

Exploring the pathways: Using transition theory to understand the strategies undergraduate computing students leverage as transfer students

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Alexandra Coso Strong works and teaches at the intersection of engineering education, faculty development, and complex systems design. Strong completed her doctorate in aerospace engineering at Georgia Tech in spring, 2014. While a doctoral student, Strong was a National Science Foundation graduate research fellow and a member of the Cognitive Engineering Center. The goal of her doctorate research was to improve students' abilities to think more broadly about complex systems design and to take into account stakeholder-related considerations within their design projects. Prior to attending Georgia Tech, Strong received a bachelor's degree in aerospace engineering from MIT (2007) and a master's degree in systems engineering from the University of Virginia (2010). For her master's degree work, she developed a mixed methods research design to examine undergraduate engineering students' prior knowledge about interdisciplinary approaches to design and problem-solving. Strong comes to FIU after completing a postdoctoral fellowship at Georgia Tech's Center for the Enhancement of Teaching and Learning (CETL) and three years as a faculty member at Olin College of Engineering in Massachusetts. Strong's research aims to improve the design of educational experiences for students by critically examining the work and learning environments of practitioners. Specifically, she focuses on (1) how to design and change educational and work systems through studies of practicing engineers and educators and (2) how to help students transition into, through and out of educational and work systems.

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Abstract

As described in this Complete Research paper, prior research suggests that to diversify the computer science profession, educational scholars need to investigate and explore alternative pathways into the field. The 2-year to 4-year institutional pathway can serve as one such pathway, mainly due to the pragmatic allure of a 2-year program to first-generation college students—including but not limited to Black and Hispanic students. This research inquiry explored the unique and often symbiotic relationship between one 2-year college and one 4-year university. To better understand this alternative pathway, the following research questions were posed: 1) what are the experiences of students at critical transition points from a 2-year college to 4-year computer science programs, 2) what are the strategies invoked by students that help their transitions, and 3) what types of support do students use and benefit from during their transitions? To answer these questions, we leveraged a cross-sectional approach to explore the perspectives at multiple points within the 2-year to 4-year institutional pathway. While a longitudinal study would observe one subject over a period of time, often taking years, a cross-sectional inquiry observes multiple subjects on the same trajectory at different snapshots of time. To further ground the study, we used Anderson, Goodman, and Schlossberg's Transition Theory as the guiding and analytical frameworks. The team identified three critical transition points along the pathway to a bachelor of science in computer science: the start of the 2-year institution, the end of a 2-year institution, and the start of a 4-year institution. We then recruited students who were at each of those transition points, resulting in ten student interviews. We found that students utilized a variety of constructive coping strategies and support structures that enabled them to successfully make their way through a computer science 2-year to 4-year institutional pathway. Strong partnerships, including transfer orientations and bridge advising, between 2-year and 4-year institutions were helpful for computing Hispanic/Latinx transfer students in navigating the transition between the two institutions. The results of this work have implications for policy and procedures at both the 2-year and 4-year institutions to smooth the transition for a more diverse population in computing.

Introduction

The call to broaden participation in computing has gotten increasingly louder. The motivations for this call to action range from social justice to keeping up with computing professional demands [1]. No matter the reason, one thing remains the same—there are not enough Black and Hispanic students studying computer science as an occupational pursuit. Enrollment trends

remain flat or with minimal increases, and once enrolled, persistence becomes an additional barrier to solving the problem of diversifying the tech world [2]. To address these barriers, scholars have begun to investigate the pathways to computer science of minoritized populations [3]. One such pathway is the community college (or 2-year institution) to university (or 4-year institution) college pathway [4], [5]. The often pragmatic approach to college that includes a less expensive, often local start to undergraduate education then transferring to a 4-year institution is a common pathway for first-generation college students of which Black and Hispanic students commonly identify [6]-[8].

