applications for assigned tasks.<br>• Creation of artefacts is typically limited to specific CS curricula.<br>• Time is limited to the duration of the school lesson.<br>• Unstructured gaming and hardware engagement are generally absent or restricted.</td><td>Focused & Project-Based:<br><br>• Primary emphasis on creating computational artefacts and engaging with hardware systems (e.g., robotics).<br>• Acquiring skills is advanced and goal-oriented.<br>• Digital gaming may be reframed as a creative activity (e.g., game jams).</td></tr>
</table>

### D. *Framework of Multidimensional Technology Experience*

Building upon these distinct theoretical foundations, this paper develops and puts forward a novel conceptual framework, which we term the **Multidimensional Technology Experience**. Figure 2 presents this framework, which integrates quantitative indicators with contextual and interactional dimensions into a unified model.

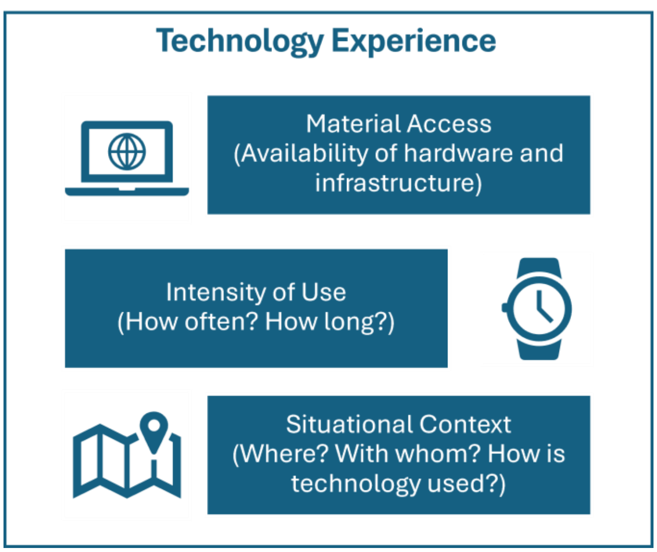



Figure 2. Technology experience, Source: own depiction.

At the quantitative level, 'Material Access' and 'Intensity of Use' serve as the primary indicators of technology exposure, defining the magnitude of the user's contact with ICT. It can be considered as a prerequisite condition for any digital literacy or extended engagement with ICT. This exposure is necessarily situated within specific situational contexts, capturing the socio-spatial setting (e.g., the structured environment of a school vs. the informal environment of the home) and the social nature of the task (individual vs. collaborative).

### E. *Ability Self-Concept*

The expectancy-value theory by Eccles and Wiegfield (see e.g., [33]) posits that a person's motivation to engage in a particular task is determined on the one hand by their expectation of success in that task, and on the other hand, on the value they place on it. It helps explain motivational factors that translate into behavioral outcomes, such as selecting a particular study program or career path [2]. The ability self-concept refers to a person's perception of their own competence in a particular domain or area. It is the personal view on the own ability to perform tasks or succeed in activities related to this domain. An example that is intensively studied is the self-concept of math ability, or short math self-concept. It is influenced by previous experiences, feedback from significant others (such as parents, teachers, and peers), the immediate social environment, and social comparisons [2]. For instance, a student's math self-concept would be shaped by their past performance in math (e.g., in tests), the feedback they receive about their math skills, and how they see themselves compared to their classmates in math-related tasks.

*1) CS Self-Concept:* Just as with math self-concept, the idea of self-concept can be applied to CS, corresponding to the question "How do I assess my own skills in CS?" There are studies that address the self-concept of computer ability (see e.g., [2]), which typically pertains to general computer usage skills, such as using software applications, or internet navigation. However, this idea differs from a CS self-concept, which is concerned with perceptions related to CS as an academic and professional field, including for instance programming, understanding algorithms, or problem-solving. Unlike the large number of studies on math and science self-concept, the CS self-concept seems not well covered.

*2) Gender differences in STEM-related self-concepts:* Past research often revealed gender differences in STEM-related self-concepts, being already apparent at school. Typically, boys express greater confidence in their success and skills in areas traditionally considered male-dominated, such as mathematics, physical sciences, and sports [2]. Conversely, girls tend to have a higher self-concept of their verbal abilities compared to boys.

