Building Curricular Supports Through Undergraduate TAs to Scale Individualized Instruction in CS1

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Highlights

- Designed and implemented a new undergraduate teaching assistant hiring process, including a written application and interview.
- Developed asynchronous training modules & lesson plans delivered through Canvas.
- Altered course structure to reduce faculty teaching load and increase the amount of time students spend in the classroom with a smaller student-to-instructor ratio.

Problem & Motivation

At the University of Delaware (Newark, DE), all first-semester College of Engineering (COE) students must take a CS1 course.

With more students enrolling each year, the student-to-instructor ratio is ever-growing.

The Computer & Information Sciences department already widely used undergraduate teaching assistants (uTAs), but without a dedicated TA Coordinator position, only an ad-hoc hiring process was possible, with no department-wide training.

To accommodate the department's limited faculty and annual influx of new students, the meeting schedules for UD's CS1 courses were updated as follows:

Previous Course Structure	Fall 2022 Course Structure
3 x 50 min lectures led by the instructor (~60:1)	1 x 75 min lecture led by the instructor (~48:1)
1 x 90 min open work time with uTAs present to help (~15:1)	1 x 75 min "practicum" activity led by the uTAs (~12:1)
3 sections (180 students total): 7.5 hours/week lecture load	4 sections (192 students total): 5 hours/week lecture load

Rather than simply being present to assist students while they work on the course's homework, uTAs would be playing an active role in the classroom through a "practicum" activity:

- uTAs present slides reviewing that week's content
- Students work in small groups on a Google Doc worksheet while uTAs assist
- uTAs review answers at the end of class

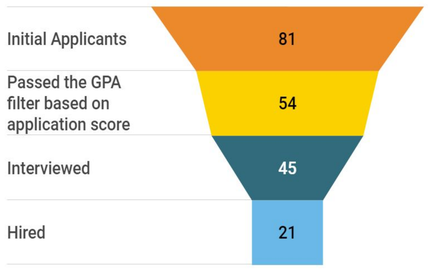
However, for this format to be successful, we needed to carefully select and train our own CS1 uTA team.

Hypotheses

The updated course structure, combined with properly hired and trained uTAs, would:

1. **Reduce instructor lecture load** and keep the staff management workload tolerable.
2. **Empower undergraduate teaching assistants** to feel prepared to teach and mentor students.
3. **Improve student motivation,** especially their feeling of belonging in CS, without negatively impacting learning outcomes.

uTA Hiring Process



To hire the Fall 2022 CISC108 uTAs, the following process was developed:

1. Candidates applied via a Google form, distributed on undergraduate listservs and UD CIS Discord server.
2. Written applications were scored, and interview offers were determined by applying a GPA requirement based on application score, where higher scoring applicants received more leniency in GPA.
3. Applicants interviewed over Zoom in groups of three, for 45 minutes per group.
4. Interviews were scored using the developed interview rubric rubric.
5. Final hiring decisions were made based on availability for class times, combined written and interview scores, and consideration of matching course staff with expected demographics of students *(e.g. prior experience levels, CS major or minor, etc.).*
6. Offers made in mid-summer.
7. Hiring decisions finalized before August.

Written Applications

In addition to asking for availability and other basic information, applicants were asked to answer the following questions:

- Which CISC class was (or currently is) the most challenging for you? Why?
- In 1-3 sentences, describe what qualities or values you think are essential to be a "great TA."
- If you could change any ONE THING about UD's CIS Department, what would you change? Why?

These written questions were designed to probe applicants' critical thinking about their experiences so far with the CIS department.

Applications were then scored on the following rubric:

5	All short answers are notably thoughtful and detailed, and demonstrate significant passion for the position and/or critical thinking.
4	Some, but not all, answers exceed the expected thoughtfulness and details.
3	Answers provide expected thoughtfulness and details.
2	Answers lack detail or contain many spelling/grammatical errors.
1	One or more questions not attempted (e.g. "I don't know," leaving it blank).