To add to this body of literature, we designed a cross-sectional inquiry into the experiences of students from one identified transfer ecosystem. This ecosystem consists of two Hispanic Serving Institutions (HSI)—one 2-year institution to one 4-year research institution. Both institutions offer computing programs. The 2-year institution offers Associate's degrees in computing fields with a pathway towards a Bachelor's degree at the nearby 4-year institution. Per state system agreements, transfer credit for courses is seamless based on uniform numbering and naming conventions but are capped at 60 credit hours. Transferring credits is typically the biggest hurdle that students face when transitioning between institutions [9]; but in this case, the state system has addressed that through policy. However, despite removing this barrier, students still endure challenges to their transition related to perceptions of their performance despite the similarity in performance metrics like grade point average (GPA), SAT scores, and graduation rates compared to non-transfer students [10]. Social challenges further heighten this perception hurdle during the transition [11]. Still, transfer students often outperform their non-transfer counterparts [12], [13], except for those in STEM fields [14], [15]. STEM fields are challenging for all students, and transfer students are no exception. However, the potential for their success and the implications for broadening participation in computing can not be ignored.

Therefore, in this study, we investigate the 2-year to 4-year institutional pathway of Hispanic/Latinx computing students. This study specifically investigates students' experiences at certain points within the 2-year to 4-year pathway through the lens of Transition Theory, which is explained in further detail below. Additionally, we investigate supportive and beneficial coping strategies used by these students at each point within the 2-year to 4-year institutional pathway, which is also explained in further detail below. Better understanding of *how* students successfully traverse the landscape of computing from a 2-year institution to a 4-year institution could help break down some of the barriers that cause challenges for students, along with how students persist despite these challenges.

Theoretical framework

Transitions, such as those experienced by students transferring from a 2-year to a 4-year institution, can impact a student's "roles, relationships, routines, and assumptions" [16, p. 159].

Therefore, to further examine the experiences and perceptions of transfer students within computer science, we leveraged Schlossberg's Transition Theory [16], [17], a theory originally developed for use in adult education and counseling. This theory outlines coping strategies that play a critical role in understanding an individual's response to a transition and determining what resources or structures could be designed to support a particular transition better. To categorize coping strategies that would be applicable regardless of the transition or where an individual was within the transition, Schlossberg defined the 4 S system: *situation*, *self*, *support*, and *strategies* [16], [18]. Situation focuses on the context surrounding the transition. Self acknowledges the individual's characteristics, personality, outlook, and values. Support classifies the different groups of individuals that may be key resources during a transition (e.g., intimate relationships, family units, friends, institutions, and/or communities). Lastly, strategies define how individuals cope with a particular transition, whether through modifying the situation, reframing events or parts of the transition, or managing stress.

We will also be framing both the research questions and the findings through the anti-deficit achievement framework [19]. The anti-deficit achievement framework was created to push back on the common deficit-oriented nature of research questions posited by researchers around the underrepresentation of minoritized groups in STEM. The framework encourages researchers to re-frame and re-orient deficit-based research questions to anti-deficit questions, focusing on the strengths of minoritized students and investigating the characteristics that allow them to succeed. For example, in this study, instead of looking at the strategies that hinder their transition, we look at strategies that help students.

Research questions

For this specific study, the following research questions were posed:

- 1) What are the experiences of students at critical transition points from a 2-year college to 4-year computer science programs?
- 2) What are the strategies invoked by students that help their transitions?
- 3) What types of support do students use and benefit from during their transitions?

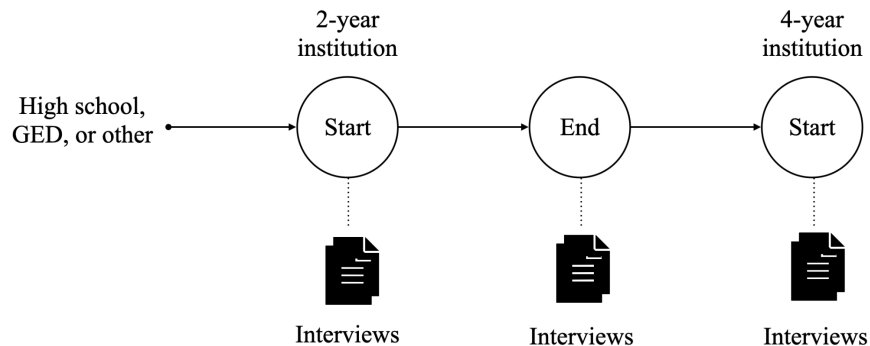
Methods

Research design:

This study utilized a qualitative cross-sectional inquiry design, an observational technique that analyzes qualitative data from a population at specific points within a timeline [20]. The qualitative data collected for this study were student interviews. This research design was chosen due to its ability to gather data around three critical transition points across multiple students over a 4-year timeline. More specifically, these three transition points are the beginning of a 2-year institution, the end of the 2-year institution transitioning into a 4-year institution, and the beginning of the 4-year institution experience. Figure 1 below demonstrates the research design

and data collection points. Additionally, this research design was chosen due to its benefits over a traditional longitudinal study. Longitudinal studies take years and observe one subject closely [21]. Cross-sectional inquiries have many of the same benefits as longitudinal studies, but a particular key benefit is that you can observe the same phenomenon of a longitudinal study using *multiple participants* within the same trajectory [20], which in this case is the 2-year to 4-year institutional transfer pathway.

