# Future Career Pathway Perceptions of Lower-Income Computing Students Through the Lens of Capital Exchange

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## 1. Background

While significant broadening participation efforts in computing higher education have focused on gender and race [1]-[3], the experiences of lower-income students in undergraduate computing education are as yet underexplored. One major effort focused on lower-income students is the National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program, a funding program designed to support lower-income students to persist and succeed in STEM fields. The implicit goal of S-STEM programs is to increase the social mobility of lower-income students. More recently, S-STEM programs have included education researchers and expanded the research based on understanding lower-income students in STEM.

This paper is part of a broader education research effort connected to the Florida Information Technology Graduation Attainment Pathways (Flit-GAP) S-STEM program across Florida International University (FIU), University of Central Florida (UCF), and University of South Florida (USF). Flit-GAP offers an opportunity to study the pathways of lower-income students and the factors that enable their participation in computing career paths. Our focus on lower-income students' viewpoints of barriers, risks, and opportunities associated with different career pathways in computing can further S-STEM programs to better support the students and help increase participation in computing. This qualitative interview study will analyze the initial perceptions of the Flit-GAP student participants at FIU on their future career pathways through the lens of capital exchange.

## 2. Literature Review on Computing Students' Career Pathways

Within broadening participation in computing research, there has been substantial work focused on identity development [4]-[8], and a more recent work on the sense of belonging of undergraduate computing students [9]-[11]. However, there has been less focus on underrepresented students' transition from their undergraduate education to their computing careers. McCartney and Sanders [5] conducted two longitudinal case studies of computing majors for five years to analyze how their professional identities impacted their career pathways. Kapoor and Gardener-McCune [7] found that computing students decide on their career choice based on both intrinsic (self-interests and abilities), and discipline-based factors, pertaining to the computing profession. Researching within a similar S-STEM program named the Julian Scholars Program, Townsend and Sloan [17] identified that their computing student participants were not aware of the various careers in the computing field. Within its programming, Flit-GAP defines three primary career pathways for computing students: entrepreneurship, professional, and graduate school. Next, we review the relevant literature on the career pathways of computing students in general and low-income computing students, specifically.

Regarding entrepreneurial and professional pathways, Smith et al. [12] found that computing students' willingness to pursue entrepreneurial efforts after graduation are impacted by their socioeconomic status, gender identities, and job market conditions. These studies indicate that socioeconomic status and market conditions are primary factors for students choosing a career as an entrepreneur in computing. Other research found that the school and job-related events the

students participated in had an impact on their professional identity as well as their experiences as a professional [5]. Internships and job interviews had a significant impact on and were impacted by the course-related events, and internships were stressful for many computing students as they were becoming a computing cultural obsession [5]. Another study examined an entrepreneurship course offered to low-income Brazilian students enrolled in science, technology, education, and arts disciplines [13]. The students in the study preferred to enter a more stable job market rather than risking their financial status to become an entrepreneur [13]. In another study, lower-income students envisioned themselves employed in the software industry in their immediate future and wanted to venture into entrepreneurial efforts later [17].

Regarding graduate school pathways, prior scholarship found that faculty motivation and students' identity development with computing were factors that help computing students pursue graduate education [15]. According to Charleston [16], most African-American computing students aspired to pursue graduate school in order to attain knowledge in specialized domains within computing. Kinnunen et al. [6] also found that middle-income computing students in Europe had this aspiration. Although we found no literature on lower-income computing students' graduate school choices, low-income students, in general, face difficulties in pursuing a full-time graduate school pertaining to their familial and financial responsibilities [14].

This literature gives important insight into computing students' career pathways in general, yet it provides relatively little insight into lower-income students' perceptions of their career pathways. Though Townsend and Sloan [17] highlight the importance of an S-STEM program for computing majors to help them better understand career options, they do not explore the interrelationship between students' career pathway perceptions and programmatic features. From this, we infer that understanding students' unique perceptions will be key to designing S-STEM programs and other interventions to help broaden participation in computing. We also believe this paper will begin to address some of the important gaps in the literature on supporting lower-income computing students.

## 3. Purpose

This study seeks to better understand the future career pathway perceptions of lower-income undergraduate computing students through the lens of capital exchange theory. As such, we address the following research questions:

- How do lower-income computing students perceive their career pathways?
- How does considering lower-income computing students' perceptions of career pathways through the lens of capital exchange theory inform our understanding of their economic, cultural, and social capital?

## 4. Theoretical Framework

We utilize Bourdieu's theory of capital exchange [18] to understand lower-income students' perceptions of their future career pathways. Within this theoretical framework, economic capital can be understood as the material assets one possesses, including money and property [18]. Bourdieu [18] explains that this material form of capital can be manifested and transformed into immaterial capital (i.e., cultural and social capital) and vice versa. Cultural capital is described as an inherited form of capital that "combine[s] the prestige of innate property with the merits of

acquisition" [18, p. 18]. In other words, the cultural capital one possesses can be understood as the time and resources one has to invest into attaining objects of social value, which are determined by the institutions that shape a given society and the product of that investment. Specifically, Bourdieu classifies the attainment of educational qualifications as cultural capital [18]. Furthermore, social capital is characterized by the resources one is able to acquire based on their social network [18]. For instance, one may gain recognition and, in turn, access to certain opportunities through their membership to a selective social group, such as a professional society.