*3) Influencing Factors on CS Self-Concept:* Self-concept is not formed in a vacuum. It is profoundly shaped by social factors such as school interactions, family support, peer influence, the availability of relatable role models to look up to, and personal interest [2]. Regarding the CS self-concept, especially the situational contexts in which young people are exposed to technology are relevant. In structured settings like a classroom, a student's CS self-concept is shaped by feedback, especially from teachers. Grades, teacher comments in class, and competition results establish a system where students are openly judged, which can motivate but also demotivate them [32]. Students inevitably benchmark themselves against their peers, observing who is quicker, more adept, or more celebrated for their abilities in areas like coding, debugging, or robotics.

The home context, however, works more subtly, shaping the value and emotional tone associated with CS. Feedback is not delivered through grades but through daily conversations with family and friends, shared activities, and the implicit encouragement or discouragement of certain pursuits. A parent's enthusiasm can frame a technical challenge as a valuable learning opportunity, while frequent restrictions can signal that such activities are a trivial waste of time.

### *F. Research Questions*

The studies presented in the literature review analyzed the effects of technology experience from various perspectives. However, to the best of our knowledge, they do not examine how the different dimensions of this experience—ranging from the access, intensity of use to the situational context—are associated with interest in and self-concept regarding CS.

To address this, the inquiry begins with the logical foundation: the relationship between technology exposure and CS self-concept. The principle is straightforward: increased access and regular use are expected to build familiarity and technical competence, which in turn should strengthen an individual's CS self-concept, i.e., their belief in their own ability to succeed in the field of CS.

While this provides an essential starting point, it treats exposure primarily as a material phenomenon, often overlooking the crucial situational context in which it occurs. As discussed in Section II, the informal and affective nature of the home environment is profoundly different from the more structured, evaluative contexts of school or extracurriculars.

Building upon this foundational model, it is hypothesized that the social dynamics within the home, specifically, the degree of supportive family interaction with regard to CS, act as a key mediating factor. This proposes that it is not merely access to technology, but the encouragement surrounding its use, that builds a resilient CS self-concept. This integrated line of reasoning is operationalized in the following research questions. Furthermore, special emphasis is placed on differences between young women and young men, as studies in STEM often report significant gender disparities (see Section II.B).

- **RQ1 (The Foundational)**: To what extent is technology exposure in the home context related to young adults' CS self-concept, and are there significant differences between young women and young men?
- **RQ2 (The Contribution of Family Support)**: To what extent is the perceived family support for CS related to young adults' CS self-concept, and are there significant differences between young women and young men?

## III. METHODOLOGY

The next section presents the methodology, including the study design, the sample composition, and the data analysis strategy. Moreover, it discusses the limitations of the presented approach.

### *A. Study Design*

The data analyzed in this paper were collected in a German-wide study on young adults' career choices with regard to CS. Ethical clearance was obtained from the ethics committee of the authors' institution. In June 2024, an online survey was conducted in collaboration with a reputable market research organization who already had a market panel consisting of young adults in all federal states of Germany. The panel is ISO 20252 certified and adheres to strict ethical standards, including those set by, for example, DGOF, ESOMAR, and ADM, for participation in market research studies. Students under the age of 18 may join the panel only with the written consent of their parents. This form of collaboration was chosen because regulations on whether and how students can be contacted via schools differ among Germany's federal states, significantly limiting direct access to the student population. The study was funded by the authors' higher education institution. The authors declare no conflicts of interest related to this work.

The online questionnaire contained closed and open-ended questions, taking a total of about 15 minutes to complete. This survey explored a diverse range of topics, including the determinants of young adults' career decisions, their perceptions of CS as a viable professional path, and different factors influencing young adults' career decisions for or against CS. One set of questions focused on technology exposure, specifically the availability and the regular use of ICT devices at home. Another set of questions asked participants how they perceive their family support with regard to CS.

### B. Sample Composition

The online survey targeted students and young adults between 15 and 20 years of age who are in the process of choosing a career, or who have just decided on a course of study or occupation. As the aim of the study is to analyze the factors that influence career choice, it is important that participants are in this decision phase. For this reason, participants outside this age group were excluded from the survey. Students under the age of 15 often have not yet decided on a particular profession or field of study. In contrast, young adults over the age of 20 have usually already taken this decision. A total of 822 respondents participated in the online survey. The sample comprised 315 (38.3%) young men, 506 (61.6%) young women, and one person who identified as non-binary (0.1%). Table II summarizes the sample characteristics.