Figure 1: Cross-sectional inquiry design along with their associated data collection points.



Setting:

This cross-sectional study explores students' experiences at critical transition points between a 2-year institution and a 4-year computer science program. The research was conducted at two public, Hispanic-Serving Institutions (HSIs) located in the Southeastern United States. One is a 2-year institution serving more than 54,973 students (fall 2018), and the second is a 4-year institution—a large research university that serves over 57,942 undergraduate students (fall 2018) [22]. These educational establishments are ideal for the study because both house the most significant number of Black, Hispanic, and first-generation students [23]. Both institutions enroll the highest number of minority students in Florida and the U.S. [24], providing an ideal setting for understanding the 2-year to a 4-year institutional pathway of Hispanic/Latinx students in computer science. According to institutional data at the 4-year institution, of those that enrolled in 2018, around half of all new enrollments were transfer students. This setting offers a unique opportunity to understand better the specific needs of minoritized students traversing from a 2-year to a 4-year university to complete their computer science program.

Participants/sample:

This study utilized purposive sampling using Transition Theory to identify students for solicitation. We looked at each critical transition point identified for our sample of interest and solicited students based on whether they were within this transition. More specifically, at the 2-year institution, students were identified as having just started or just completed their 2-year degree program through faculty leadership to recruit participants for the interviews. While this approach introduces the potential for selection bias, it was appropriate for both the research design and for truly understanding the unique experiences of these groups of students. At the

4-year institution, students were identified as having transferred from the specific 2-year degree program in computer science and having just started at the 4-year degree program in computer science through the advising office. Ultimately, ten participants were recruited to participate in interviews across the three transition points mentioned above. Three participants were interviewed at the beginning of their 2-year institution experience; five were interviewed at the end of their 2-year institution experience, who were in the transfer process to the 4-year university. Lastly, two participants from the 2-year institution were interviewed at the beginning of their 4-year institution.

The demographic information of the participants can be seen in Table 1. With relation to gender, three participants self-identified as male, six self-identified as female, and one did not identify their gender. Regarding race, six participants self-identified as being white, one self-identified as being Black, one self-identified as being mixed (Black/white), and two did not self-identify their race. Finally, seven self-identified themselves as Hispanic, two identified as either Hispanic/Latinx, and one identified as Latino. Overall, all our participants self-identified themselves as either Hispanic, Latinx, or Hispanic/Latinx. All of the participants in this study were majoring in computer science (CS). Table 1 below includes intersectional demographic data, including gender, race, and ethnicity for each transition point.

Table 1: Intersectional demographic and academic data of participants.

Transition Point	Pseudonym	Gender	Race	Ethnicity	Major
2-year start	Luis	N/A	N/A	Hispanic	CS
2-year start	Kit	Female	White	Hispanic/Latina	CS
2-year start	Melanie	Female	Mixed (Black/white)	Hispanic	CS
2-year end	Alejandro	Male	White	Hispanic/Latino	CS
2-year end	Sofia	Female	N/A	Hispanic	CS
2-year end	Nicolas	Male	White	Latino	CS
2-year end	Gloria	Female	White	Hispanic	CS
2-year end	Celena	Female	White	Hispanic	CS
4-year start	Nio	Male	Black	Hispanic	CS
4-year start	Sarah	Female	White	Hispanic	CS

Data collection:

Qualitative data were collected through audio-recorded interviews that were virtually conducted during June 2020, November 2020, and February 2021. Three different semi-structured interview protocols were developed through alignment with the theoretical framework and used for each different transition group. These transition groups include the 2-year start, the 2-year end, and the 4-year start. The interview protocols were semi-structured to provide flexibility in probing while also maintaining consistency across interviews. Probing allows interviewers to clarify and gain further insight into the interviewees' experiences.

