Transfer Student Success in CS: Modeling Pathways and Outcomes

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Introduction

My dissertation focuses on understanding the experiences of transfer students in computer science (CS), identifying how institutions can better support them, and uncovering concerning patterns and emerging themes to better conceptualize this student population.

The project is organized into four phases: (1) conducting a systematic literature review to synthesize current research and highlight gaps; (2) designing and deploying surveys to both pre-transfer community college students and post-transfer university students; (3) applying data analytics, machine learning, and knowledge graphs to identify patterns and predictive factors of student success; and (4) synthesizing findings into a data-driven, transferable framework to help institutions support transfer students more effectively.

Ultimately, the goal is to promote academic success for transfer students, ensuring equitable opportunities regardless of where students begin their educational journeys.

Motivation

My motivation for this work is deeply personal. As a first-generation immigrant, I have seen how access to education transforms families and creates opportunities for upward mobility.

Community colleges offer an important entry point for many students seeking to improve their futures, providing a flexible and cost-effective pathway into higher education [10]. However, transfer students pursuing computer science (CS) degrees often encounter challenges distinct from other fields. Unlike disciplines such as engineering, where curricular structures are standardized through accreditation bodies like ABET [4], CS curricula vary widely across institutions, leading to barriers in credit transfer, prerequisite alignment, and academic progression [3, 6].

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Although transfer pathways are critical to meeting workforce needs [5], CS transfer students remain underexamined. My research addresses this gap by producing scalable, data-driven insights to strengthen transfer pathways.

My goal is to fill this gap by producing research that is concrete, scalable, and actionable across institutions. By systematically identifying patterns of success and struggle, my work aims to improve academic outcomes for CS transfer students and help institutions build stronger, more navigable pathways to degree completion.

Research Approach

Phase 1: Literature Review on Transfer Students in Computer Science

The first phase of my dissertation involved conducting a systematic literature review focusing on transfer students in computer science. Initially, I conducted a literature review using a focused search term. Following reviewer feedback, I expanded the scope to conduct a more comprehensive and in-depth review.

The study synthesizes findings from 68 papers across major venues (ACM, IEEE, ASEE, and *Computer Science Education*) to examine the experiences and challenges faced by transfer students pursuing CS degrees. Motivated by the critical role transfer pathways play in expanding access to computing careers, the review highlights systemic barriers that complicate student success, including curriculum misalignment, inconsistent programming paradigms, and limited institutional coordination.

Compared to other STEM disciplines like engineering, which benefits from standardized prerequisites and ABET accreditation [4], CS transfer pathways are often fragmented. This lack of standardization creates persistent challenges in credit transfer and course alignment [3, 8]. The literature identifies key barriers such as credit loss, financial strain, prerequisite mismatches, and limited academic and social support [1, 2, 9].

The review also synthesizes interventions that show promise, such as articulation agreements, early advising, bridge programs, and near-peer mentorship [13, 15]. However, significant gaps remain, particularly regarding curricular standardization and scalable support models. Using frameworks such as Transfer Student Capital (TSC) theory [12] and Tinto's Model of Student Retention [16], the review emphasizes the importance of building both academic and social capital to support transfer students' persistence.

Surveys consistently show that transfer students report lower rates of peer support, mentorship, and belonging compared to native students [1, 14]. Based on these findings, the literature review concludes by recommending greater alignment across CS curricula, the development of AI-assisted tools for evaluating transfer credits [7, 11], and the creation of inclusive academic environments to improve computing self-efficacy and student outcomes.

Together, these findings set the foundation for the next phases of my project, informing the design of surveys, predictive modeling approaches, and knowledge graph construction.

Phase 2: Quantitative Survey Research

The second phase focuses on collecting data directly from students. To capture a thorough understanding of transfer experiences, I have developed two surveys: one targeting students currently enrolled in community colleges (pre-transfer population) and another targeting students who have already transferred to public universities (post-transfer population). The surveys aim to capture students' experiences with academic preparation, struggles during the transfer process, the types of institutional support received, and perceptions of what was beneficial. To ensure survey validity and clarity, I piloted the survey instrument with a small sample at my own institution and conducted informal interviews with transfer students and community college students regarding their experiences and the survey content. Although the design will not be longitudinal due to anonymization and privacy concerns, surveying both pre- and post-transfer groups allows for a reconstructed view of the transfer experience.

Phase 3: Predictive Modeling on Transfer Student Success

The third phase will involve applying knowledge graphs, machine learning and data analytic techniques to better understand the collected data. I will construct temporal knowledge graphs (KGs) using Neo4j and NetworkX, modeling student milestones as time-annotated triples. Temporal graph neural networks (e.g., TGAT) will be applied to uncover latent patterns and dynamics within academic pathways.

Using libraries such as pandas, SciPy, and scikit-learn, I will conduct both descriptive and inferential statistical analyses to find trends and associations. I will also train machine learning models, including logistic regression, random forests, gradient boosting, and neural networks, to uncover hidden patterns and identify factors that correlate with student success. Model performance will be evaluated through accuracy, precision, recall, and F1-score. To enhance interpretability, I will use SHAP (SHapley Additive exPlanations) analysis to determine which factors most strongly contribute to predictions of persistence

Phase 4: CS Transfer Identity Model

The final phase will synthesize the findings from the prior phases into a conceptual and practical framework. Drawing on insights from the literature review, survey analyses, machine learning models, and knowledge graph exploration, I intend to propose a set of actionable recommendations for institutions. This framework will guide universities and community colleges in designing better transfer pathways, improving advising and support structures, and minimizing barriers to degree completion. Ultimately, the aim is to build a clear, scalable, and research-driven model that can be adapted across different institutional contexts to better support CS transfer students and improve academic outcomes.

Expected Outcomes

This project has already produced a systematic literature review on CS transfer students, providing a foundation for broader dissertation work. I have completed the design and piloting of survey instruments, and data collection is currently ongoing. Additionally, I developed technical expertise in knowledge graph modeling through a separate project published on arXiv, preparing me to apply these methods within this educational context.

As the project progresses, I expect to produce an empirical analysis of transfer experiences based on survey data and predictive modeling. Temporal knowledge graphs will offer a novel approach to visualizing transfer pathways and academic transitions. The project will culminate in a data-driven framework that strengthens CS transfer pathways and contributes to both education research.

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