**Thesis Project Portfolio**

# Optimizing Computer Science Office Hours Through Technology-Driven Grouping

(Technical Report)

# Efficiency vs. Equity: A Critical Look at Group-Based Office Hours in Computer Science

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

**Thao Nguyen**

Spring 2025

Department of Computer Science

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### Technical Project Abstract

The traditional first-in-first-out office hour system at the University of Virginia struggled to meet the needs of a rapidly growing computer science student population. With more and more students enrolling in the major, office hours face problems of long wait times, overwhelmed teaching assistants (TAs), and inconsistent student support revealing critical inefficiencies. To address these issues, a redesigned office hour system was developed featuring two major innovations: automated student grouping and a Large Language Model (LLM)-based chatbot. The grouping tool uses a Cosine Similarity algorithm to create a "hyperspace" of student-submitted question vectors, clustering those with smaller angles between them, indicating shared words, into groups. Thus, TAs can now assist multiple students simultaneously in a collaborative environment and improve overall help session efficiency. Meanwhile, the LLM chatbot provides immediate support for common or straightforward inquiries with course and Piazza data being inputted by professors, reducing TA workload and minimizing bottlenecks.

Initial deployment across eight computer science courses demonstrated moderate improvements in session efficiency and student throughput. However, results also revealed that grouping strategies are not universally effective as some students had negative feedback and some TAs reported challenges in assessing individual understanding within group settings. These outcomes suggest that while algorithmic grouping and AI integration can address logistical inefficiencies, they cannot fully substitute for the instructional value of personalized support. Future work must refine similarity measures, explore hybrid queue models, and recognize that systemic limitations, like staffing shortages, may ultimately constrain the scalability of technical solutions alone.

**STS Project Abstract**

While technological solutions such as AI-driven chatbots and automated student grouping offer promising efficiency gains, they also raise critical concerns about equity and accessibility. My research investigates how UVA's enhanced, technology-based office hour system impacts academic support for underrepresented and disadvantaged computer science students. Applying technological determinism as a key framework, I argue that design choices embedded in educational technologies are not neutral – they shape social outcomes, often reinforcing or disrupting existing inequalities.

My research focuses on the experiences of students from diverse racial, socioeconomic, and digital literacy backgrounds, as office hours often serve as a crucial and often only academic lifeline for them. Poorly structured office hours, even when enhanced by technology, have the potential to widen educational gaps by privileging students with greater digital literacy, quicker access to resources, or more confidence navigating group learning environments. Additionally, intentionally inclusive design can help bridge these gaps by making support more timely, navigable, and equitable for all students. To assess these impacts, surveys were conducted at the end of every office hour session to collect qualitative feedback from a broad range of students and TAs engaging with the system.

Ultimately, my work highlights how sociotechnical design must actively centralize the needs of marginalized students to avoid worsening achievement gaps. As institutions increasingly adopt AI-based academic support tools, it becomes essential to recognize that technology is shaped by existing power structures. By critically evaluating UVA's office hour redesign, my research offers broader insights into how educational technologies can either deepen or narrow inequalities in STEM education.

**Relationship Between the Two Projects**

The technical and STS sections of this project are closely interconnected exploring how technology impacts office hours experiences at UVA. While the technical project focuses on solving and streamlining logistical inefficiencies in UVA's office hours through automated student grouping based on Cosine Similarity and a Large Language Model (LLM)-chatbot integration, the STS research critically examines the broader societal and ethical impacts of these innovations. Specifically, it looks into whether these technical solutions improve academic support equitably across diverse student populations or unintentionally reinforce existing disparities. Since the newly redesigned office hour system is more dependent on technology, it is important to assess that new features do not privilege some students more than others.

By combining technical development with sociotechnical analysis, this project recognizes that technical effectiveness alone is insufficient. Automated grouping and AI chatbots may streamline sessions, but without careful attention to issues of accessibility, usability, and inclusivity, they risk marginalizing students who already face systemic barriers in STEM education. The technical work aims to streamline some aspects of office hours but the STS analysis emphasizes that long-term success is measured by how inclusively and equitably support is provided. While the technical project seeks to improve wait times and overall office hour efficiency, the STS project evaluates how these enhancements influence educational equity, reinforcing the idea that technical design decisions inherently shape social outcomes. Together, these two perspectives reinforce the importance of centering marginalized student needs in any technological redesign, ensuring that innovation narrows instead of widening existing achievement gaps in STEM education.