Additionally, the interviewer was trained in qualitative data collection to ensure familiarity with the interview protocol [25]. Interviews were conducted through the Zoom platform due to the COVID-19 pandemic, recorded, and sent out for transcription via a third-party transcription service. The interview transcriptions were saved and stored in an encrypted folder with all identifying information removed and replaced with pseudonyms to ensure participant privacy and confidentiality.

The *2-year start* interview protocol focused on the participant's background, such as gender, race, ethnicity, and where they were born. Additional questions focused on their family and their status as first-generation college students. In alignment with Transition Theory, other questions sought to capture their experiences as first-time college students, specifically around their transition into college, what their first few weeks were like on campus, and why they chose this specific institution for their 2-year college degree. The *2-year end* interview protocol included the same questions from the 2-year college start interview protocol and additional questions on the transition from a 2-year to a 4-year college. In other words, questions focused on the transfer process from the 2-year college to the 4-year college, including why the participant chose that specific 4-year college, how they were preparing to transfer, whether they engaged in any transfer orientation and their experience with the entire transfer process. Finally, the *4-year start* interview protocol was the same as the 2-year start interview protocol but instead of focusing on their experiences with the 2-year institution, it focuses on the participants' experiences with the 4-year college.

Data analysis:

The interview transcripts were deductively and inductively coded using a deductive codebook based on the theoretical framework. This codebook was created based on Schlossberg's Transition Theory. More specifically, codes were created based on the 4 Ss used to capture coping strategies: Self, Situations, Strategies, and Support. Four research team members then coded a randomly chosen interview to validate the deductive codebook. Codes were added and removed based on relevance with the transcripts to create the final version of the codebook. This codebook was then used across the rest of the interviews to code data for each group of

participants. A mind-mapping software called MindNode [26] was used to create mind maps for each transition group (2-year start, 2-year end, 4-year start) to find overarching themes for the data. A final aggregated mind map was created for each transition experience.

Results

Starting at the 2-year institution

Participants spoke about various situations they encountered at the beginning of their time at the 2-year institution. Many talked about the transition from high school to college being confusing and challenging, as everything was brand new. Participants discussed their choices of their 2-year institution, navigating the campus for the first time, choosing their major, learning how to enroll in courses, figuring out what courses were required for their degree, handling financial aid, their class, curricular, and club experiences at the college. Some participants in this study were also working part-time or full-time jobs during this transition; they spoke about the struggles and successes with school-work-life balance. Additionally, participants spoke about navigating and adapting to the new world of starting college entirely online for the first time during a global pandemic. Finally, some participants spoke about some of the challenges they encountered with their general advising experiences.

Participants enacted many coping strategies that helped them navigate their transition into college. When deciding on their 2-year institution, their major, and building their course schedule, many participants mentioned that they *negotiated*, meaning they had to compromise or choose the best option given the constraints of their situations [27]. The negotiation strategy was utilized in choosing their college due to its proximity to participants' homes, families, quality, and institution's affordability. This same strategy was also employed in participants' choice of computer science as their major. Many noted that computer science was a compromise between their interests and job opportunities in the future. Lastly, many had to negotiate their course schedules based on the difficulty of the instructor, their existing course load, and the pedagogical styles of the instructors.

Students just starting at the 2-year institution used an information-seeking strategy to navigate through the transition. *Information-seeking* is a strategy that deals with finding additional contingencies or options through reading, observation, or asking others [27, p. 242]. Starting out, many participants needed help obtaining information around the transition and choosing a major, and so they asked others for what resources they had. Information for these participants came from activities and services, advisors, course instructors, family, financial advisors, their peers within class, and programs within the college to gain additional resources and knowledge. Another common strategy used during the transition into the 2-year institution was *problem-solving*. The problem-solving strategy is defined as adjusting an action to be effective [27, p. 241]; in other words, these are active, constructive, and problem-focused means to change

a situation. Participants leaned on this strategy to get to school on time, manage their schedules, and make decisions such as picking courses and deciding on their major.

Less common coping strategies included accommodation and support-seeking. *Accommodation* refers to flexibly adjusting preferences to the current options [27, p. 227]. Participants exercised the accommodation strategy to help them adjust to the 2-year college experience. Participants accommodated their preferences to the existing options by learning to like math and managing their time. *Support-seeking* is a strategy that focuses on using available social resources and shifting attention away from the situation towards support [27, p. 245]. Participants leaned on this support from family and friends to mitigate their problems and help others whenever possible.