TABLE II. SAMPLE CHARACTERISTICS

| Age | Results | | | |
|---|---|---|---|---|
| | ***Female* N (%)** | ***Male* N (%)** | ***Non-binary* N (%)** | ***Total* N (%)** |
| 15 | 37 (7.3%) | 44 (14.0%) | 0 | 81 (9.9%) |
| 16 | 60 (11.9%) | 53 (16.8%) | 0 | 113 (13.8%) |
| 17 | 84 (16.6 %) | 58 (18.4%) | 0 | 142 (17.3%) |
| 18 | 133 (26.3%) | 75 (23.8%) | 0 | 208 (25.3%) |
| 19 | 99 (19.6%) | 37 (11.7%) | 1 (100%) | 136 (16.6%) |
| 20 | 93 (18.4%) | 48 (15.2%) | 0 | 141 (17.2%) |
| **Total** | **506 (100%)** | **315 (100%)** | **1 (100%)** | **822** |

### C. Data Analysis Strategy

Descriptive statistics are used to characterize the patterns of technology exposure among young adults, specifically focusing on indicators of exposure (self-reported availability and regular use) within the home context. Subsequently, inferential statistics (independent-samples t-tests) are applied to examine significant differences between young women and men. Finally, correlation and regression analyses are performed to determine the extent to which these exposure metrics are associated with the participants' CS self-concept. The same approach is applied to analyze the perceived family support for CS.

### D. Limitations

There are some limitations based on the study design and the data obtained. Although the participants were drawn from all federal states, the data are not fully representative of all German young adults and should not be generalized. Regarding the respondents' age, the young men were slightly younger than the young women. The data set contains only one non-binary person, who was excluded from all gender-specific analyses as no meaningful statistical conclusions can be drawn from a single participant. Moreover, the assessment of technology exposure has certain limitations, notably that it did not quantify the frequency of use of each device in terms of hours per week, nor did it assess the purpose of use like it was done for instance by [27].

## IV. ANALYSIS OF TECHNOLOGY EXPOSURE

The quantitative analysis operationalized technology exposure through self-reported availability and regular use of ICT devices at home. It considers both the physical access (Do I have the device?) and functional access (Do I have internet?). The intensity of use is approximated by regular use, which serves as a proxy for sustained engagement with technology.

### A. Young Adults' Technology Exposure at Home

The survey asked respondents about the use of IT devices at home, especially a computer/laptop or tablet, the constant availability of Internet access, and the availability of a game console or VR glasses at home. A Likert scale of 1 and 5 was used to scale the responses, ranging from strong disagreement (1) to strong agreement (5).

*1) Overview:* First of all, an overview of the young adults' exposure to technology is provided. Table III shows the extent of technology exposure of the young adults surveyed. The vast majority of the young adults, 83.4% (sum of the top-2 boxes "agree" and "strongly agree"), have consistent internet access, underscoring prevalence of connectivity. Only 7.2% (sum of "strongly disagree" and "disagree") report limited internet access, indicating a minority facing potential barriers to ICT.

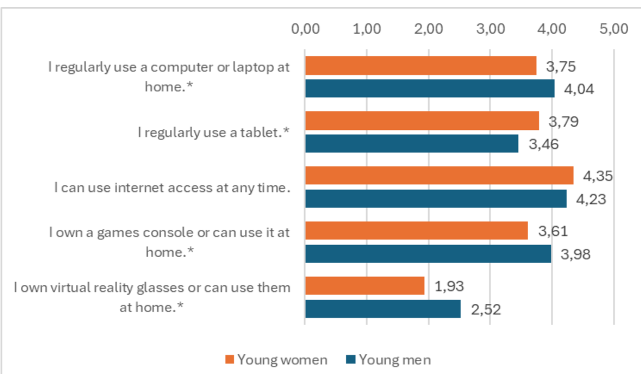
About two-thirds, 66.3% (top-2 boxes), report regularly using a computer or laptop at home, indicating widespread access. A small percentage, 13.9% (top-2 boxes), do not engage in regular use, which may reflect either a lack of necessity or access. Tablets are also common, with 61.5% (top-2 boxes) of respondents engaging regularly. A relatively higher percentage (19.9%) disagrees or strongly disagrees with regular usage compared to computers/laptops (13.9%).

Game consoles are popular, with 66.1% (top-2 boxes) of respondents having access, while 17.8% do not. VR glasses have the least exposure, with only 19.6% reporting access and 67.2% lacking or not using them at home. These low figures reflect either the novelty, cost barrier, or niche market status of VR technology compared to more established devices like computers and tablets.