Some prior undergraduate computing education literature has focused on social capital, such as Brown et al.'s [19] study on the formation of social capital in introductory electrical and computer engineering coursework and Mein et al.'s [20] examination of the role of social capital in Latina engineering and computer science students' experiences of persistence. However, economic capital and cultural capital have not been widely used as a theoretical lens in this space. In undergraduate STEM education more broadly, social capital has been employed to better understand undergraduate students' experiences in a social community within mentorship programs [21] and to identify how different manifestations of social capital influence community college students' intent to transfer to a bachelor's degree-granting STEM program [22]-[23]. Also, prior engineering education studies have utilized social capital to explore underrepresented undergraduate engineering students' sources of social capital [24]-[28] and the impact social capital has on their decision to pursue an engineering degree [24], [27], [29], persistence in an engineering major [24], [26]-[27], [29]-[30], and experiences as an engineering student [24]-[25], [28]-[30]. Additionally, Corple et al. [31] applied Bourdieu's definitions of social capital and cultural capital to examine how biomedical engineering students draw on these forms of capital to navigate their professional development.

We utilized the lens of economic, cultural, and social capital to help us understand our research topic in two particular ways. First, our research protocol asked participants to assess the benefits and drawbacks of three distinct career pathways. As participants weighed the pros and cons of these pathways, economic, social, and cultural capital helped us map participants' responses onto what they hoped to gain or risked losing by selecting a particular pathway. Second, we had an intuition that the participant population (lower-income students, primarily from underrepresented racial demographic groups in STEM) might hold different forms of capital, such as linguistic capital and navigational capital, regarding computing career pathways relative to the majority of computing students who come from more privileged backgrounds [32]. By examining participant responses with an eye toward the forms of capital that enable or inhibit access to their desired career trajectories, we can help identify the areas where students' capital needs supplemental support. Importantly, though some traditional Bourdieuian analyses position low-income communities of color as lacking the cultural competence or social skills necessary for upward social mobility [32], we understand the barriers to success that low-income communities of color face to be a product of systemic oppression. Our discussion of participants' lack of economic capital or normative cultural and social capital should not be interpreted as lower-income students being at fault or at a deficit. Rather, our analysis aims to acknowledge the realities associated with navigating oppressive institutions and identify ways in which programs geared towards lower-income populations can better serve these student groups.

## 5. Context

Flit-GAP was launched in September 2021 as an NSF-funded collaborative scholarship and educational research effort at three public research universities in the Southeast United States. It is designed to support lower-income students pursuing a degree in a computing field, including computer science, information technology, cybersecurity, and computer engineering. The scholarship component of the program offers junior-level students up to 10 thousand dollars per year based on their unmet financial need to support them in completing a bachelor's degree within three years of entering the program. Additionally, the program can include up to 10 thousand dollars to support participants for one year of graduate studies in a computing field at one of the participating universities.

According to the solicitation for NSF S-STEM programs [33], a student's unmet financial need is calculated by subtracting their expected family contribution and their state, university, and private grants/scholarships from the cost of attendance, which is determined by the university. At the time this study was conducted, all Flit-GAP student participants had at least 500 dollars of unmet financial need. Moreover, all participants received a Pell Grant for the 2021-2022 school year. It is important to note that the vast majority of Pell Grant recipients' income falls within the lowest 50th percentile of household incomes in the United States [34]. Hence, most recipients are low-income or lower middle class. Given this information, we describe the participants in our study as lower-income students.

In addition to financial support, Flit-GAP offers a variety of co-curricular opportunities to participants, including the selection of a career pathway experience that reflects their interests. Each participant has the opportunity to explore either an internship (professional pathway), research (graduate pathway), or entrepreneurship pathway based on their interest in going into the computing industry/government, pursuing a graduate degree, or working for a small start-up company / starting their own business upon graduation. Program activities are held on-campus and virtually as collaborative events with scholars at the other institutions. Events and activities promote community building, expanding the scholars' networking and learning space, and supporting their chosen pathways. Activities and events include informational events, an annual symposium, job search support, networking, mentoring, and online elective courses.

This paper focuses on the lead institution for Flit-GAP, FIU, which is a large Hispanic-serving institution (HSI). Flit-GAP is housed within the School of Computing and Information Sciences (SCIS). SCIS has nearly three thousand undergraduate students that comprise a racially/ethnically diverse student body (64% Hispanic or Latino, 13% Black or African American, 10% White, 5% Asian, and 7% other minority groups) [35]. Out of these students, 20% are first-generation college students [35] and 44% are Pell-receiving [36]. SCIS also has a high volume of non-traditional college students. 46% of undergraduate students in SCIS are community college transfer students [37], and 26% of undergraduate students are over the age of 26 [36].

