“I would be afraid to be a bad CS teacher": Factors Influencing Participation in Pre-Service Secondary CS Teacher Education

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ABSTRACT

Objectives. Teachers are essential to making computing education available to students. A key place to sustainably prepare computer science (CS) teachers is in pre-service preparation programs, which are often required for certification in the United States. Prior work has examined many reasons that people choose to become teachers — or choose not to — but little prior work has examined factors that shape the pursuit of CS certifications in pre-service in particular.
Participants. We recruited five teacher candidates who chose to pursue CS training in a new pre-service teacher preparation program in the United States and five candidates who expressed interest, but ultimately opted out.
Method. We conducted semi-structured, remote interviews and performed a thematic analysis to inductively identify factors that influenced candidates' decisions.
Findings. Candidates displayed many conceptions of justice that motivated them to teach CS, including repairing past wrongs in education, improving representation, and expanding literacy. Candidates reported many content knowledge and identity factors, including negative experiences in CS education, low CS self-efficacy, and a sense of not belonging or being respected in CS communities. Capacity for care as novice teachers was another factor: candidates feared not being able to care for students' needs while experiencing exhaustion from teaching and training during a pandemic, as well as the risks of added course preparation workload from being certified in multiple subject areas. Finally, candidates also considered opportunity costs like loss of income and job security as factors influencing their decisions.
Conclusion. These factors highlight the importance of surfacing and dismantling implicit barriers, like injustice and inequity, and explicit barriers, like funding and overwork, so that future teachers feel confident in teaching CS and feel able to create equitable, inclusive environments for students to learn.

CCS CONCEPTS

• **Social and professional topics → K-12 education**.

ICER 2022, August 7–11, 2022, Lugano and Virtual Event, Switzerland

ACM ISBN 978-1-4503-9194-8/22/08.
https://doi.org/10.1145/3501385.3543966

KEYWORDS

teacher education, pre-service, CS education

ACM Reference Format:
Jayne Everson and Amy J. Ko. 2022. “I would be afraid to be a bad CS teacher": Factors Influencing Participation in Pre-Service Secondary CS Teacher Education. In *Proceedings of the 2022 ACM Conference on International Computing Education Research V.1 (ICER 2022), August 7–11, 2022, Lugano and Virtual Event, Switzerland.* ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3501385.3543966

1 INTRODUCTION

Global efforts to increase access and engagement in primary and secondary CS education depend on many things, including policies, funding, curricula, educational technologies, and more. But there is one thing these efforts depend on most: CS teachers. The importance of teachers cannot be understated: they not only shape student learning, but also who feels welcome, inspired, and capable of learning in CS [29] and education more broadly [20]. Efforts across the world have therefore focused intensely on various forms of CS teacher professional development, predominantly for in-service teachers[1] with expertise in other subject areas, but increasingly by starting pre-service CS teacher education programs that grow aspiring teachers' CS content knowledge, CS pedagogical content knowledge, and CS teaching self-efficacy[27]. There are many barriers to creating these pathways – for example, the 2018 report *Priming the Computer Science Teacher Pump* highlighted the need for CS education faculty to design these programs, for doctoral pathways to prepare these faculty, for school leaders to recruit, hire, and support CS teachers, and the need for CS educator community, to prevent isolation [5].

But even if all of these barriers were addressed, one thing must be true: people must want to *be* CS teachers. One can see parallels between the work done, and Social Cognitive Career Theory (SCCT)[19], which examines factors such as identity, self-efficacy, experiences, and environmental influences in career choice. Part of this desire to teach depends on why people choose to teach at all.

Research on motivations to teach has revealed many factors. For some, it is for altruistic reasons, because they think that they can make a positive impact on the world [6, 7]. For others, it it is because they want to offer good instruction to students and make the world better, and believe they might have the skills to do it [3, 6, 7, 16, 30]. Sometimes people pursue teaching to right previous wrongs that they observed or experienced in their own education [14]. Other work shows that some teachers are motivated to support youth to become capable, contributing, and fulfilled adults [1, 21]. Others

[1] Teachers who are already certified and working in schools

still are motivated by developing meaningful relationships with students and offering them care [30].

Whereas many motivations to teach are discipline-agnostic, prior work has found that some factors are discipline-specific. For example, some aspiring teachers report being "called" to the profession to share and cultivate particular disciplinary knowledge with students [1, 16]. Some teachers carry a deep affinity for a subject and want to share their passion [21], or believe they would be particularly good at teaching a discipline's skills and ideas [6]. Perceptions of teaching careers can be greatly shaped by direct observation of or experiences with teaching, like service or shadowing opportunities [15], as well as direct encouragement from a mentor, family member, or advisor [16]. Importantly, which particular factors motivate disciplinary teaching can vary across cultures, especially in relation to a society's respect and need for teachers [10, 15, 18]. And research shows that the specific motivations that drive teaching in particular disciplines varies by discipline. For example, one study showed that the motivations for teaching in STEM varied substantially from teaching the humanities [18]. And, of course, discipline-specific motivations vary by individual [17].