Participants interacted with advisors, programs, and services to find support during their transition into the 2-year institution. Advisors seemed to be the most critical support structure for students starting their 2-year institution. Some noted the importance of STEM-specific advising in helping them figure out their course load and academic plans. For instance, one participant notes:

“...Well, I went to advisors but many of them ... I felt like some of them or the people I reach out didn't really know what to do, or what I should do because... They help with some things but not everything. They know general thing for everybody... But when you go to a specific point, sometimes they can't do it. So I went to [campus name] because [campus name] is more like the STEM people. So I went there and I talked to some of them and, well, when I wanted to know like my map, I didn't know what my map was. So I wanted my map so I can plan ahead...” –Luis

Advisors provided students with information and resources to enroll in required courses, keep students on track with their degrees, and fill out documentation when needed. Participants noted the importance of advisors assisting them in Spanish to help them navigate the transition through their home country's context, as some participants had emigrated from other countries.

Finally, programs and services were pivotal as a means for support for participants. The STEM-FLA* (name anonymized*) program is a National Science Foundation-funded project that provides scholarships and support to low-income STEM students with high academic achievement; it functioned as a support system for some participants in this study.

Experiences during their time at the 2-year institution

During participants' time at the 2-year institution, they spoke about their classroom, curricular, and out-of-class experiences along with COVID-19 complications that impacted their experience. When discussing their classroom experiences, participants' generally focused on the overall climate of the classroom along with their pedagogical experiences in different courses. The climate of the classrooms was highly variable in size and pedagogical styles, though

participants were generally happy with the instructors and their courses. Participants' curricular experiences mainly focused on the increase of pace and rigor of the college classroom compared to their expectations. However, participants noted that their difficulties with the curricula diminished as they moved further along in their programs. Out-of-class experiences included participation within clubs and socializing within on-campus labs and lounges.

Participants during their time at the 2-year institution leaned on the same strategies as those beginning at their 2-year institution, including information-seeking, support-seeking, and problem-solving. Participants used the strategies above in the same ways as the 2-year start participants did. However, there were additional usages of these strategies during participants' time at the college. More specifically, the information-seeking strategy was used by participants to maximize their potential for success within their courses, as participants researched online to find reviews on professors so that they could find the best ones. Support-seeking was used to minimize their struggles within the 2-year institution; participants leaned on the support of tutors, friends, and course instructors for help. Finally, the problem-solving strategy was used to plan out their future in computing while maximizing their potential success for the future.

Participants mentioned several support structures they leveraged during their time at the 2-year institution. These support structures included advisors, course instructors, family members, financial advisors, financial aid, learning assistants, peer leaders, and peer classmates. General advisors assigned by the college were also seen as barriers by students. Services such as the tutoring centers, including the Students in STEM Center* (name anonymized) were supportive to students by providing them a space to engage with their peers and professors. The Students in STEM Center was mentioned as a source of community for students due to its tight-knit nature. Additionally, programs such as the STEM-FLA program, the GetAhead* (name anonymized*) program, which is a program that provides free tuition, textbooks, two introductory classes for first-year students, and the Honors College at the 2-year institution were noted as support structures for students.

Transferring to the 4-year institution

When speaking about the transfer transition, participants spoke mostly positively about their experience in transferring from the 2-year to 4-year institution. Initially, some experienced fear and anxiety around transferring. The feelings and situations that participants faced prior to the transition were similar to those of the 2-year transition. One participant at the end of their 2-year institution sums this up well when asked about the beginning of their transition to the 4-year institution:

“I think I'm repeating the same feeling about [2-year institution], about the beginning is scary. Right now I feel scared, I don't know if I'm good enough...I think everybody feels that way sometimes when you're starting something new, that you're out of your comfort zone. A little bit scared, I don't know how it's going to be if it's maybe harder than [2-year

institution] and things like that. But excited at the same time. I want to start my computer, my programming classes, so it's a mix.” –Gloria

Others had an easy time with their transfer experience and were excited to transfer, take their core computer science courses, and engage with computing clubs at the 4-year institution.