## 6. Methods

Participants were recruited for this interview study based on their participation in Flit-GAP at FIU. In September 2021, after admission decisions were finalized by the program coordinators, the lead author sent an email to all of the admitted students to request that they participate in an interview study that explored their future career plans and initial perceptions of the three pathways offered by Flit-GAP. Participants were offered a $25 Amazon giftcard as an incentive

to participate in the interview study, and all 16 students agreed to participate. Table 1 lists each participant's pseudonym, gender identity, race/ethnicity, and major, as well as information about whether they are a first-generation college student (FGCS) or continuing-generation college student (CGCS).

**Table 1:** Participant Background Information

| Pseudonym | Gender | Race/Ethnicity | Major | Generation Status |
|---|---|---|---|---|
| Brad | Man | Hispanic or Latino/a | Computer Science | FGCS |
| Lencho | Man | Black or African American | Computer Engineering | CGCS |
| Damien | Man | Black or African American | Information Technology | FGCS |
| Gustavo | Man | White, Hispanic or Latino/a | Computer Science | FGCS |
| Natalie | Woman | White, Hispanic or Latino/a | Computer Science | CGCS |
| Rafi | Man | Asian | Computer Science | CGCS |
| Rachel | Woman | Hispanic or Latino/a | Computer Science | CGCS |
| Penny | Woman | Asian | Information Technology | CGCS |
| Cesar | Man | Black, Hispanic or Latino/a, Cuban | Computer Science | FGCS |
| James | Man | White, Hispanic or Latino/a | Cybersecurity | FGCS |
| Violet | Woman | Black or African American, Haitian | Computer Science | FGCS |
| Jose | Man | Asian, Hispanic or Latino/a | Computer Science | CGCS |
| Mahir | Man | Black or African American, South Asian and Hispanic | Computer Science | FGCS |
| Ilya | Man | Asian, White, Russian | Computer Science | CGCS |
| Odeh | Woman | Black or African American | Information Technology | FGCS |
| Ron | Man | White | Information Technology | CGCS |

With each of the four authors acting as interviewer for at least one interview, a one-on-one semi-structured interview was conducted with each of the 16 participants. The interview protocol (see Appendix A) aimed to collect baseline information about participants' future career plans and their viewpoints on industry, graduate school, and entrepreneurial career pathways. As such, we aimed to collect our data prior to the first Flit-GAP event, orientation. We were able to interview 11 participants prior to orientation, and the remaining five participants were interviewed within two weeks of the orientation (prior to any other Flit-GAP events or activities). A semi-structured interview protocol allowed us the flexibility to gather in-depth insight into participants' perspectives while also maintaining consistency across the topics covered in each interview [38]. Interviews were conducted via Zoom and lasted approximately 40-60 minutes. The Zoom audio recordings were saved and transcribed verbatim by the first and second authors.

The first two authors analyzed the transcripts using a three-cycle thematic coding technique [39]. This process was overseen by the third author, an experienced qualitative researcher. For the first cycle, both authors read the transcripts and open coded any significant events and the particular points in which participants discussed their future career pathway sections. Based on this open coding cycle, the authors developed a mutually agreed upon codebook then conducted a focused coding cycle. Both authors coded all of the transcripts, each focusing on a different subset of codes. After both authors completed their focused coding, they checked each other's work to strengthen reliability. Once the accuracy of the focused coding cycle was verified, the emergent themes were identified. Our analysis of participant quotes focused on the ways students considered the pros and cons of their career trajectories, mapping their tradeoffs to decisions to expend or expand on their economic, social, or cultural capital. We also attended to implicit indications of these forms of capital present in the students' discourse [40], such as language usage and pronoun selection.

## 7. Findings

In the following subsections, we present the themes that emerged from participants' discussion of their future career plans and viewpoints. We grouped the findings into themes that merged the topical focus: attending graduate school, working in the computing industry, and pursuing an entrepreneurial pathway, with the categories of our theoretical framework: economic capital, social capital, and cultural capital.

### 7.1 Financial Considerations for Attending Graduate School

While financial considerations were a central theme across each of the three pathways, they were particularly prominent in discussions about graduate school. Nine participants mentioned concerns related to paying tuition. Natalie's quote below is one example:

*I am saving up my money as much as I can so that I can have enough funds for [graduate school]. And that's also one of the reasons that I had applied to Flit-GAP because [a professor] told me that they might be able to support me for master's as well. So, it's a big thing– I'm relying very much on scholarships.* (Natalie, White, Hispanic or Latino/a woman)

Natalie indicates that she is already in the process of saving money for graduate school and plans to pursue scholarships to support her as a graduate student. Natalie seems aware of some funding options at FIU, although it's unclear from calling them "scholarships" whether she is aware of funding structures like graduate assistantships and tuition remission. In an undergraduate landscape, scholarships may supplement but not entirely cover tuition, whereas, in computing graduate school, scholarships typically come with a small stipend and tuition remission.