Research on CS teacher pathways is emerging, but has yet to investigate teacher motivations. Most prior work has focused on how to offer CS professional development to in-service teachers and examined the challenges that teachers face in learning. For example, some studies have explored the challenges of talking about equity in professional development [8, 11, 12]. Reviews have found that most professional development in the United States has focused on developing teacher CS content knowledge [22]. Some efforts have integrated with specializations such as special education [2, 24] and social studies [25]. Some studies examine introducing computing concepts to pre-service teachers[32]. Many professional development opportunities are designed to help build teacher CS self-efficacy [28, 31]. Some work has been done to examine teacher identity[26].

While this prior work is developing key insights into how to prepare CS teachers once they have decided to learn, few prior works have provided insight into the specific disciplinary factors that shape teacher decisions about *whether* to learn to teach CS (or not). In this paper, we explore this gap specifically for secondary CS teaching, asking, *what are candidates' motivations for pursuing or not pursuing a CS certification?* We examined this question by interviewing 10 pre-service teachers[2] who were offered an opportunity to engage in a new pre-service CS teacher education program as an extension of their masters in teaching, earning an additional secondary certification. Of these, five decided to join and five did not; we probe into the factors that shaped their decisions to enroll or not enroll.

2 METHOD

Our approach to answering the research question was nominally a series of semi-structured interviews of pre-service students in a one-year Masters in Teaching at a university in North America. We asked questions in the interviews about the phenomena of this decision, with a mind to previous CS experiences, and background that align with the principles of SCCT[19]. However, because we were deeply situated in students' academic program as instructors, many other factors shaped our rapport and relationship to them. Therefore, throughout the methods, we discuss our positionality in the broader context of the students' academic program and how this influenced our recruiting, interviewing, and analysis.

2.1 Positionality

The first author is a white woman with 11 years of classroom mathematics, science, engineering, and CS instruction. She is currently a doctoral student. In her former position as a teacher, she also held roles helping other teachers incorporate CS across disciplines. She believes that CS is a tool that can open doors, but that must be taught with a critical perspective. She was motivated to do this work because she sees how important it is to have teachers that recognize the full selves of students and work to make the most just classrooms possible. Prior to the interviews, the first author served as a Teaching Assistant in the candidates' math teaching methods course in Spring 2021 and their math/science combined assessment course during Fall 2021. She also served as instructional coach, visiting and observing math teacher candidates in their placement classrooms. As a result, she spent eleven months working with, developing rapport, and relationships with candidates interviewed. She was also the pre-doctoral instructor of the CS assessment course required as part of this CS certification program.

The second author is a white and Asian transgender woman with more than a decade of experience in teaching adolescents computing and information in secondary and post-secondary formal and informal settings. Like the first author, she was motivated to study and engage in critical CS pedagogy to help envision and create a world that has a more accurate understanding of the strengths and weaknesses of computing, especially from an equity and justice perspective. She had only met the candidates in a recruiting session six months prior to the study, but was known to the candidates as one of the professors that had helped create the pre-service CS teacher education program to which students were being recruited. She also was aware of many of the candidates' experiences in the pre-service program prior to the interviews, through observations that the first author shared. The second author is the first author's doctoral advisor and helped her with research design, data analysis, and writing.

2.2 Context

This study was conducted during the 2021-2022 academic school year (August-March). Because of the ongoing COVID pandemic, candidates, universities, and schools were shifting back and forth between remote instruction and in-person instruction.

The candidates were enrolled in a one-year masters in teaching at a large public university (hereon referred to as SMIT). The program was one full academic year with a particular focus on equity and justice in education and teaching. Courses run throughout the entirety of the program to provide domain specific support for methods, assessment, literacy, working in schools, and caucusing. Caucusing meant candidates would meet in groups with others who shared some identity facets once a week to learn about, grapple with, and discuss complex justice topics of race, gender, and sexuality.

[2]Teacher Candidates who are studying to learn to teach and not yet certified

The teacher candidates in the program start primarily in coursework with one school placement per week, and over the course of the program transition to full time main instructors with mentor teachers in local public schools as part of their student teaching placement. At the time of the interviews, candidates were completing the end of the one year program and mostly engaged in teaching placements and coaching.

In a typical year, SMIT enrolls 60-100 teacher candidates in the domains of English, Languages, Social Studies, Science, and Math. Students had the option to enroll for an additional term to earn a certification in English Language or Computer Science. The two authors were two of four instructors in the CS certification program.

2.3 Recruiting

To recruit candidates for the CS certification program (which we will refer to as SMIT CS) the SMIT CS team first reviewed all incoming program applicants' transcripts and resumes during the 2020 SMIT application cycle. We tried to identify applicants who had taken at least one introductory programming course or had work experience in software development. We asked these applicants about their interest during the program's normal pre-admission interviews. One thing we observed was that this process did not identify all of the teacher candidates who would be qualified to join SMIT CS. Many candidates had not declared a CS major, but had other majors or minors like Information Science or Data Science, which had adequately prepared them to teach middle and high school level CS.

After admission, we announced an information session about the program to all SMIT students during the first term orientation, also specifically sending invitations to candidates with some possible CS content knowledge. In the information session, the second author explained many equity and justice issues in K-12 CS, higher education, and industry and framed the SMIT CS certification as a way to help create more equitable and just secondary CS learning contexts. The SMIT team continued to communicate with interested students during the program.