TABLE III. RESULTS ON TECHNOLOGY EXPOSURE

| Technology exposure at home | Answers: Total number = 822 (100%) | | | | |
|---|---|---|---|---|---|
| | *Strongly disagree N (%)* | *Disagree N (%)* | *Neutral N (%)* | *Agree N (%)* | *Strongly agree N (%)* |
| I regularly use a computer or laptop at home. | 35 (4.3%) | 79 (9.6%) | 163 (19.8%) | 236 (28.7%) | 309 (37.6%) |
| I regularly use a tablet. | 70 (8.5%) | 94 (11.4%) | 153 (18.6%) | 229 (27.9%) | 276 (33.6%) |
| I can use internet access at any time. | 18 (2.2%) | 41 (5.0%) | 77 (9.4%) | 223 (27.1%) | 463 (56.3%) |
| I own a games console or can use it at home. | 74 (9.0%) | 72 (8.8%) | 133 (16.2%) | 245 (29.8%) | 298 (36.3%) |
| I own virtual reality glasses or can use them at home. | 362 (44.0%) | 191 (23.2%) | 108 (13.1%) | 98 (11.9%) | 63 (7.7%) |

*2) Gender Differences:* The next step was analyzing differences in technology availability and accessibility among young women and men. Figure 3 shows the technology exposure reported by both genders for all five statements. Using an independent samples t-test, statistically significant gender differences could be identified. Effect size is measured using Cohen's d and interpreted according to Cohen [34], with values of approximately 0.2, 0.5, and 0.8 indicating small, medium, and large effects, respectively.




t-test, N female: 506, N male: 315, *. p <0 .001

Figure 3. Gender Differences in Technology Exposure.

Regarding the regular use of a computer or laptop, young men have a higher mean score ($M_m$=4.04, and Standard Deviation $SD_m$=1.108) compared to young women ($M_f$=3.75, $SD_f$=1.164). The difference is statistically significant (t(691)=-3.164, $p$<0.001) with a small effect size (Cohen's d= -0.256), suggesting a slight gender preference towards computer usage among males. The opposite is the case for tablets, which are used more by young women ($M_f$=3.79, $SD_f$=1.204) than young men ($M_m$=3.46, $SD_m$=1.369). This difference is also statistically significant (t(602)=-3.518, $p$<0.001) with a small effect size (Cohen's d= -0.260).

Young men ($M_m$=3.98, $SD_m$=1.182) reported higher values with regard to the ownership and use of games consoles than young women ($M_f$=3.61, $SD_f$=1.311). This difference is statistically significant (t(717)=-4.219, $p$<0.001) with a small effect size (Cohen's d=-0.296), indicating a more noticeable gender disparity. With respect to the ownership or use of VR glasses, young men have a substantially higher mean ($M_m$=2.52, $SD_m$=1.408) compared to young women ($M_f$=1.93, $SD_f$=1.191), indicating greater access or usage among males. This disparity is statistically significant (t(584)=-6.175, $p$<0.001) with a medium effect size (Cohen's d= -0.461).

Regarding the availability of internet access, there is no statistically significant difference between the genders ($M_f$=4.35 / $M_m$=4.23, $SD_f$=0.915 / $SD_m$=1.078).

### B. *Young Adults' CS Self-Concept*

To assess the CS self-concept, an established scale based on the expectancy-value theory was used. The items used by [3] to measure expectations of math success were adapted. For instance, the item "I am talented at math" was changed to "I am talented at CS". The same 5-point Likert scale [1-strongly disagree to 5 strongly agree] was used as for the measurement of technology exposure. For the following independent samples t-test, these items are aggregated for each participant to a single score "CS self-concept".

The average CS self-concept in the sample was M=2.96 (SD=0.950). The results show some caution in self-assessing one's competence, with many values falling in the moderate range. Comparing genders, young men have a higher average CS self-concept ($M_m$=3.35, SD=0.891) than young women ($M_f$=2.72, SD=0.906). The difference is statistically significant (t(819)=-9.735, $p$<0.001) with a medium to large effect size (Cohen's d = 0.699).

### C. *Impact of Technology Exposure On CS Self-Concept*

Having analyzed technology exposure and CS self-concept separately, the relationship between these two concepts is explored. Like the CS self-concept, the overall technology exposure scale score for each participant is calculated based on the mean score of the above presented five items measuring various aspects of technology exposure.