Participants' coping strategies when transferring from the 2-year institution to the 4-year institution included accommodation, information-seeking, negotiation, support-seeking, and problem-solving. Many participants used the accommodation and negotiation strategies to decide on a 4-year institution and a bachelor's program. Some participants noted that, while they preferred other out-of-state or more expensive institutions, they would only be able to attend if they received a scholarship. Otherwise, they would prefer attending the 4-year institution of this study, as it is affordable, conveniently located, and provides quality education. Some mentioned that this 4-year institution was the best choice given their constraints, indicating the usage of the negotiation strategy. Finally, participants negotiated on the choice of their bachelor's degree. One spoke about choosing a Bachelors of Science (BS) over a Bachelors of (BA) in computer science based on the BS having better job opportunities than the BA. Another mentioned a negotiation on the bachelor's choice based on prior negative experiences with CS at the 2-year institution.

During the transfer to the 4-year institution, participants used information-seeking and problem-solving strategies to navigate the transition process, including the bureaucratic transfer process. This information seeking included researching 4-year institutions and their amenities, such as clubs. This information-seeking process included knowing the documentation needed and minimum transfer requirements. Information was found through academic advisors at the 4-year institution and bridge advisors specific to this 2-year to a 4-year institution. Problem-solving was used to ensure the process went smoothly; one participant mentioned reaching out to an academic advisor at the 4-year institution in advance to prevent any delays with the transfer process.

Support-seeking was leveraged to minimize the stress around transferring to the 4-year institution. One student struggled with ageism at the 2-year institution and experienced a feeling of isolation due to their age. This student was excited about transferring and looking forward to meeting people age alike at the 4-year institution. Another was excited to attend the 4-year institution due to the programming clubs. The support that helped students transfer to the 4-year institution included transfer orientations offered by the 2-year and 4-year institutions and academic advisors at both the 2-year and 4-year institutions (including bridge advisors). Transfer orientations are delivered by advisors or staff from the 4-year institution when they visit the 2-year institution to provide students with information about transferring. Participants also mentioned the importance of having good advisors that understand the transfer process and provide information about departments and services that could help students have a smooth transfer process.

Starting at the 4-year institution

Those starting at the 4-year institution spoke about their experiences within the classroom, managing the new curricula, out-of-class experiences, and some COVID-19 complications impacting their experience. Their classroom experiences mainly focused on the differences in pedagogical styles between the 2-year and the 4-year institution. Students saw the curriculum as either the same that they were experiencing before or much more challenging. The COVID-19 pandemic caused students to struggle academically due to online instruction, making the transition to the 4-year institution more challenging. However, students spoke about adapting to the online learning environment, and some preferred it.

Only two strategies, accommodation, and information-seeking were found for participants navigating the new institution, perhaps because this group had only two participants. One participant accommodates her personality within her courses to make progress:

“I don’t tend to work together with other people... I do think that I do better on my own. I know [working with others] helps a lot of people, and I do do it sometimes when I'm challenged, but for the most part, I think I'm most effective if I just get through things on my own... I feel like if I go in a group setting, look at us. We're talking a lot...” –Sarah

In contrast, Nio talks about using the information-seeking strategy regarding programming assignments by attending Zoom office hours and speaking to the professor about his concerns. This strategy helped him cope with the stress he encountered to complete his assignments:

“I believe two classes for my programming class, I was stuck on the program. I didn't know how to fix, because I had some bugs, and my teacher walked me through it. And he didn't... He could have just told me the answer, but he didn't do that. Basically had me talk to him and told him what I currently get out of the program. And then while doing that, I actually found the issue just by me telling him about the program. So that was actually pretty helpful with that.” –Nio

Participants leaned on several support structures when beginning at the 4-year institution. More specifically, participants went to their advisors for support with course scheduling and guidance. Additionally, Nio mentioned the impact of his family on his decision to pursue the BS in computer science, stating that:

“...my parents really pushed me to do the BS and power through it and still... Because I really didn't want to do the BS at first... So my parents did really push me and helped me. They basically made me feel that I could do the BS degree.” –Nio

Finally, Nio mentioned the support of his instructors for concerns about assignments or questions regarding course content. Nio also mentioned working in groups with his peers on assignments for the course and chatting with them via text group chats.