In early winter we emailed the entire cohort more information. We were able to offer full tuition scholarships to the initial cohort through a combination of federal and state grants, and so we also asked students to express formal interest and to share what financial needs they would have to enroll. After soliciting this information, we selected a set of students to receive funding based on need, sent invitations to join the program, and invited all students to enroll by a particular deadline if they were interested.

After the enrollment deadline, five students had decided to enroll (all receiving partial or full tuition support) and ten (some of whom had received partial-funding or full-funding offers) declined. We recruited these student candidates by asking all five of the students who had decided to enroll in the certification. All five enrolled students agreed to the interview. We also asked six of the students who had previously been identified as qualified and interested in the CS certification by attending informational sessions or reaching out to program instructors, focusing our recruiting on the most engaged and active candidates. Four of those students signed up for interviews. One did not reply until after all other data had been gathered, and another candidate originally agreed to be interviewed and later declined because of personal obligations and scheduling conflicts. A fifth candidate who decided not to enroll and had not self-identified as interested in SMIT CS had casually mentioned to the first author about their decision not to enroll, so we interviewed them as well.

2.4 Candidates

Of those invited to interview, a total of ten agreed to participate, including all five who decided to enroll and five who declined. Table 1 shows candidates' open field self-reported demographics, primary area of certification, and whether they enrolled in the SMIT CS program. Overall, a small majority identified as female, seven identified as Asian, three as White, and one as Middle Eastern. This is approximately representative of the larger program, but not exactly representative because of sample size.

2.5 Interviews

The first author conducted one hour interviews over Zoom during the local public school midwinter break in February of 2022. The student teachers were in their final required term of the program and were in full-time school placements serving as main instructors. At the point of the interview, all of the students had either committed to join the computer science certification or had decided not to join the certification.

The semi-structured interviews consisted of seven questions that covered the narrative of why these candidates had decided to pursue teaching certification, their attitudes and experiences with computer science, and the decisions and motivations behind their choice to join or not join the CS certification. We began with the prompt *Tell me the story of how you ended up here in the [SMIT] program.*, and then asked clarifying questions. We then asked the candidates *How do you feel about computer science?* and *What were your first experiences with computer science?* Next, we asked candidates *What went into making this decision?* followed by *What hopes do you have?* and *What fears do you have?* Finally, we asked candidates who did not join the program, *What would have convinced you to join [SMIT CS]?* All interviews were recorded and automatically transcribed.

2.6 Analysis

Our analysis followed the principles described by Hammer and Berland [9], who positioned qualitative thematic analysis as interpretative claims about data for later testing, not as structured data for quantification. Therefore, rather than reporting inter-rater reliability analyses and quantities, we share here our analysis process and the interpretative disagreements that emerged in building a shared interpretation.

Our procedure began with the first author reviewing and cleaning the transcripts to verify transcription accuracy. Then, both authors independently performed an inductive thematic analysis of transcripts to identify themes and quotes "generating themes from analysis of significant statements" [4]. The authors then met to present their themes to each other, clarify to each other the theme meanings, and then proceeded to resolve disagreements, synthesizing a shared set of themes representing claims about the data.

Table 1: The ten candidates interviewed, their self-reported gender, race, and ethnicity in a free response survey, their primary field of certification, and whether they chose to enroll in SMIT. Throughout, we note candidates who chose to pursue the CS certification are noted with a superscript '+' (e.g., C6$^+$) and candidates who chose not to pursue a CS certification are noted with a superscript '-' (e.g., C1$^-$).

Candidate	Self-Reported Gender Identity	Self-Reported Race or Ethnicity	Primary Certification Field	Enrolled
C1$^-$	Female	Asian	Science	No
C2$^-$	Cis female	Asian	Mathematics	No
C3$^-$	He/Him/His	Filipino American	Mathematics	No
C4$^-$	Female	White	Language Arts	No
C5$^-$	Cis-female	White	Mathematics	No
C6$^+$	Cis-female	Asian, White	Science	Yes
C7$^+$	Cis-Male	Persian - Middle Eastern	Social Studies	Yes
C8$^+$	Cis Male	Asian	Science	Yes
C9$^+$	Male	Asian	Mathematics	Yes
C10$^+$	Female	Asian	Mathematics	Yes

There was significant overlap in the two authors' themes, but with varying granularity and differences in articulation. Most disagreements concerned nuances in interpretations of justice and teacher motives (e.g., righting historical wrongs versus advocating for new universal literacies). We also discussed nuances in how we interpreted funding barriers and opportunities. Furthermore, we discussed content knowledge versus self-efficacy interpretations between the authors. We examined differences in interpreting structural incentives versus teacher autonomy. After discussing our interpretations of these nuances, both authors perceived high agreement and so we collaboratively synthesized a final set of merged themes based on our individual interpretations.

With this final set of themes, the first author then re-analyzed transcripts to identify instances of the already agreed upon themes, linking them to supporting evidence. She then member checked thematic interpretations of quotes by emailing candidates with their quotes in the context of the results section, asking candidates to verify that interpretations aligned with candidates' intents.