Relatedly, when Rafi was asked to describe his plans for graduate school, he indicated that financial factors inform his future direction:

*I'll most likely continue with FIU. . . . In terms of financial, economic reasons, I think that would be the best choice. . . . the tuition and, you know, the living expenses, and with me commuting for grad school, I think that would save a lot of money. . . so I can allocate that [money] to tuition.* (Rafi, Asian man)

Rafi is aware of a number of financial costs that can impact attendance at a university, including tuition, living expenses, and money for commuting. Once again, these sound similar to his present reality for attending FIU as an undergraduate student. He may or may not be aware of tuition remission as a significant factor for graduate school. Rafi's undergraduate university has a reputation for being affordable at the undergraduate school level, but many graduate programs may be open to him if he received a graduate assistantship and tuition remission. Participants' focus on the cost of graduate tuition and their living expenses during their time as graduate students demonstrates the strong influence economic capital and the lack thereof has on lower-income students' outlook on continuing their education.

Though the cost associated with graduate school was largely viewed as a drawback of their future pathway, participants like Jose indicated that they believed obtaining a graduate degree could improve their job prospects:

*I feel like when you walk in and you know, just show yourself to a company to tell them that you have a master's or a doctorate. I feel like it does put you, it does emphasize you from the rest of the competition, the rest of the candidates. So yeah, I feel like your, the likelihood of you getting a job with a higher education or graduate school education is, is definitely higher.* (Jose, Asian, Hispanic or Latino/a man)

Jose described that having a graduate degree will put him in a competitive position during a job interview and that his chances of getting the job will also be higher. Although many participants saw primarily financial downsides or upsides to graduate school, it was clear that others were weighing the financial risks and rewards simultaneously. This quote from Ron presents one version of how those risks and rewards play out:

*I would take out student loans to pay for grad school. And then I would use the advancement that I would get in my field because I would hop into my field making six figures, I would use that advancement to turn around and pay those loans off relatively quickly.* (Ron, White man)

Here Ron described his intention to take out loans for graduate school and quickly pay them back with the high salary he will earn with a master's degree. Ron's confidence around his expectation for quickly commanding a high salary after graduate school may or may not be well-placed, but it makes sense why graduate school is a less daunting proposition for him. Violet is a bit more uncertain about the relative tradeoffs of the graduate school pathway versus others:

*With the opportunity of having the scholarship, I might as well increase my education because, apparently, the higher education you have, the better opportunities you can get, but then there's also the argument where like, the more experience you have, the more opportunities you get. . . . So, I will probably get my master's, and I will try to maybe, hopefully, work in the industry at the same time.* (Violet, Black or African American, Haitian woman)

In this quote, Violet considers the tension in the decision to either pursue a graduate degree or to gain industry experience in order to access better job opportunities.

Across the participant quotes about graduate school, we note the presence of two primary forms of capital. First, most clearly, there is a strong presence of economic capital. There is the risk that students will sacrifice their economic capital with the costs of tuition, living expenses, and commuting. Second, there is the opportunity that students will gain economic capital with

higher-paying and more secure employment after graduate school. More subtly, there are elements of cultural capital, where lower-income students may not know how the systems of graduate school work. Their use of vocabulary like scholarships typically reserved for undergraduate settings is a subtle indication of that lack of cultural capital to the graduate school system. Programs hoping to help these students could focus on supplementing both economic capital realities and concerns, and supplementing the cultural capital in the form of further information and insight related to the pathway.

## *7.2 Financial Stability in Industry versus Financial Risk in Entrepreneurship*

Financial considerations were also clearly present in participants' perspectives about industry and entrepreneurial pathways. In general, eight participants highlighted financial stability as an advantage of taking the professional pathway. For example, Natalie said:

*I think the pros [of going into industry] would be that it's something that's more established. So, it's more– I mean, even though nothing is necessarily guaranteed, I think it's more guaranteed income, right? You're getting a job with a specific paycheck that's coming every two weeks, or whatever, or a month.* (Natalie, White, Hispanic or Latino/a woman)

Compared with the other pathways we asked Natalie to discuss (graduate school and entrepreneurship), her impression is that professional pathways at least can offer a steady paycheck. One wonders again whether Natalie is aware that graduate school assistantships can provide a small but steady paycheck. Although the industry pathway seems stable, she remains aware that "nothing is necessarily guaranteed." Similarly, Ilya shared:

*That's one of the main reasons I'm working now is– I, you know, stable income, solid. You're gonna get the same amount every month, guaranteed. And, you know, they, they're not going to withhold anything from you. They're not going to do anything like that, because it's all automated basically. . . . You're not gonna suddenly wake up and just have no income or something.* (Ilya, Asian, White, Russian man)

Ilya uses similar examples to Natalie in discussing the attraction of an industry pathway, with a strong focus on the consistent monthly paycheck. Word choices like "stable," "solid," and "established" indicate the security Natalie and Ilya are seeking in the pathway. As students with current unmet financial need, they are likely experiencing greater financial insecurities in the present, and their future hopes are pinned on finding that financial security. This indicates that the expectations of the students might differ with their socioeconomic status.