Interviews

In each 45 minute group interview session, three applicants took turns answering questions. The questions were divided into four categories:

- **"Standard" interview questions** (e.g. "Why do you want to be a TA for CISC108?")
- **Realistic TA scenarios**: (e.g. "How would you respond to a student getting overwhelmed and crying during office hours?")
- **Position-specific questions:** (e.g. "If you were to be hired, what is the largest challenge you'd expect to have as a CISC108 TA?")
- **Overarching theme questions:** (e.g. "What is one action you can take as a TA to foster an inclusive and diverse learning environment?")

After each interview session, applicants were scored in the following categories, adapted from Leyzberg et al.'s "Nailing the TA Interview: Using a Rubric to Hire Teaching Assistants" [1]:

- Clear and confident speaking
- Active listening
- Engaging speaker/Can hold students' attention
- Empathetic toward struggling students
- Open to improving teaching skills
- Sensitive to the freshman experience
- Open to innovation and change
- Cognizant of diversity, equity, and inclusion issues in CS
- Passionate about building community among students

[1] Leyzberg, Lumbroso, and Moretti. 2017. Nailing the TA Interview… In ITiCSE '17. Association for Computing Machinery, New York, NY, USA, 128–133. https://doi.org/10.1145/3059009.3059057

TA Training

Once hired, undergraduate teaching assistants were previously offered only basic instructions, with no dedicated training on pedagogy or logistics.

The new TA training curriculum takes the form of a separate Canvas course, where uTAs are added as students. This separate course page allows senior course staff to provide feedback and resources to teaching assistants through a familiar platform.

Within the first week of the semester, uTAs are expected to have completed the TA Training Curriculum, which is organized into 3 modules:

- **Module 0,** which has the absolute essentials for TAs, including onboarding procedures, ethics, FERPA compliance, and the course's expectations for its teaching assistants.
- **Module 1,** which prepares TAs to fulfill their duties. This module includes instructions to navigate Canvas and the department's Discord server, advice for first-time TAs, and preparation for the first lab of the course.
- **Module 2,** which offers uTAs basic pedagogical training on student learning, grading effectively, building community with their students, and creating an inclusive classroom.

Each module features autograded quizzes to confirm TAs' comprehension of the information.

Limitations

Time: These hiring processes and training materials had to be created and executed prior to the start of the Fall 2022 semester.

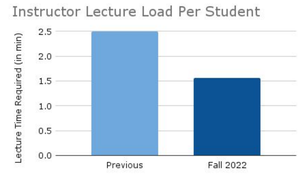
Lack of Comparable Data: Due to the COVID-19 pandemic, the last "normal" semester of this course was Fall 2019, and little to no uTA feedback data was gathered prior to this project.

Limited Data: Students & uTAs had to opt in at the beginning of the semester to have their data be used for research purposes. Furthermore, students/uTAs who were more motivated and performed better in the course were more likely to respond to surveys.

Fall 2022 Results

I) Reducing Instructor Lecture Load

Reduces lecture time per student from 2.5 min/student to 1.5 min/student, freeing up additional time for individual help through office hours, review sessions, and more.



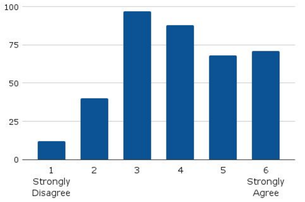
II) Empowering uTAs

Some comments from Fall 2022's uTAs:

- *"I was certainly better than any other time I've been a TA, but I feel that's because I was given far more responsibilities."*
- *"Being a TA for 108 was one of my favorite experiences of college. I believe you gave us just the right amount of autonomy to learn and grow while also providing excellent support."*

III) Improving Student Motivation & Community

On the course's final survey, students were asked to rate their agreement with the phrase **"My TA makes me feel more connected to the course."** The following graph plots the results from our 376 consenting students.



Future Work

As of January 2023, the Computer & Information Sciences department at UD now has an official TA coordinator! Within the next several months, the uTA Hiring and Training materials created for this project will be revised for general use across the department by the TA coordinator.

Future research may entail:

- Comparing candidates' hiring process scores to their performance as a teaching assistant.
- Determining which questions are most indicative of whether someone will be a good uTA candidate.
- Exploring ways to increase uTA usefulness in other beginning courses, such as CS2 or data structures.
- Continuing to gather feedback and refine all materials through additional semesters of students and uTAs.

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