*1) Correlation:* First, it is explored whether there is a positive correlation between technology exposure and CS self-concept. The hypothesis is: The higher a young adult's overall exposure to technology, the higher their CS self-concept. Pearson's Correlation Coefficient was calculated. According to [35], there was a moderate to strong positive correlation between technology exposure and CS self-concept, r(820)=.403, p<0.001. Looking only at young men, a strong positive correlation can be seen with $r_m$(313)=.542, p<0.001, while there is a moderate positive correlation ($r_f(504)=.292$, p<0.001) for young women.

*2) Regression Analysis: Technology Exposure as Predictor of CS Self-Concept:* The next step was to examine whether technology exposure predicts the CS self-concept. Overall, a significant regression was found with $R^2 = .163$, $F(1,820) = 159.297$, $p< .001$, corresponding to a moderate effect size according to [34].

For young women, the analysis indicated a significant regression was found with $R^2=.084$, $F(1,504)=47.134$, $p<0.001$, corresponding to a moderate effect (f=0.30). Conversely, for young men, a strong effect (f=0.65) was observed, with $R^2= .294$, $F(1,313) = 130.110$, $p< .001$. These results suggest that technology exposure has varying predictive power on the CS self-concept based on gender. For young women, technology exposure is a minor predictor of their CS self-concept, explaining only 8.4% of the variance. In contrast, it is a substantial predictor for young men. Approximately 30% of their CS self-concept is explained by technology exposure. This means that there are other factors that explain the remaining 70%, which could be factors such as school experiences, family background, or friends.

In summary, to answer RQ1, technology exposure in the home context (availability and regular use) has a moderate relationship with young adults' CS self-concept overall. However, there are profound and significant differences between genders. For young men, technology exposure is a strong predictor, accounting for a substantial 29.4% of the variance in their self-concept. In stark contrast, for young women, the relationship is much weaker, explaining only a modest 8.4% of the variance. This indicates that the home technology environment plays a significantly more influential role in shaping young men CS self-concept than it does for young women.

## V. Analysis of Young Adult's Perceived Family Support for CS

After analyzing young adults' technology exposure at home, the focus now shifts to the support that young adults perceive their parents to provide with regard to CS.

### A. Young Adults' Perceived Family Support for CS

To measure perceived family support, the survey asked respondents about their parents' beliefs regarding CS as a career and the young adult's personal competence in the subject. The questionnaire employed four items adapted from the scale used by Esch & Grosche [34], which is designed to capture parental encouragement and esteem support. Respondents rated their agreement with statements on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

*1) Overview:* Table IV shows young adults' perception of their parent's beliefs regarding CS and their own competence in this field. The descriptive analysis of the four family support items (N=822) indicates that young adults, on average, perceive their family support as modestly positive. With all mean scores hovering slightly above the neutral midpoint of 3.0 (ranging from M=3.11 to M=3.37 on a 5-point scale), a deeper look at the frequency distributions reveals a more complex and polarized landscape than the means suggest.

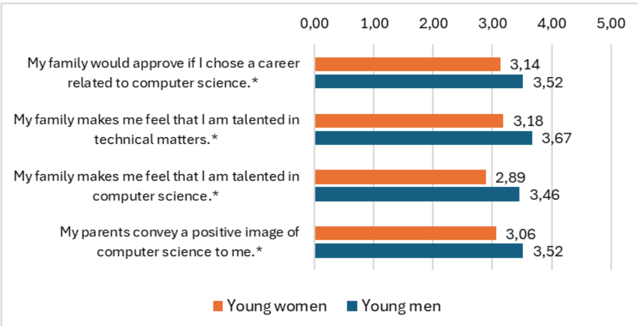
A notable contrast emerges between the two items measuring perceived competence. Young adults felt the most support for their general "technical talent", with a majority (50.3%) agreeing with this statement. However, this encouragement did not translate to the specific discipline of CS. In fact, the item measuring perceived "talent in computer science" received the strongest negative feedback, with nearly one-third of respondents (31.9%) actively disagreeing. This gap suggests that while families praise general tech-savviness, they are far less likely to affirm their child's specific abilities within the academic field of CS.

Another key finding is the large number of neutral responses. For questions about career approval and the image of CS, "neutral" was the single most common answer, chosen by nearly one-third of respondents (30.8% and 31.5%). This widespread neutrality suggests that for a large portion of young adults, their family's attitude is not one of support or opposition, but of simple indifference or disengagement. This points to a missed opportunity for parental encouragement.

