CoMInDS Program Profile: University of Michigan

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Program Snapshot:

The University of Michigan runs an intensive, week-long teaching institute, or "training week," before the academic year begins, which serves both new graduate teaching assistants and new postdocs. Weekly course meetings, shared lesson plans, and feedback from observers and students support instructors' continued development after the term begins.

How did the program originate?

TA preparation at Michigan is connected to its large calculus program, developed in the early 1990s as part of the national calculus reform effort (Carreon et al., 2017). Previously, the department ran a shorter orientation for new graduate teaching assistants (GTAs)*. When the calculus reform effort began, this training was expanded and recentered on the reformed course, and follow-up support including class visits was added. Faculty new to the department were also included, especially the many postdoctoral scholars serving as visiting assistant professors.

The course emphasizes problem solving in a cooperative learning environment, and all instructors are expected to incorporate small group work into about half of each class period. Web-based homework and 'gateway' assessments are used to check students' mastery of core skills such as differentiation techniques, while team homework projects emphasize challenging, conceptual problems, often set in novel contexts, and mathematical communication. Each fall over 3000 undergraduates take calculus courses in small sections, each meeting for three 80-minute periods a week and led by a GTA, postdoc, or tenured faculty member. The number of instructors is large, and thus the course is highly coordinated and strongly supported. Preparing instructors for teaching in these courses is seen as essential for the calculus program's success.

What is the scope of the program?

- All new instructors teaching precalculus ("Data, Functions and Graphs") or Calculus 1 participate in training week, typically about 60 graduate students and postdocs.
- Most first-year graduate students teach precalc or Calc 1, as do new postdocs. A few take tutoring roles to gain practice in understanding student thinking from one-on-one work.
- Experienced GTAs may teach Calc 2, run labs for other courses, or serve as course co-coordinators, but most will work in the well-supported precalculus and Calc 1 courses.

*Here the term graduate teaching assistant (GTA) includes all graduate students holding or preparing for teaching roles. Local terminology may differ.

How is the program staffed and funded?

- Each of Michigan's three core calculus courses is overseen by a course coordinator with an appointment as lecturer. Together they serve as co-directors of the introductory math program. The course coordinator sets the day-by-day scope and sequence, homework problems, exams, and grading standards, and runs weekly meetings with instructors. Training and supporting instructors is part of the formal job description.
- Coordinators of large courses receive course releases. For example, in Fall 2017, Calc 1 enrollment was 1700 students in 87 sections taught by 63 instructors. The coordinator of this course taught no sections; he may teach 1-2 sections in a term when enrollment is lower. Course releases provide coordinators the time to meet these large-scale responsibilities but also communicate that their efforts are expected and valued.
- Training week activities are collaboratively designed and taught by a team including the course coordinators, GTA co-coordinators, and others engaged with introductory math.

What are the main components of the program?

The week-long institute or "training week" is held the week before fall term begins. It includes workshop-style sessions on a variety of core instructional skills: asking questions, presenting material in mini-lectures, running cooperative classrooms, understanding student thinking, and managing student expectations. Participants gain practice by working with a specific calculus topic as they prepare and revise a mini-lecture and, later, devise a group activity. They try out the student testing system by completing a gateway assessment on graphing calculator use. Other topics include classroom troubleshooting, inclusivity, professionalism, and grading, plus general orientation and social time. While most activities target both GTAs and postdocs, a few sessions are tailored for each group, such as short talks to foster research connections among postdocs.

Training week sessions model the group-based pedagogies that GTAs are encouraged to use, such as setting a group task, debriefing it, and coming to closure. Sessions also send strong, positive cultural messages intended to build participants' confidence in the program: the department places high value on good teaching; the calculus program is successful and supported by research; the staff is welcoming to individual GTAs for support and advice; teaching math is fun and rewarding. As an introduction to the program describes, "Good teaching matters. Active learning matters. Training matters—but non-experts can succeed. Our model here works."

Once the semester begins, additional support includes:

- *Weekly meetings* that provide instructors with reminders about course activities and deadlines, and focus on course material that is coming up. Discussion addresses student conceptions and mistakes and key points to emphasize. Instructor attendance is required.

- *Lesson plans*, available for precalculus for the entire term, and for Calc 1 up to the first exam. These offer advice about the content and timing of lessons, based on strong pedagogical content knowledge. Instructors are not required to use them, but many do.
- *Feedback*. A few weeks into the term, course coordinators and co-coordinators visit each new instructor's class and provide feedback. After the first exam, students are invited to complete an anonymous survey about their instructor. These activities help instructors understand their students' experiences and gain advice from an experienced instructor on how to improve their teaching. This feedback is also used to identify instructors who may benefit from more support, such as a second round of visiting and feedback. Coordinators find that these processes typically enable instructors to succeed over time.

The department does not formally measure the impact of its professional development activities, but its participation in high-profile studies with strong results (e.g., Epstein, 2013) is thought to have had positive influence on views of the program by university administrators. Math GTAs have frequently won the graduate school's annual teaching award. Noted one program leader, "I am proud when I see an instructor who struggled initially but changed their attitude about teaching—who starts to say, 'My students answered this challenging question.'"

What aspects of this program make it work in the local institutional context?

- *Departmental support:* Course coordinators cite substantial departmental support as essential to sustaining the program. In addition to their financial investment in instructional support for calculus, department leaders state their support directly to new instructors, and it is also signaled by classrooms furnished with tables for group work, instead of lecture-style seating. "The furniture sends a message. It's not just that one person says teaching is important—the department's investment shows," said a coordinator. Training materials are crafted to encourage GTAs to decide for themselves to embrace this approach to teaching. Institutional support has in turn been important for initiatives such as offering smaller class sizes.
- *Vision and structure:* The program expresses an unusually strong and specific vision of what counts as good teaching. "We talk about how students understand ideas. Teaching is not just showing up and putting notes on the board," said one leader. Student-facing materials communicate a vision of learning consistent with this, so that the messages are well aligned.
- *Community building* occurs through highly coordinated courses and close interactions among instructional staff. "People can't get isolated" in our system, noted a coordinator. "We instill a sense that we work as a team, an environment that everyone is part of a bigger thing."

Leaders' advice about this program model

- Strong and consistent messaging about the importance of teaching, and the department's commitment to this model for calculus, builds instructor buy-in. Postdocs in particular are

sometimes surprised by this emphasis, which may differ from their prior, often minimal teaching preparation experiences, but generally have a positive attitude about participating.

- For many years, Michigan's calculus program was run by a single director, Karen Rhea. Moreover, different people rotated through the course coordinator roles. It was hard to improve the program because of this constant change; there was no fixed group of invested leaders to consult and make decisions or adjustments. Sharing the extensive workload among three co-directors, and making these roles more formal and permanent, have made it possible to strengthen the program. Working with Rhea prepared the current coordinators well for the role, and this careful succession planning has benefited the program's continuity and growth.

Where can I learn more?

Professional Development Introductory Programs explains the department's philosophy. https://lsa.umich.edu/math/about-us/professional-development-introductory-programs.html

The *Math 105/115/116 Student's Guide* communicates expectations for calculus learners. http://www.math.lsa.umich.edu/courses/sg/

The blog *Michigan Math in Action* offer insights on how the department structures its classes and incorporates inquiry learning. https://sites.lsa.umich.edu/michigan-math-in-action/

Resources from this program are available on the CoMInDS Instructional Resource site, http://cominds.maa.org/instructional-resources Search on "Michigan" to find them.

Sources cited

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