Discussion

In this study, we explored the experiences of Hispanic/Latinx computing students within the 2-year institution to a 4-year institutional pathway. The transition into the 2-year institution was challenging for many. However, this study found that transferring to a 4-year institution was even more problematic to students. The experiences of participants transitioning to the 2-year institution echo the findings of the 3-phase model on moving in, moving through, and moving out of a transition [28]. The moving-in phase is a time for participants to adjust to the new environment, learn the system, and determine how the institution works [18, p. 57]. Participants in our study had to learn how to navigate the new educational system from both a cultural and a bureaucratic standpoint, as some participants came from Latin American countries with different educational systems. Participants sought support from friends and family that had previously been through this pathway as a support system to overcome difficulties. In addition, due to the unique context of the 2-year institution, many advisors at the 2-year institution are familiar with these contexts and are bilingual, which was essential for students.

During the transition into the 2-year institution, participants used several constructive coping strategies that helped them to navigate their transition. Students had to negotiate or choose the best option given their circumstances for several significant decisions during their “moving-in” phase, including deciding on their major or institution. Negotiation as a coping strategy has been identified in psychology literature as a “constructive autonomous response to coercive threats, actions, or situations” and is one of the most common ways of coping with interpersonal stressors [27, p. 243]. For many, this meant a negotiation on computer science as a degree to improve their socioeconomic status. Others negotiated on their choice of a 2-year institution because it provided the best opportunity to engage with a quality education with minimal student debt due to financial aid, common among many community college students [29]. This negotiation process has been noted in the literature to be part of this “moving in” phase students go through [30], as selecting an institution and deciding whether it is convenient enough in both cost and location are prerequisites to this process.

Information-seeking and problem-solving were also beneficial to students while navigating the transition into the 2-year institution. Engaging with several sources of information and flexibly finding solutions was critical in navigating their entry. While this study did not focus on the negative ramifications of these coping strategies, it is vital to note that students’ time constraints should be considered when evaluating the benefits of coping strategies. Information-seeking is crucial for students to engage with, but considering other work-life responsibilities that many community college students have [11], institutions should aim to minimize students’ burden in finding the necessary information.

Throughout the interviews, students mentioned that they struggled with general advising at the 2-year institution regarding the specificity of helpfulness and availability. These findings are significant when trying to increase the persistence rates of those in this institutional pipeline. Prior research has noted that inaccurate advising can be a barrier for transfer students [31] and that community college counselors and advisors have a significant influence on students' persistence, particularly for Hispanic/Latinx community college students [32]. In addition, STEM-specific advisors were noted as helpful to students during their transition.

After the moving-in phase, participants' time at the 2-year institution was spent experiencing the learning process of time management, adapting to the new course load and teaching styles of the 2-year institution, and balancing work, school, and other personal responsibilities. These findings are similar to the moving through phase where students have become adjusted enough where they are now "moving through" the transition [18], [28]. By the end of participants' time at the 2-year institution, participants already seemed to have ended their transition and were now beginning their moving in phase during the transition to the 4-year institution. Those that spoke about their experiences at the 4-year institution similarly talked about adjusting to the new 4-year institution; this included adjusting to the new campus or online learning environment, new course loads, new instructors, and embracing the rigor of the institution. The findings from this study demonstrate that when proper support mechanisms, such as transfer orientations, advisors, and bridge advisors are available, students' burden and the transition are less stressful for them. While those transferring to the 4-year institution had to adjust to the new university system, most of the participants shared having a positive transfer process.

The 2-year start participants and those transitioning to the 4-year institution had many similarities in their experiences. The negotiation, information-seeking, problem-solving, and support-seeking strategies were also found to be leveraged by those that transferred to the 4-year institution, signaling that many of these initial 2-year transition strategies are "carried over" into the 4-year transfer. This finding mirrors the theory of "transfer student capital" [11, p. 180], a concept where "cumulative knowledge and experiences of higher education environment promote successful adjustment when students transfer from a community college to a 4-year university." This is good news when students leverage beneficial coping strategies; however, it can mean that more negative strategies could also be carried over as well. Additionally, those transferring to the 4-year institution leaned on academic advisors and bridge advisors to support their transition.

Across all of the groups, the most beneficial coping strategies were accommodation, negotiation, information-seeking, support-seeking, and problem-solving. These specific strategies led participants to find their way through each transition with as much ease as possible. Participants were able to accommodate their original preferences to the given constraints to adjust to their situations flexibly. Participants were able to lean on negotiation when making decisions such as

choosing their 2 and 4-year institutions, their major or program of choice, along with course schedules and course loads. Participants leveraged information-seeking to decide on a major, figure out their next steps within the transition process, navigate bureaucracy, and decide on their 2-year and 4-year institutions. Support-seeking strategies were enacted to help ease the stresses of the transitions by reaching out to family, friends, tutors, course instructors, and advisors for assistance and support. Finally, problem-solving strategies enabled students to solve any issues they encountered when transitioning, such as looking at what steps they needed to take to solve issues with bureaucracy and finding the best course of action for their future.