3 RESULTS

All of the themes emerging from our analysis were distinct but interacting factors influencing candidates' decisions to pursue or not pursue the CS certification. We discuss each of these throughout the results, identifying why each factor mattered and how it interacted with other factors.

3.1 Justice

One major set of factors concerned candidates' varying perspectives on what constituted fair and just teaching.

3.1.1 Correcting Historical Educational Inequities and Inequalities. Most candidates saw teaching as an opportunity to correct historical inequities and inequalities in access and representation. They saw enrollment in SMIT CS program as an opportunity to understand and impact change. Many candidates shared previous experiences with computer science that they hoped to fix in their own classrooms.

For example, C2$^-$ shared that they had enrolled in SMIT *"because of their diversity program and teaching for social justice."* and said that when they were considering teaching computer science:

> *"I thought it would be really awesome to start teaching kids of color. Giving them that opportunity. Right? Because I didn't get it until I was in college and I just think that's just an injustice, you know, it's like... it's already weeding out so many kids who were not able to go to college."* – C2$^-$

They went on to share:

> *"You know, it's kind of this tension right. The thing that I fear is that, you know, you need to teach race and gender well in a computer science class, as well as teaching the computer science content well."* – C2$^-$

They felt that they could not teach CS without addressing the inequities of race and gender that CS can perpetuate.

Whereas fears of discussing race and gender in class deterred C2$^-$, C6$^+$ was motivated by representation:

> *"I had a pretty bad experience with computer science in college. I took one class, and … people don't know how to teach computer science and it's a very just white male dominated field, and they teach it like that, and [the authors] know how to teach it – so it'll be okay."* – C6$^+$

This candidate was joining the program because they wanted to teach it better than it was taught to them. They had bad experiences, wanted to learn to teach it well, and were confident that SMIT CS might help them.

When sharing some of their experience in earlier computer science classes, C10$^+$ shared:

> *"looking around my classroom, I think I was more aware of like 'Okay, are there any other girls in this class, where are they?' And then, yeah I felt like it was majority men. I did make one friend and we helped each other out but... I think we both pursued different majors afterwards."* – C10$^+$

While C6$^+$ and C10$^+$ were motivated by correcting under representation, C7$^+$ noted the historical wrong of inequitable access:

> *"One thing was about the ability to climb out of whatever social status, you are based on economic, social status that you are in. The kind of the consistencies of reinforcing certain cultural issues that kept on coming up. I really wanted like also – just what exactly we're teaching for – something that was a big thing for me, and I wasn't sure that's exactly I wanted to do. I'm also a little bit upset about teacher pay And how much debt was going to be incurred If I continue to my program. And yeah, you know, and then also the support from the community, while everyone always says teachers are the best, there it feels like a very much like a gas lighting situation."* – C7$^+$

C10$^+$ felt similarly, envisioning the kind pedagogy she felt students deserved:

> *"have them explore not only CS, but math as well, like the content, as well as what you can do with that. And I think high school is definitely a place in which that can happen. Because not only are they encouraged to do so, but they help their friends. They have all this level of support that is available to them and it's not like they're gonna be wasting time – because that is the time to explore. And so that's one, and I think another hope I have is just for a very selfish... I just want to be like that teacher where [students] are like, 'Oh, I'm very thankful for Ms.[C10$^+$] because she was very encouraging and helped me to realize this passion that I had that I didn't even know I had.'"* – C10$^+$

In contrast, C8$^+$'s conception of justice viewed CS as a way to achieve the American Dream, the myth of financial stability and comfort:

> *"Coming from like an immigrant family, my parents are first generation, like they often... like a lot of my friends and their families kind of see getting into CS as a way to like get into this society. 'Oh you work and you make 100 K and you're set. That's the American dream.' and then like you don't need to like go own a small business and work, seven days a week, every day."* – C8$^+$

This diversity of conceptions of CS education justice, while all emerging from ideas of equity, each emphasized different inequities, from opportunity and pedagogical gaps to ones of representation and oppression. Candidates that raised these justice motives envisioned classrooms that were in contrast to what they had experienced: classrooms in which students were curious, excited to learn, explore, and take risks. However, some had clear enough expectations of themselves that they did not believe they could meet them and declined to enroll.

3.1.2 CS as a Necessary Literacy. Whereas some teachers were motivated by pursuing their notion of CS justice, others had more abstract motivations around bringing CS as a literacy to youth[13]. For example, many candidates shared that they hoped to embed principles of CS in their primary subject certifications like Math, Biology, or History courses. C1$^-$ envisioned a science classroom in which students would be able to use CS as a tool in Biology and Chemistry classes, reflecting:

> *"Oh! bringing computer science into both of those would be amazing right, and you know because, biological and chemistry research, I mean it was like CS and like Data analysis and all that stuff, like it'd be such a good thing to have."* – C1$^-$

Another candidate, C3$^-$ stated:

> *"I really enjoy computer science. I think it's also just like something that's really important to modern day, especially. Like now that I'm in a classroom, I especially see my students using computer science all the time."* – C3$^-$

They then shared anecdotes of students bringing some of their CS skills from a tech class into a middle school math class. Similarly, C6$^+$ was excited about helping students prepare to critical thinkers. They shared many hopes about how their future students might think:

> *"In society, they need to be technologically critical as well, so yeah I feel like as a science teacher, that it will... It will be really good for me to learn how to do that and to help prepare students as much as possible for the world that they're going to lead us in. So I'm excited about that."* – C6$^+$

C9$^+$ was envisioning more effective ways to teach math content such as polynomials. "*I'm hoping, I could combine the CS classes in an algebra 2*[3] *class to get them to collaborate together and turn it into a CS algebra 2 class."*

Candidates' eagerness in brainstorming new forms of literacy at the intersection of CS and other disciplines revealed a desire to give all students the opportunity to explore CS in a safe, collaborative space embedded across subjects and curricula, just as with justice motives. However, these dreams were not always enough to enroll, because of other factors.