An entrepreneurial pathway was far from the default route for our participants; most seemed to have never really considered it for themselves. More than half of the participants expressed their concern with the lack of financial stability in pursuing an entrepreneurial pathway, directly contrasting with their viewpoints of an industry pathway. As Brad thought through the benefits and drawbacks of entrepreneurship, he said:

*I think there are more risks [to entrepreneurship] than benefits because you're betting– you're betting everything on the business. If you fail, then you might end up bankrupt. You might not have any money.* (Brad, Hispanic or Latino/a man)

In Brad's view, the risks of entrepreneurship clearly outweigh the benefits. His language indicates the seriousness of those risks, that you could be "bankrupt" and "not have any money" if you bet "everything on the business." Ilya also described financial instability as a drawback of entrepreneurship:

*Entrepreneurship is unstable. At first, when you just begin, it's very unstable because you don't know if you're going to have good sales or poor sales. You don't know, if you're going to be able to sell that product. . . . There's always that that thought of, you know, you never know if you're going to be able to make money.* (Ilya, Asian, White, Russian man)

Participants' focus on financial stability in their future careers indicates the strong influence of economic capital on lower-income students' expectations of securing their future financial status. Students' perceptions of their pathways could be seen as calculations to secure economic capital. While the entrepreneurship pathway can offer the possibility of significant economic capital, that possibility is far less prominent in the students' perceptions than the possibility of significant loss of economic capital. Conversely, the industry pathway offers security in the pursuit of economic capital. While entrepreneurship may always be perceived as a risk, the students' lower-income / unmet financial need status is likely an important context that increases the aspiration for financial security over great financial success.

### 7.3 Access to and Connections Gained from Industry Experience

Participants also indicated social aspects of gaining post-graduate employment, including how to gain access and the networking benefits of that position. Several participants emphasized the importance of internship experience as a way to gain access to the computing industry. For instance, Violet said:

*Right now my focus, since I'm a junior, is to get an internship. So I'd probably do the internship path because everyone's like, you need an internship under your belt. Like that's how you're going to get into the door.* (Violet, Black or African American, Haitian woman)

Violet is hearing from "everyone" that she needs an internship to "get into the door." Violet perceives the internship not necessarily as an indicator of qualifications or a way to gain valued knowledge, but in terms of access to the social system of the company that could increase her chances of continued employment. Similarly, Gustavo noted the importance of an internship for gaining access to a specific type of position:

*It's very hard for you to get your first job as a software engineer, as far as I know. But if you get it, and even if you have just, let's say six months of experience, it opens so many doors afterward…I really want to get an internship, or even if I was to get a full-time role right now, I know I can do it, but it will be very hard for me to get like let's say, a junior developer position without an internship.* (Gustavo, White, Hispanic or Latino/a man)

Though Gustavo indicated that finding a job would be difficult without internship experience, he noted the potential to quickly advance once you enter the industry. Both Violet and Gustavo explained that having internship experience is important to secure a job after their graduation. Similarly, some participants who had not yet completed an internship shared that completing at least one internship before graduation is a central focus of theirs because of the weight that experience carries when being considered for an entry-level industry position post-graduation.

Participants like Violet and Gustavo seem to have relatively more knowledge about internships than other pathways we asked about.

Jose also shared aspirations about vertically advancing in his career over time:

*I'll probably start as a junior. And one of the things that I want to do is, after a couple of years working for the company, if I can become, maybe, a senior– their senior software developer, that'll be great. And then with that knowledge, maybe I could become the CEO of the department or the manager of the department. It's all about, you know, climbing the ladder, but that takes time.* (Jose, Asian, Hispanic or Latino/a man)

Here, Jose describes how working in the same company for a longer time will give him the benefits of advancing into more senior positions. In addition, participants described that going unnoticed as an employee in a large company would be a drawback of an industry position.

Regarding social capital in industry, we see that participants are essentially weighing their options to expend and expand their social capital. They are prioritizing internships as a way to "get into the door" and "[climb] the ladder" of these large corporations, both indicating that access to the social network and social system of the larger company has advantages. While the only (relatively minor) risk brought up associated with industry and social capital was going unnoticed, it seems the greater risk with the pathway itself is simply gaining access, students are particularly worried that they lack the social capital to acquire an internship and that others are getting ahead of them in that regard. Still, the students seem to have a baseline of socially shared knowledge ("everyone says") around the topic. As the industry pathway was the most commonly expressed interest of our participants, it is likely that fostering students' access to social networks and internship opportunities would address not only their future career outlook, but their mental security in the present.