Implications & Future Studies

This study focused on students' experiences and coping strategies within the 2 to 4-year institutional pathway. The findings from this study have several important implications for institutions given the extensive findings on which coping strategies and supports students leverage. One recommendation is simplifying the amount of information-seeking students must engage with to set students up for success and reduce the overwhelm they already face when beginning the moving-in phase. This can be accomplished through advising and orientations at both the 2-year institution and the 4-year institution, as Lazarowicz notes that the moving-in phase should be structured and supportive for students to help them reduce their stress [33]. Institutions should work together to provide bridge advisors specific to the 2-year and 4-year institutions and transfer orientations at the 2-year institution. Institutions could help students smooth their transition between institutions by having STEM-specific advisors who create relevant academic plans early on in their pathway. In addition, having advisors available early on can prevent students from taking unnecessary courses that waste time and money, promoting early STEM academic momentum [15]. These practical recommendations may alleviate students' stresses during the moving-in phase at the 2-year and 4-year institutions.

The second recommendation is that institutions also provide and work to find students ample financial aid and STEM-specific scholarships & programs. This study reveals that students spend much time engaging in information seeking, problem-solving, and negotiating strategies. As such, institutions should have mechanisms to help students during the "moving in" phase to reduce the stress caused during transitions into both the 2-year and 4-year institutions. Students at both the 2-year and 4-year institutions mentioned that the opportunities provided by the 2-year institution of this study were highly supportive in their journey into computing financially, emotionally, academically, and socially. Therefore, other 2-year institutions should create and sustain STEM-specific programs, scholarships, and computing cohorts that provide meaningful experiences for students to be exposed to role models and like-minded students within computing. This recommendation is supported by other studies that demonstrate that exposure to computing communities, such as role models or other peers within computing, helps to strengthen computing identity and ultimately persistence within computing [34].

Future studies should compare students who had access to bridge advising and transfer orientations vs. those without to understand the impact on transfer students. Additionally, future research should examine the impact of “negative” coping strategies on students within the 2-year to 4-year institutional pathway to understand what interventions may help to promote healthier coping strategies, as this study used anti-deficit framing to look at helpful coping strategies.

Limitations

As with all studies, there were limitations to this study. First, there were only two participants within our 4-year institutional start group, meaning there are some limitations to the generalizability of the experiences and coping strategies used by this group. Second, due to the methodological limitations of qualitative research, there are limitations in the generalizability of this study. Additionally, due to the pandemic, there were limitations in the data collected on the physical experiences of students on-campus; some participants were forced to begin at their 2-year or 4-year institutions fully online during this unique time. This means that pandemic-specific findings of this study may not be relevant to future researchers studying this space during normal, non-pandemic circumstances. Furthermore, selection bias is inherent in the sampling methods deployed for the interviews. Neutral and critical feedback from participants, however, supports the notion that these participants were chosen primarily for their willingness to participate rather than the likelihood that they would cast their program in a favorable light. Finally, due to the HSI standing of these two institutions, and the close relationship between the two institutions, the findings of this study may be contextual and may not be replicable at non-HSIs.

Conclusion

In this study, we investigated the 2-year to 4-year institutional pathway of Hispanic/Latinx computing students through the lens of Transition Theory. We explored students' experiences at each transition point within their pathway, including the entry at the 2-year institution, their experiences being at the 2-year institution, their experiences transferring to a 4-year institution, and their experiences after transferring to the 4-year institution. We also investigated the coping strategies they leaned on to help support and navigate these transitions. We found that students utilized a variety of constructive coping strategies and support structures that enabled them to successfully make their way through a computer science 2-year to 4-year institutional pathway. The support structures identified were strong advising, including STEM-specific advisors and bridge advisors, STEM-specific scholarships and programs, financial aid, friends, family, and instructors. In addition, strong partnerships between 2-year and 4-year institutions were helpful for computing Latinx transfer students in navigating the transition between the two institutions.

This 2-year to 4-year institutional pathway should be strengthened to increase retention and persistence of Hispanic/Latinx students within computing and ultimately broaden participation.

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