3.2 Knowledge and Belonging

While justice motives concerned candidates' visions of the factors, candidates also mentioned many factors related to their CS content knowledge and how it influenced their sense of belonging in CS.

3.2.1 Prior Interest in CS Teaching. Several candidates shared previous experiences with CS and some expressed desires to develop that interest in some way or form. Some candidates had minors in CS, or had pursued courses outside of university degrees. For example, P10 shared:

> *"Well I've always wanted to teach CS. It was like, my parents are like, 'Oh, you should just go into the tech field, and because you like teaching you could just teach CS when you get into the tech field.' And I'm like, 'Yeah that's that's an option too,' and then I'm like 'wait, but I like high school.' It's better."* – C10$^+$

She also shared that she had considered majoring in CS after an enjoyable high school class, but after negative experiences in

[3] A second algebra course generally the second year of highschool

introductory CS programming classes in college, elected to find other places that felt safer to learn to code, eventually earning a technical minor in a related field.

Some candidates previously held professional roles which required and developed CS content knowledge. For example, C5$^-$ held a position as an educational public policy analyst and described that work as motivating to joining the teaching program initially. C2$^-$ held a developer role for a news organization and was responsible for all things technical. Other candidates shared stories of other ways they sought to develop their interest in CS. C4$^-$ had enrolled in a database course previous to their enrollment in the teaching program in hopes of a career pivot into a technical position. C7$^+$ had completed a six month "full-stack" coding bootcamp before pursuing a teaching degree. All mentioned that their existing CS content knowledge was a significant factor in their interest in a CS certification.

3.2.2 Low CS Self-Efficacy. Many candidates expressed low CS self-efficacy. Some expressed this despite earning minors in technical disciplines like information science and data science. For example, C2$^-$ shared:

> *"It would take a lot of my time. I would want to make sure that I got it right. And yeah, I think that would, that would, that's what I'm scared of that I wouldn't get it right."* – C2$^-$

Because they wanted to teach well, and CS would require a lot of effort to teach well. C4$^-$ shared that they were not sure they would be able to support students when they did not know something and needed to look it up, stating:

> *"I don't even know enough computer science jargon, to try to really... Say but like if someone asked 'how do I code this thing?' or like 'how do I make the sequence give me this result that I'm looking for?'"* – C4$^-$

C4$^-$ contrasted CS knowledge with with a grammar construction or something else in Language Arts where they felt more confident and knew how to help students find answers.

Similarly, C5$^-$ had held several positions in data analysis for education non-profits and shared:

> *"I am not confident in my own coding abilities… I frequently use R and Stata at work. But I don't think that's what we teach in school. I don't know. I don't think we teach those languages, but like when I'm doing stuff for work I'm frequently googling things."* – C5$^-$

They noted that it would be overwhelming to teach a computer science course in a first year teaching position and did not perceive data analysis using programs like R and Stata as authentic coding.

Another teacher candidate, C6$^+$ reflected:

> *"I'm scared. I'm scared that I'm going to be bad at it. I'm scared that I'm not gonna be able to figure out how to code or that I'm too old and my brain just can't think that way anymore."* – C6$^+$

Later they reflected that they were excited to stretch and learn these skills saying:

> *"I hope to be less intimidated by computer science and programming and I hope to ... develop my kind of problem solving ability and like analytical, you know, that side of the brain more. Because yeah, it's just, it's a different way of solving problems than I'm used to. And so I think it'll be really, I mean intellectually very interesting and enriching and I hope to just be a better science teacher because of it."* – C6$^+$

3.2.3 Fearing a Lack of Respect Due to their Identity. Candidates, particularly those who identified as women of color, shared that they were concerned about teaching CS and not being taken seriously by students and parents because of their identities.

C2$^-$ identified as a woman of color and had some very difficult experiences in undergraduate where her instructor, who was also a woman of color, was mocked by her peers. She reflected:

> *"I would be afraid to be a bad CS teacher. I would be afraid to be that CS teacher that is up there… the kids are mocking me and they don't respect me and kind of like that experience that I had in undergrad. I don't think that would happen, but I think that is a little bit of my fear is that. You know, I've never taught really computer science to that age group."* – P2$^-$

Similarly, C10$^+$ reflected:

> *" I'm a female. It's like. I think it would be even more difficult. Per se. especially in like the CS field because... [anonymized city]. Yes, yes, like a heavy environment where everyone wants to go into CS. It's like. I think it's scary like… Oh, I want my students to excel. I want them to do well in the CS class. Are you the best person to teach that to my child? I think that's something I'm like: 'Ooof.'"* – C10$^+$

These fears were compounded by being in a region with a high concentration of software companies and therefore parents who likely worked at software companies.