### 7.4 Implicit Lack of Cultural Capital for Graduate and Entrepreneurship Pathways

While some participants discussed their pathways solely in terms of financial stability, other participants gave an overwhelming sense that two particular pathways, graduate school and entrepreneurship, were not for them. For instance, Gustavo shared his view of getting a master's degree:

*I don't see myself continuing, let's say, with a master's degree. Because most of the time, unless if I was to go to a role like in my field, okay, if I was to go to a role within, let's say, artificial intelligence, things like that, machine learning, then you would need more than the bachelor's, then you would need you would go for a master's or even a Ph.D. But I don't think I will need to go past the bachelor's, at least for what I want to do. So I'll probably stop after I get just the bachelor's degree.* (Gustavo, White, Hispanic or Latino/a man)

The language of "don't see myself" contrasts with how Gustavo described potential challenges in the industry pathway ("I know I can do it, but it will be very hard for me"). Gustavo views graduate school as a means to gain access to a particular type of work within a specific field, which doesn't interest him. He does not emphasize the potential to learn, as much as the value of the degree to signify his readiness for the career path. Similarly, when queried about the graduate school pathway, Mahir responded:

*I feel that if you're interested in something, and you want to pursue research in that you want to learn more about it and contribute to that topic. I think that's a great thing. And that you'd be able to do that at grad school. I think that's a big pro. I think a con would be kind of financially and maybe if you-- I feel that you can also learn a lot from industry, at least for me, and that I would want to start with industry.* (Mahir, Black or African American, South Asian and Hispanic man)

The parallel nature of "at least for me" echoes Gustavo's comments and frames the idea that this pathway is just not a major part of the participants' future considerations. They may see it as valuable to someone else, but not to them. Mahir understands that it is exciting for someone to pursue research in a graduate school and contribute to their field of interest ("if you're interested in something…that's a great thing"), but he does not seem to seriously consider the path ("at least for me…I would want to start with industry"). The contrast in pronouns usage is significant when considering that the interview prompts asked each participant to consider the risks and rewards of the three career pathways. In order to answer the question about graduate school risks and rewards, Mahir shifts to the second person ("you're"), whereas his more realistic path in industry is discussed in the first person.

Participants' describing that pursuing a graduate degree is not something for them indicates some perceived lack of cultural capital, that the career path is not for them but for some other type of person. The significance of having a graduate degree is also cultural capital– having specialized knowledge and a signifier of preparation for a specific job; there is not a sense of gaining social capital (networks/access) and the economic capital is primarily seen as a loss. While overall, the sense of distance from and foreignness to the graduate school pathway indicates a lack of graduate school-specific cultural capital that support programs can help supplement, in a larger sense the participants will bring significant alternative cultural capital [32] to the pursuit of graduate school.

We observed similar patterns in asking participants about pursuing an entrepreneurial pathway. Three participants, Ilya, James, Ron, said that they plan to become full-time entrepreneurs within the first five years of completing their bachelor's degree. Six participants (Damien, Lencho, Mahir, Natalie, Rachel, and Violet) expressed that they are interested in entrepreneurship, but do not plan to pursue it until later in their career, if at all, while the seven remaining participants expressed that entrepreneurship is not a career pathway that they envision for themselves. For instance, when Penny is asked if she believes that pursuing entrepreneurship could advance her long-term career goals, she shares:

*I do see it as connected. I just– I don't know, like, how to start it. . . . And I guess I also don't have the financial [means] to start a business if ever I have an idea.* (Penny, Asian woman)

Penny's doubts about how one would start in entrepreneurship indicate a lack of knowledge about this career path. Similarly, Natalie shares the following in her interview:

*There's a lot of information that I don't necessarily have, for what it means to make a business or even how to like work in this kind of market, or even another kind of market in a different country. So, I need other people who have less STEM-y, let's say like, like, thoughts. . . so they know more about the economy and supply and demand and the customer and actually, like, the*

*legality even of creating a business. So, I definitely need to make connections.* (Natalie, White, Hispanic or Latino/a woman)

Natalie believes that she does not have the knowledge it takes to run a business and, therefore, would need to build a strong professional network (increase social capital) in order to find people to fulfill those roles. Cesar shares a similar feeling about him pursuing an entrepreneurial pathway:

*You have to know business. If you started your own business with only computer science, then your business is not gonna grow. It's gonna like– because you know how to manage your business, you know how to, to run it.* (Cesar, Black, Hispanic or Latino/a, Cuban man)

Cesar and Natalie's responses indicate that the primary barrier to students pursuing an entrepreneurship path is lacking confidence in their skills to start and run a business.