TABLE IV. RESULTS OF THE PERCEIVED FAMILY SUPPORT FOR CS

| **Perceived Family Support for CS** | **Answers: Total number = 822 (100%)** | | | | | |
|---|---|---|---|---|---|---|
| | ***Strongly disagree N (%)*** | ***Disagree N (%)*** | ***Neutral N (%)*** | ***Agree N (%)*** | ***Strongly agree N (%)*** | ***Average (Standard deviation)*** |
| My family would approve if I chose a career related to computer science. | 64 (7.8%) | 130 (15.8%) | 253 (30.8%) | 258 (31.4%) | 117 (14.2%) | 3,28 (1.13) |
| My family makes me feel that I am talented in technical matters. | 60 (7.3%) | 126 (15.3%) | 223 (27.1%) | 275 (33.5%) | 138 (16.8%) | 3,37 (1.15) |
| My family makes me feel that I am talented in computer science. | 91 (11.1%) | 171 (20.8%) | 212 (25.8%) | 255 (31.0%) | 93 (11.3%) | 3,11 (1.19) |
| My parents convey a positive image of computer science to me. | 69 (8.4%) | 136 (16.5%) | 259 (31.5%) | 247 (30.0%) | 111 (13.5%) | 3,24 (1.34) |

*2) Gender Differences:* The data clearly shows that young men and women experience family support for CS in fundamentally different ways (see Figure 4). Across all four categories, young men reported significantly ($p$<0.001) higher levels of encouragement than young women.




t-test, N female: 506, N male: 315, *. p = 0.000

Figure 4. Gender Differences in Perceived Family Support for CS.

Gender disparities are most pronounced in the area of perceived competence. The most striking difference is in feeling “talented in computer science”, where the average score for young women ($M_f$=2.89, $SD_f$=1.188) falls below the neutral midpoint. This suggests that young women, on average, feel their families actively doubt their specific abilities in the field, a stark contrast to the clear encouragement young men report ($M_m$=3.46, $SD_m$=1.095). The difference is statistically significant (t(819)=-6.924, p=.000) with a medium effect size (Cohen's d= -0.497). A similar, though less severe, pattern appears for general “technical talent”. While young women feel modestly supported ($M_f$=3.18, $SD_f$=1.143), they receive significantly less praise than their male counterparts ($M_m$=3.67, $SD_m$=1.091), and (t(819)=-6.028, $p$<0.001) with a small to medium effect size (d=-0.433).

This trend extends to broader career support, where young men report consistent, positive reinforcement from their parents for choosing a CS career ($M_m$=3.52, $SD_m$=1.057) and a positive image of the field ($M_m$=3.52, $SD_m$=1.081). Young women, in contrast, report scores barely above neutral ($M_f$=3.14, $SD_f$=1.149, and $M_f$=3.06, $SD_f$=1.134, respectively), indicating a lack of active family endorsement for pursuing a CS path. For both items, the differences are statistically significant (t(819)=-4.780, p<0.001 for a CS career, and t(819)=-5.680, $p$<0.001 for a positive image of CS) with a small effect size (d=-0.343 and d=-0.408).

### B. Impact Of Perceived Family Support for CS On CS Self-Concept

Now, the relationship between young adults’ perceived family support for CS and their CS self-concept is explored. Therefore, the overall perceived family support scale score for each participant is calculated based on the mean score of the above presented four items measuring different aspects of family support.

*1) Correlation:* A Pearson correlation coefficient was calculated for both young women and young men to evaluate the relationship between perceived family support for CS and CS self-concept. The strength of the relationship is interpreted according to [33]. The hypothesis is that the higher a young adult’s perceived family support for CS, the higher their CS self-concept. For young women, a significant strong positive relationship between perceived family support for CS and CS self-concept was found ($r_f$(504)=0.620, p<0.001). Considering only young men, there was a significant positive relationship, too ($r_m$(313)=0.657, p<0.001). A direct comparison of the coefficients shows that the strength of the relationship between family support and self-concept is very similar for both genders, though slightly stronger for young men. As hypothesized, the results show that the more family support a young adult perceives, the higher their CS self-concept.

*2) Regression Analysis: Family Support as Predictor of CS Self-Concept:* Then, regression analysis was used to examine whether perceived family support for CS predicts the CS self-concept. For young women, there was a significant regression F(1,504) = 315.264, p< .001. The $R^2$ was 0.384, indicating that perceived family support for CS explained 38.4% of the variance in CS self-concept. The effect size is large (f=0.79), interpreted according to [34]. For young men, a significant regression was found F(1,313) = 238.035, p<0.001. The $R^2$ was 0.432, indicating that perceived family support for CS explained 43.2% of the variance in CS self-concept, corresponding with a large effect size (f=0.87). These results suggest that family support is a powerful predictor of CS self-concept for all young adults. However, the model indicates that family support has slightly more predictive power for young men's self-concept than for young women's.