3.2.4 Belonging in CS. Some candidates reported that they felt a degree of belonging in the CS community because of peers, family, partners, and acquaintances. They had observed that one did not necessarily need a CS degree to be successful in a technical careers. For example, C4$^-$ shared a number of people they were closely associated with regularly in computer science in their day to day, and considered the importance of teaching CS to high schoolers as a factor in deciding to pursue the certification:

> *"I think it's really cool I wish I knew more about it. And I wish that it had been pushed on me more when I was younger, but I have very little like background in it. My partner knows general coding and my sister doesn't know that much computer science, but she started working for T-Mobile with, like, no technical background and now she's a technical.. She's in the IT department managing people and she, like, learned how to do basic coding to understand your job better and stuff and. So I have people in my life that know code and like how valuable it is. I just don't know much about it, but I am glad that it's being taught to students."* – C4$^-$

Knowing people in CS, however, was not enough to persuade C4$^-$ to enroll.

C8$^+$, who had majored in physics, was referring to a high school friend group who also took intro CS classes together when they said:

> *"All of them majored in CS, and they're working in the field now. And I have a couple others. One, for now, actually majored in physics with me, and he's working in the field in CS as well. So he's one of the reasons to think that you don't need CS to work in CS."* – C8$^+$

In their case, knowing people in CS *did* give them the confidence to enroll.

3.2.5 Trusted Teacher Mentors. Although this sentiment was not prevalent explicitly, some candidates who elected to enroll shared that they were explicitly motivated by the identities of the instructors on the SMIT CS instructional team. For example, C6$^+$ reflected:

> *"I just felt like I could really trust you guys to take care of me and help me learn. Without that I don't I probably would have done it if it was going to be taught by a bunch of dudes. I would not have done it."* – P6$^+$

Others noted that one of the (non-author) instructors had been their high school or college CS teacher and had really appreciated their teaching and mentorship.

3.3 Entering the Profession

Where some motivations concerned visions of how CS teaching should be, and others stemmed from candidates sense of identity and knowledge, a third set of factors concerned fears about entering the teaching profession, especially after finishing an intensive graduate program and starting jobs as teachers in new roles in new schools.

3.3.1 Exhaustion and Burn Out. The candidates had done the entirety of their training during the pandemic. This was an additional layer that went into the decision making, and thought processes of joining the profession. All candidates expressed that they were exhausted from attending classes, completing observations, and student teaching: in addition to surviving a pandemic and remote challenges. Throughout the program, schools in the region were in high need of substitute teachers (colloquially referred to as "subs"), and since all of the candidates were qualified to substitute teach during the spring of 2022, several expressed the tension between earning money and supporting schools by taking roles as substitute teachers and staying for the SMIT CS program.

For example, C1$^-$ speculated:

> *"I think, maybe, if it were a non-pandemic year. I would have said yes. But, honestly I'm pretty exhausted by that point. I'm like, 'Okay, I just want to you know, be done with the program now.' And I just know that there's such a need for subs right now."* – C1$^-$

Additionally, since social events and life had been affected by the pandemic, candidates felt a need to catch up with friends and family. C4$^-$ shared:

> *"I do think if it hadn't been for COVID and I would have had a normal last two years, I definitely would have done it, but because, like you said, I have been doing nothing for two years and, like now all these things are building up and it's extra important for me to see [friends and family]. It wasn't worth it."* – C5$^-$

3.3.2 Loss of Agency in Teaching Assignments and Workload. Often candidates heard horror stories from colleagues and mentors about autonomy and extra workloads assigned when you were qualified for more than one subject. Candidates wanted to teach well and expressed worry that if they were certified to teach CS, they would have too many courses to teach at once (often referred to as additional "preps"). For example, C2$^-$ reflected:

> *"I think I'm just... I'm overwhelmed right now teaching one prep. For, not all of the periods in a day, I think that that's where the exhaustion aspect comes in a little bit. I'm a little bit worried that … if I have the computer science endorsement*[4]*, like on my application or even on my resume, that, you know, they'd be like okay you're teaching like three preps of math and then additionally this computer science."* – C2$^-$

Similarly, C1$^-$ was warned by a mentor teacher: *"that's a great program but you know you're asking for more preps."* which meant being responsible for additional course teaching and preparation without additional compensation or planning time. Often candidates also realized that more classes and preps, in addition to content they were less familiar with would mean that their ability to teach well might be affected. C3$^-$ reflected on what getting the certification would mean for working in a new job:

> *"I assume they would want me to be teaching tech classes, because it's not a popular thing that teachers have. And so, just like adding having two preps right now, and then thinking about if I had to add a third prep, especially for computer science, where I don't know the subject very well it's like that would take up a lot of my time like I don't know if I'd be able to stay in."* – C5$^-$

These perceptions of professional risks, especially upon entering a new profession, revealed the many structural disincentives of being certified to teach in multiple subject areas.