In contrast with most of our participants, Ron, a junior in Information Technology, is confident about his career in entrepreneurship after graduation from his bachelor's degree:

*I have a lot of good ideas. I hate to, like, boil it down to that, but I feel like I have a lot of good ideas. A lot of it is software development, though. I want to be able to create an app, push it out, roll it out, adjust it to the needs of the consumer, and then sell it.* (Ron, White man)

Here, Ron expresses confidence in his entrepreneurial ideas and shares his plans to design, develop, and sell software. Brad indicated he already had prior direct experience as an entrepreneur:

*I enjoyed being an entrepreneur. I think it was a great experience. But I think that, like I said, it's very hard to gather all the resources you need. . . . If I go to graduate studies, universities, or even large companies like Google, they have large research programs that have all these resources that you can use to work on specific projects or problems.* (Brad, Hispanic or Latino/a man)

In spite of his familiarity with entrepreneurship, Brad noted that he did not want to pursue it as a career because of the difficulty associated with acquiring the resources necessary to run a company. We note the difference in the confidence levels, knowledge, and interest in a career in entrepreneurial pathways, between participants like Penny, Gustavo, and Cesar on the one hand, and Ron and Brad on the other. We view this difference as a form of cultural capital, where formal and informal knowledge of how a particular pathway works is a piece of acculturation that allows access to that pathway. In this case, acculturation and confidence also seem connected to traditional forms of privilege, where women and some men lack knowledge of the entrepreneurial pathway, while men are the ones most confident in the pathway.

## 8. Discussion

In the following section we discuss our findings and their contribution to literature, what they reveal about Bordieu's forms of capital in computing students, and practical recommendations for S-STEM programs and computing education.

### 8.1 Contributions to the Literature on Computing Students

In general, we noticed that the literature about computing students' career pathways and perceptions has not focused on lower-income students. Also, we found that literature on broadening participation has tended not to focus on lower-income students or career pathways and transitions. Our findings help contribute to these gaps in specific aspects of the literature. Regarding entrepreneurship pathways, we found, consistent with prior literature [12]-[13], that lower-income students were hesitant about pursuing entrepreneurship pathways. Our findings on professional pathways mirror those of other literature (e.g., finding that internships are becoming a "cultural obsession" [5]). Finally, regarding graduate school pathways, prior literature found that the interests of middle-income European students [6] and African American students [16] were primarily around gaining expertise in their areas of interest. In our study, this intrinsic interest was either not present or was outweighed by financial insecurities or other perceived net benefits. When a curiosity or interest in a topic was discussed as a positive for pursuing graduate school, it was often discussed in the hypothetical for some other person, not as a genuine interest of the student. Another key contribution to the literature stems from our analytical lens, which we discuss next.

### 8.2 Forms of Capital and Exchanges of Capital

One of the key components of Bourdieu's theory of capital is the exchanges that people make between different forms of capital. Bourdieu was interested in when and why individuals choose to invest significant economic capital (money) to pursue cultural capital (e.g., a degree) or social capital (access to an exclusive club). The career paths we asked our student participants to consider could be seen as tradeoffs between forms of capital. In general, the risk of losing economic capital loomed large in considerations. For pursuing graduate school, the eventual cultural capital of a graduate degree was assessed in terms of its potential for secure or gainful employment (economic capital); however, this tradeoff was by and large not as attractive as securing economic capital more readily through a professional pathway. Similarly, for entrepreneurship, the prospect of entrepreneurial success with a large gain in economic capital was not seen as attractive for students as the more secure economic capital found in regular professional employment. The participants' relative financial need creates anxiety around sacrificing present economic capital for eventual cultural or economic capital. The students best positioned to invest in socially-valued cultural capital are those who have the time and economic capital to expend.

Professional pathways were also described as a means to gain the significant social capital of a professional network and access, whereas graduate school and entrepreneurship were not as often viewed as a form of building social capital. Participants' anxieties about internships spotlight how the "cultural obsession" [5] with internships in computing fields can have a particularly negative impact on lower-income students. Prior quantitative studies indicate that undergraduate students from low socioeconomic backgrounds are less likely to participate in student clubs/organizations, engage in professional networking, and receive mentorship [41], [42]. This barrier to acquiring social capital, as well as the financial concerns lower-income students face, make it more difficult for them to complete internships, which ultimately hinders their ability to advance in their profession and improve their economic circumstances [43]. Our data suggests the pressure to gain social capital was at the forefront of our lower-income participants' minds as they contemplated their future career pathways.

Finally, students indicated an overall sense of dissociation with pathways for entrepreneurship and graduate school, which we inferred to be an implicit or perceived gap in access to requisite cultural capital. This is not to say that our student participants cannot or should not become entrepreneurs or obtain Ph.D. degrees, or that those students bring no valuable skills to those subject areas. Bridging the palpable gap between lower-income students and career pathways in entrepreneurship and graduate education can and should require universities to attend to these gaps and to reframe recruitment, admissions, and education around the cultural capital strengths of lower-income students [32]. Ultimately, the solution to bridging the gaps is not to change the student but to change the institutions so that they are equipped to meet students where they are.