In summary, to answer RQ2, perceived family support for CS has a strong positive relationship with young adults’ CS self-concept overall. The key finding is that this support is a foundational predictor for both genders, explaining a substantial 43.2% of the variance for young men and a similarly large 38.4% for young women. The critical disparity, therefore, is not in the importance of this support, but in the amount of support that is actually perceived. As the analysis in Section V.A showed, young women report receiving significantly less encouragement than young men. The significant gender disparity lies not in the strength of this relationship, but in the unequal distribution of support itself, with young women reporting significantly lower levels of encouragement than young men, depriving them of a crucial resource for building confidence.

## VI. Discussion and Implications

This section discusses the key findings from both the quantitative analyses and explores their broader implications.

### A. From Access to a Broader Picture of Technology Experience

The analysis of the survey data on technology exposure at home (Section IV) confirmed that the widespread access to ICT devices – particularly computers, laptops, tablets, and game consoles – can nurture a general comfort with ICT. A high technology exposure had an overall moderate effect on young adults' CS self-concept. However, the data indicates gender differences. Regarding technology exposure at home, males generally reported higher usage of computers/laptops, game consoles, and VR technology, while females reported higher usage of tablets. The differences, though statistically significant, mostly indicate small effect sizes except for game consoles and VR, which show moderate gender-specific preferences. These results are in line with a German-wide study on the media equipment and media usage of teenagers (12-19 years) in 2024 [36]. In terms of owning devices, boys are more likely to own fixed and portable game consoles and computers compared to girls. In contrast, girls tend to own smartphones, tablets, and e-book readers more frequently than boys [36, pp. 7–8]. The study did not ask for the ownership or usage of VR glasses.

Bitkom e.V. analyzed the usage of consumer technology in Germany in 2024 [37], differentiating between age groups but not gender. In the group of 16 to 29-year-olds, 43% have already used VR glasses. Nearly half of this age group thinks VR glasses will become standard household equipment in the future. In the study presented here, about 20% of young adults reported the availability of a VR glass at home. This discrepancy between usage and availability suggests that while many young adults may have tried VR glasses, possibly at exhibition centers, in museums or event arenas, fewer of them have made the transition to owning this technology. This might be due to factors such as cost, perceived need or little knowledge of possible applications.

The analysis in Section IV showed an overall moderate effect of technology exposure on young adults' CS self-concept. Placing this effect in the context of device availability suggests that the widespread access to ICT devices – particularly computers, laptops, tablets, and game consoles – can nurture a general comfort with ICT. While this baseline familiarity could set a foundational level of confidence, more specific or advanced technology experience might be required to notably impact self-concept. For instance, using a computer for programming or a VR setting for simulations may contribute more significantly than passive use for entertainment.

Beyond differences in access and usage, the study identified a crucial gender disparity in how exposure translates into confidence. While technology exposure serves as a substantial predictor of CS self-concept for young men, its predictive value for young women is comparatively minor. This finding fundamentally underscores the limitations of purely quantitative metrics of technology exposure. Simply having access to ICT devices sets the baseline, but is insufficient to foster a robust belief in young adults' own capabilities with regard to CS. These results validate the theoretical necessity of the multidimensional technology experience framework introduced in Section II, which expands the analytical lens to include the situational context in which technology exposure takes place.

### B. *When Support Falls Short: Gender Gaps in Family Encouragement for CS*

The analysis highlights a critical tension in the formation of young women's CS self-concept. On one hand, the quantitative analysis revealed that young women report a statistically significant lower level of exposure to computers, laptops, and game consoles. On the other hand, our work suggests that bridging this exposure gap is only part of the solution. Simply providing a young woman with a laptop is unlikely to be effective if she believes CS is a "boy's club", lacks female friends who share her interest or relatives working in the field, and feels her questions and contributions in class are overlooked. This example illustrates that the formation of self-concept is influenced by multiple factors, such as family encouragement, peer relationships, school engagement, role models, and one's own interests [2], [3].

It is precisely within this family context that the central finding of this study emerges. The analysis shows that perceived family support is a foundational predictor of CS self-concept for all young adults. Critically, however, the results also demonstrate that this vital resource is unequally distributed: young women report receiving significantly less support than young men, particularly regarding their competence. This means young women are systematically deprived of the very social-emotional support that is most critical for building the confidence needed to persist in the field of CS.