3.3.3 Limited Capacity to Care for Students. Some candidates expressed experiencing tension around being able to care for their students in addition to teaching content well. For example, C3$^-$ shared that they viewed teaching, including caring for the students as humans, as their first role, and then teaching the content, in this case math, as their secondary role:

> *"I've always thought about I'm a teacher before I'm a math teacher. I guess I've always thought about that, like teaching. I'm teaching but I'm also… I'm teaching math like. I'm teaching kids more than just math. Because like I'm teaching students more. The subject comes second to me, I guess, like the student comes first. So, like we can stop, if something happens in my classroom we're not going to be learning math like we're going to stop and, like, address what's happening in the classroom. Because, students need to learn to grow, be*

[4] synonym for a teaching certification

good people because, like not everyone needs to be a crazy amazing mathematician to succeed in this world." – C3^{-}

C7^{+} shared they also worried about supporting their students:

"Also, I think another fear is not being able to support those students, which is a consistent fear any of my teachers now to support students who really need it right. And helping them get to the place where they need to be at." – C7^{+}

This demonstrated the tension and respect they carry for the care work that is part of teaching.

Where C8^{+} recognized that teaching CS in particular could put additional pressure on students. Because of some of their previous experiences, they shared:

"I feel like CS also puts a lot of pressure on students to like perform. And some students, that they have a lot of expectations going into it, and so I feel like CS could also be a field where there's a lot of people who are impacted by rejections, and getting burnt out when things get too hard, because I know a lot of my friends kind of took those intro class and they're like oh just not for me I'm just out." – C8^{+}

These sentiments that candidates consistently expressed showed that they cared deeply for their students, recognized that teaching was more than just communicating content, and that they carried deep respect for their students into their role and career decisions as teachers, but that they perceived these as potentially in tension with teaching CS.

3.4 Cost

The fourth major set of factors concerned the costs, both financial costs and opportunity costs.

3.4.1 Cost as a Barrier and/or Opportunity. We were able to offer our candidates full-funding if they enrolled SMIT CS. But, because funding was limited and we did not know quite how many would enroll in the program, we emailed to gauge interest and need. C2^{-} shared that in addition to exhaustion played into their decision before we had shared final funding amounts.

"So the first thing was exhaustion as well as the financial aspect of it, I knew that I think there was kind of a point where we were making decisions about filling out that form and stuff where we didn't know if it was going to be paid for not." – C2^{-}

C1^{-}, who also chose not to enroll reported, *"it was hard to say no to full-funding, because I did get that email saying like Oh, I have full-funding".*

Among the candidates who did enroll, several reported that they saw the funding as a benefit that lowered the risk of investing their time. C8^{+} shared:

"It sounds like fun and then there's the whole tuition is covered. And so like not really anything to lose by doing it right?" – C8^{+}

Which indicated that they were willing to invest the time to learn.

C6^{+}, who had shared a little more trepidation at joining the program because of previous CS experiences, saw this as an opportunity they could not pass up:

"It's also such an opportunity to have it be funded. Yeah, I was like, 'Oh my God ...it's funded' that would be a silly thing to pass up on. It's only a quarter[5]*. Like it's worth it to get this really good extra experience and it's extra endorsement, that I think is very important. So I was, yeah ... definitely worth it."* – C6^{+}

3.4.2 Reserving Limited Funding for Others. Some candidates looked collaboratively at the program, and when they knew there was a limited amount of financial aid and wanted their classmates to have the tuition. For example, C2^{-} shared:

"You know I don't think that this is going to be something I'm going to teach immediately, so I can let my peers who might want to teach this immediately go forth with it. Because I had known other folks who had actually majored in computer science and stuff like that, who were interested in that or engineering of some sort. And so I didn't want to take up the tuition that would have been offered." – C2^{-}

These candidates view themselves as part of a broader network of teachers, and they want to support each other emotionally, pedagogically, and practically.

3.4.3 Job Security. A few candidates reported that they enrolled in the program because an additional certification offered them job security. For example, C9^{+}, who also earned an certification in math, shared that they pursued the CS certification:

"Because I don't want to be fired just for being a only a math teacher. Okay, I thought, having a CS endorsement would help me with my chances." – 9

They additionally shared they heard of other teachers being downsized with budget cuts. C7^{+} who has already earned an certification in social studies shared:

"The finances for me here are really big. I can say that for certain and honestly having another thing, another endorsement under my belt, that I find is really useful." – C7^{+}

4 DISCUSSION

Our research revealed several factors that influenced candidates' decision to pursue a secondary CS certification. We observed factors related to candidates' sense of CS justice and injustice, their knowledge and perceived knowledge of CS, their anxieties about being novice teachers, and several aspects of financial and opportunity cost. Throughout, there was no obvious trend in which these factors weighed more or less in candidates' decision to pursue a CS certification: each faced an unique context and set of concerns. Our results reveal, however, the broader structural deterrents to pursuing CS teaching: candidates need confidence, money, and support from school leaders to teach CS. Even in our small sample, there was a robust and diverse set of positive reasons for teaching CS,

[5] one term in SMIT

even without any systematic secondary CS teacher outreach in our region.