### 8.3 Practical Implications for S-STEM Programs and Universities

Our findings suggest a number of practical implications for Flit-GAP and similar S-STEM programs, which may also be applicable for computing education and university policy more broadly. First, S-STEM programs like Flit-GAP can offer a variety of programming and allow students to self-select into programs that match their interests. While this is positive and responsive programming, it may assume that students have a baseline set of knowledge about each of the pathways to allow an informed decision. In our findings, we saw that students may lack certain relevant understandings of a particular pathway or have no foundational knowledge for deciding whether a particular pathway is or is not for them. Flit-GAP events could work to address those knowledge gaps about the pathways so that this lack of initial knowledge does not become a barrier contributing to students' self-selecting out of the programming path. For example, several students seemed to indicate some naivete around how graduate student funding works. The three universities collaborated on a virtual graduate school showcase to discuss graduate studies and provide information sessions on how to apply for graduate schools and find financial support. Two graduate program directors and a senior graduate advisor provided scholars with insights and resources about graduate studies at their respective institutions. Their presentations did not discuss the realities of graduate school finances in detail.

S-STEM programs can also pay particular attention to the effective perspectives of their students in designing programming. Interview content like that which we shared in this paper could be a great mechanism for assisting programs in becoming more responsive. For example, we noted that students' biggest impression of entrepreneurship was a fear of the financial risks and an implicit sense that this was an unrealistic or confusing pathway for them. They seem to be less likely to relate to entrepreneurship from a position of excitement at becoming the next Steve Jobs or Bill Gates. One of the proposed programs for [Program] is to offer a course co-developed with industry partners on entrepreneurship that will provide concepts and hands-on practice for interested scholars. By recognizing students' affective perspective and starting place, the course could meet students where they are and encourage more participation through more care and more scaffolding.

Finally, as S-STEM programs are structured to support students with unmet financial need, our participants' perspectives suggest additional reforms for student funding if broadening participation in graduate school is a serious goal for computing institutions. If universities paid graduate assistants more, the financial setback associated with graduate school would not be as extreme, and lower-income students would perceive it as a more viable pathway, thereby broadening participation in academic pathways. Flit-GAP is innovating in the area of providing graduate funding and will encourage students who wish to explore a graduate pathway in one of

the participating universities by providing a $10,000 scholarship. As the first cohort is still in their junior year, the attractiveness and feasibility of the graduate funding has not been fully realized. Nevertheless, financial assistance was clearly one of the most pressing current and future needs for student participants, and this highlights the importance of Flit-GAP and S-STEM programs in general.

**9. Conclusion**

In this paper, we examined the future career perceptions of lower-income undergraduate computing students through the lens of capital. There is an inherent tension when producing such an analysis, between highlighting the significant lack of capital while lifting up the participants' perspectives as valued and valuable. We wanted to be clear-eyed and realistic about the challenges facing our participants, without adding fodder to those who seek to discredit them. This contrasts with an approach to only focus on the assets of the students, which we feel can result in a less realistic presentation of the challenges. Aside from realism, we made this analytic choice because of the likely audience for this paper of computing educators and program administrators. Ultimately, we want to encourage that audience to see great value in the perspectives of lower-income students and to use our findings to help adapt programs that meet their needs. In future work, we plan to add to our analysis with an additional focus on the alternative forms of capital that students can draw on from their own communities [32]. We hope that ultimately this clear-eyed approach to reframing the way we see students and the way we craft educational programming will help open up access to computing for students from more diverse backgrounds.

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**Appendix A: Interview Protocol**

*Future Goals*
- What are your post-graduation goals?

*Pathway 1: Internship (Large Company)*
- Have you ever thought about working for a large company?
- Tell me what you think working for a large company would be like.
- Do you know someone who works for a large company?
    - Do you talk to them about their experiences?
    - How, if at all, has learning about their experiences impacted your opinion of this career pathway?
- How would you describe the pros/cons associated with this career pathway?
- How, if at all, do you thinking working for a large company could advance your long-term career goals?

*Pathway 2: Entrepreneurship*
- Have you ever thought about starting your own business or working for a startup?
- Tell me what you think becoming an entrepreneur would be like.
- Do you know someone who is an entrepreneur?
    - Do you talk to them about their experiences?
    - How, if at all, has learning about their experiences impacted your opinion of this career pathway?
- How would you describe the pros/cons associated with becoming an entrepreneur?
- How, if at all, do you think becoming an entrepreneur could advance your long-term career goals?

*Pathway 3: Research (Graduate School)*
- Have you ever thought about graduate school?
- What do you think you could study in graduate school given your undergraduate major?
- Tell me what you think graduate school is like.
- How would you describe the pros/cons associated with going to graduate school?
- Do you know someone who has gone to graduate school or is in graduate school?
    - Do you talk to them about their experiences?
    - How, if at all, has learning about their experiences impacted your opinion of graduate school?
- How, if at all, do you think earning a graduate degree could advance your long-term career goals?

*Pathway Choice*
- Which of these 3 pathways appeals to you, and why? You can name more than one if you'd like.
- Why do you believe this pathway suits you better than the other two pathways?