The results may point into a further direction, namely how feedback is given. Literature on this topic highlights the pronounced impact of feedback for young women [38], suggesting that the most empowering feedback often combines two elements: process-related feedback that highlights their effective strategies and effort, and person-related feedback that recognizes their talent and their abilities in STEM [39]. Our results suggest that families may be failing at this second, crucial part. While a parent might offer general encouragement for being "good with technology" (a form of process/effort praise), our data shows a significant drop-off in affirming their daughter's specific talent "in computer science". This lack of direct, identity-affirming validation in the specific domain of CS is likely a key mechanism behind the support deficit we identified.

Interventions should therefore target not only access to technology, but also the communicative practices through which competence in CS is recognized and affirmed. An effective intervention is thus not simply to tell families to "be more supportive". It is to guide them on how to provide this specific, two-pronged feedback. Just as emerging research offers tools to help teachers craft more effective feedback for female students [40], future work could focus on creating accessible resources, such as workshops or informational guides, to help parents recognize and validate their daughters' emerging identities as capable computer scientists.

## VII. Conclusion and Future Work

The study examined the relationship between technology experience and CS self-concept among young adults, with a particular focus on gender disparities. Building on a quantitative analysis in [1], this work provides a complementary quantitative analysis of the perceived family support for CS reported by the same survey cohort. A central contribution of this study is a novel, multidimensional framework for structuring technology experience. It comprises three key dimensions: Material access, intensity of usage and the situational context in which the technology is used.

The findings reveal that while technology exposure is a factor, it is insufficient on its own to shape a strong CS self-concept, particularly for young women. Mere access to technology is not enough. Consider the following example: two users may engage in the exact same activity, such as engaging with hardware, yet experience vastly different levels of cognitive demand and personal agency. For instance, one student might simply watch a video demonstrating the assembly of a robot (passive observation), while another student assembles the hardware and codes the robot's movement (constructive creation). To allow for a more nuanced analysis, future work should extend the multidimensional framework by adding further aspects on how individuals interact with ICT. Such richer forms could be characterized by increased user agency over digital systems, greater involvement in the modification or creation of digital artefacts, or deeper engagement with underlying technological structures such as software, hardware, or computational logic.

Furthermore, the results confirm the importance of a supportive context, underscoring the critical role of the family and their support in fostering confidence and interest in CS. This study demonstrates that family support is a powerful predictor of CS self-concept for everyone, yet it is a resource that young women report receiving far less of. This disparity at home represents a critical, often-overlooked barrier that educational interventions alone cannot overcome. This highlights a critical intervention point: equipping parents with the awareness and language to move beyond gendered praise and specifically affirm their daughters' potential as creators and problem-solvers in the field, thereby building the resilient self-concept needed to succeed. Based on the findings, three primary avenues for future research emerge: intervention studies to test solutions, longitudinal studies to understand development over time, and qualitative studies to explore mechanisms in depth.

First, to directly address the support gap identified in this study, intervention research should focus on designing and testing practical solutions. One promising avenue is the development of parent-child joint CS activities, such as co-designing a simple video game or building a programmable robot. For young women specifically, such an intervention would create a shared, positive experience in which parents can be guided to offer the specific, identity-affirming feedback that our study shows is often missing. Assessing the impact of such an intervention through a pre-post experimental design could provide powerful evidence for a scalable solution that strengthens the entire family support system.

Second, to move beyond correlation and understand the developmental trajectory of CS self-concept, a longitudinal study is a critical next step. Following a cohort of young adults from middle school through their early college years would allow researchers to map how family support, technology experiences, and self-concept interact and influence each other over time. Such a longitudinal design would show how different types of family support (e.g., emotional vs. instrumental) from different caregivers (e.g., mothers vs. fathers) shape career aspirations and academic choices over the long term.

Finally, while our quantitative data shows *that* a support deficit exists, qualitative research is needed to understand the lived experiences *behind* these numbers. A valuable first step in this direction can be taken by analyzing the open-ended data on "critical incidents" already collected in the present study. A first screening has revealed that some incidents describe successfully using ICT, installing software, or solving hardware issues, and highlight how overcoming technical problems can foster a sense of pride and motivate further exploration of CS. This provides a rich inventory of competence-building events. The crucial next step, best explored through in-depth, semi-structured interviews, would be to understand the social context of these very incidents.

By addressing these areas, future work can inform strategies that create a diverse and inclusive CS workforce.

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