4.1 Limitations

Of course, these results come with several limitations. First, education in North America is decentralized, and so many of these factors may have been unique to our context. This study took place in one program and one region in the United States where there is a moderate amount of secondary CS teaching and high visibility of computer science and software industries. The SMIT program is well-regarded for its focus on equity and justice, and likely attracted teacher candidates with particular interests and politics aligned with these values. And the particular structure of SMIT, as a one-year masters in teaching with an optional add-on certification, posed unique structural incentives and disincentives. These all are likely different from the structures, policies, and opportunities in other other regions and countries, potentially limiting the transferrability of our results.

Our results also have methodological limitations. Our data collection was also unique in that the two authors were closely embedded in the students' program and their decision to pursue. Candidates viewed us as the instructors, knew the first author for a year as a teacher and coach, and anticipated learning from us as teachers in SMIT CS. This could have had a variety of impact on candidates' sentiments, including influencing their desire to pursue the certification (as one candidate explicitly noted), or shaped what candidates were and were not willing to share about their decision. That said, the first authors' relationship with candidates was predominantly one of care and refuge in a program that was often overwhelming — especially due to the global pandemic — so it likely only served to improve rapport and trust, and thus candor.

4.2 Implications

Despite these limitations, our results are broadly consistent with prior work on teacher motivations *outside* of CS. As with prior work, we found that altruism was a motivation for teaching and teaching CS [6, 7] and that content-specific confidence and self-efficacy are essential to motivating teaching [3, 6, 7, 16, 30]. These findings broadly aligned with SCCT[19] where factors like self-efficacy, socialization, and experience as factors influencing career choice. Our candidates also perceived teaching as a way to impact the world [1, 21] and when they had CS content knowledge, felt that it positioned them to share it [21]. The candidates also reported being particularly concerned with developing meaningful relationships with students and offering care [30]. This overarching consistency with prior work on motivations to teach suggests that despite our specific site's unique characteristics, the candidates in our study likely viewed teaching in ways similar to those in prior work (which, surprisingly, have predominantly been conducted in Europe and Asia, and not North America).

And yet, our results also reflect the discipline-specific nature of many motivational factors. For example, discipline-specific factors in prior work have primarily concerned candidates' specific affinity to ideas in particular disciplines (e.g., loving math and therefore wanting to teach math). But candidates in our study infrequently reported disciplinary affinity, even when they had substantial exposure to CS. Rather, our results revealed a kind of *anti*-affinity: a resistance to how CS communities are and how CS is taught, and a desire to change it. The most troubling insight from our results was that this resistance was just as likely in our small sample to deter candidates from teaching as it was to motivate them. This was particularly true for one candidate, who wanted to have conversations about race and technology in class, but also felt that they simply didn't have the energy to fight that battle as a woman of color.

These findings, coupled with those from prior work, strongly suggest that pre-service programs have significant work to do to help cultivate interest and confidence in CS teaching, even before students enroll in pre-service programs, particularly for women of color. Future work should explore how to do this, examining how much CS expertise is necessary to teach high school CS courses and how to ensure that candidates feel confident both in their own content knowledge, but also in their pedagogical knowledge, and their pedagogical content knowledge. Prior work on CS professional development has found a significant desire for in-service teachers to gain substantial CS content knowledge before they feel prepared [23]. Is such depth necessary for secondary CS education, or is it just that teachers *perceive* it to be necessary because of how the culture of many CS education contexts reinforce strict notions of rigor?

Our work found that candidates want to be excellent teachers and that this desire for excellence led some to opt out of the program, as they feared repeating or perpetuating bad experiences that they themselves had. Future work might investigate to what extent these fears are substantiated: is anything but excellence actually harmful, or can novice CS teachers still meaningfully shape their students' learning and identities, even as they develop skills? And would such insight be enough to shape pre-service teachers' fears of failure?

Our work also found that candidates perceived teaching excellence as a form of justice. They saw it as important to provide their students with the best possible opportunity to succeed by providing care, encouragement, excellent pedagogy, and support. These conceptions of excellence and justice set a high bar for candidates, potentially one they did not feel capable of meeting in CS (or teaching more broadly). Future work might explore how to cultivate confidence in candidates' ability to offer care and encouragement.

Our research also has implications for practice. For example, school leaders and teacher education programs need to examine how to provide additional planning time for CS courses, particularly if CS teachers are teaching more than one content area, which happens often to teachers. They also need to examine how to address *perceptions* of increased workload, in case candidates' fears are unfounded. This of course means that if school, district, state and national level administrators want robust CS programs, they must appropriately fund training for teachers, but also fund planning time for teachers. Some of these efforts might lean on existing in-service CS teachers to help encourage aspiring CS teachers; of course, such service also needs to be resourced and supported by school leaders and governments.

Ultimately, our paper reaffirms that pre-service teachers want teach well and are deeply motivated to provide the care, content, and opportunity that their students need and deserve. How we support teachers has a direct impact how how they can support

students. As the global community builds pathways to CS teaching and communities support them, it is vital that we support them in this by providing the training, funding, and time to do what they need to do. Only by helping teachers uphold this value will they be able to offer the kinds of equitable and just CS learning experiences that students deserve.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant No. 1539179, 1703304, 1836813, 2031265, 2100296, 2122950, 2137834, 2137312, and unrestricted gifts from Microsoft, Adobe, and Google.

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