ALL ROADS START WITH MEB: A TEAM-TEACHING APPROACH FOR MENTORING NEW FACULTY

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College teaching may be the only skilled profession for which no preparation or training is routinely required or provided.[1] New faculty members generally teach their first course with little or no prior guidance, and either they eventually learn how to teach well by trial and error (a process that may take several years) or they never learn at all.

There are better ways to begin teaching careers. For several decades, most new faculty members in the Chemical and Biomolecular Engineering (CBE) Department at North Carolina State University have begun their academic careers by teaching the introductory material and energy balance (MEB) course in collaboration with mentors who are excellent teachers and have had extensive experience with that course. The new faculty mentees generally teach MEB at least twice in collaboration with their mentors, which boosts their confidence in their teaching abilities before they move into other courses. The mentor-mentee partnership is quite close in the first offering and much more casual in the second one.

Why the focus on MEB? Since only the top teachers in a department should ever serve as mentors, the number of courses that can serve as vehicles is limited. Since MEB is the gateway to all ChE core courses, there's an advantage to all new faculty members becoming familiar with its content. In addition, the introductory nature of the MEB course allows a faculty member teaching for the first time to focus more on content delivery than on relearning fugacity, the Navier-Stokes equation, or other high-level material that they may not have seen for years, if ever. This benefit is especially valuable for faculty with non-chemical-engineering backgrounds.

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However, there is certainly no problem with having a top teacher mentoring a new one in another core course, as long as the mentor normally teaches that course and the mentee is likely to eventually teach it.

The pedagogy used to teach the MEB course is based on active, cooperative, and inquiry-based learning. The research that attests to its effectiveness has been described in detail elsewhere.[2,3] The mentorship structure is not tied to that pedagogy, however, but is easily adaptable to the gateway course in any academic discipline taught using any appropriate research-proven pedagogy.

Mentorship may take two different forms, depending on whether the mentor and mentee are the only instructors teaching the gateway course that semester (or trimester or quarter) or they are part of a team of instructors teaching multiple sections of the course. We will describe the two forms separately.

ONE MENTOR, ONE MENTEE

The two instructors either co-teach a single section or teach parallel sections of the gateway course. For roughly the first fourth of the course, the mentor takes the lead in making up assignments and exams and coordinating the activities of teaching assistants and graders. If there is only one section, the mentor plans and presents most of the class sessions, and the mentee observes the sessions that he or she doesn't teach. If there are two sections that meet at different times, the mentor teaches the one that meets earlier while the mentee observes, and then the mentee covers the second one with the mentor observing. Either way, as the course proceeds, the mentee gradually takes more responsibility for planning the class sessions, assignments, and exams, and the mentor does less lecturing and more observing. If the two sections meet at the same time, the instructors periodically switch which one they cover, and occasionally each instructor arranges for coverage of his/her section by a colleague or teaching assistant in order to observe the other instructor's classes.

The most important feature of the mentoring is regular debriefing sessions in which the instructors discuss how the last one or two class sessions went, how the course as a whole is going, and what to do the following week. An effective way for mentors to begin these sessions is to (1) ask what the mentee thinks went well in the classes he or she taught or observed, and then offer and discuss their own thoughts on the topic; (2) repeat that process for problems and areas for improvement in those classes—first get the mentee's perceptions, then share and discuss their own; (3) ask the mentee to summarize what he or she will take away from the debriefing—first, areas for improvement, and then what went well. The sessions generally conclude with planning for the next week.

Debriefing sessions may be as short as 10 minutes if everything has been going smoothly or as long as an hour (rarely more), but it is essential for the pair to keep reflecting explicitly on the pluses and minuses of the class sessions throughout the course rather than regressing to "come see me if you have questions or problems." The latter approach usually leads to the mentoring part of the sessions tailing off after several weeks, even if the planning continues.

THREE OR MORE COURSE INSTRUCTORS, WITH AT LEAST ONE MENTOR AND ONE MENTEE

In departments with large student enrollments, the MEB course commonly has multiple sections taught by three or more instructors. Those departments generally adopt one of two approaches. In the first one, the instructors who teach the course work as a team, with lesson plans, assignments, and tests coordinated so that the course content and assessments are consistent across sections. In the second approach the instructors work independently, trying to cover the same content by the end of the semester and possibly giving a common final exam. If the latter approach is adopted, two of the instructors may form a mentor-mentee pair and operate as described in the previous section.

The course is almost invariably better if the first approach—closely coordinated multiple sections—is used, but a somewhat different mentoring structure is required. The team of instructors periodically meets to review the course schedule, figure out how to bring back into synchronization sections that have drifted away from it, and discuss any problems that have arisen. Much of the mentoring that would occur in the one-on-one debriefing meetings described previously now takes place in these team meetings. Mentor-mentee class observations and debriefing sessions may be less frequent and more communication between the two instructors may be online rather than face-to-face, but the impact of the process on the mentee's teaching can be just as great as in the two-instructor case.

In both approaches, when mentees teach the course for the second time, they have full responsibility for their sections. The mentors from the previous course offering now serve as informal advisors, occasionally observing the mentees' classes and then meeting with them to offer suggestions. When the second offering concludes, the formal mentorship officially ends.

BENEFITS AND COSTS OF THIS APPROACH TO MENTORING NEW FACULTY

Using the MEB course as a vehicle for mentoring new faculty members in teaching offers considerable benefits to the new faculty members and their departments.

- *Teaching a new course always involves a major expenditure of time and effort, especially if the instructor is new to teaching. Team teaching with an experienced*

colleague reduces the burden considerably for mentees. When the mentorship begins, most of the lecture notes and/or slides are already in place—the mentor just has to walk the mentee through them to make sure everything is clear. The new faculty members can then focus more on how they are delivering the course content than on relearning possibly long-forgotten material or trying to learn material new to them.

- *The mentor can observe the mentee's class sessions to provide feedback and suggestions without the pressure of a formal peer review, and the mentee can observe the mentor's classes to get modeling and guidance on how to implement learner-centered teaching methods such as active learning; make effective use of technology; and deal with technical, logistical, and classroom management problems that may arise during class. Mentees can also provide useful feedback to their mentors, especially if they are familiar with new instructional technology and alternative teaching resources and methods from their graduate and postdoctoral experiences.*
- *Best practices can be institutionalized and shared with new faculty members in their first teaching experience. The use of teaching strategies and tools such as active learning, cooperative learning, in-class demonstrations, creativity exercises, mid-course evaluations, LearnChemE (<www.learncheme.com>), the AIChE Concept Warehouse (<https://jimi.cbee.oregonstate.edu/concept_warehouse/>), and constructing rigorous but fair assignments and tests, can be modeled by the mentor and practiced by the mentee.*
- *Students' experience in the MEB course often plays a key role in helping students decide whether to continue in chemical engineering, switch to another department, or in extreme cases, drop out of school. Using this course as a vehicle for mentorship means that the course is consistently well taught, which can have (and at NC State, has had) a significant positive impact on student retention.*
- *Team teaching a multi-section course ensures consistency across the sections so that all students receive the same content at the same pace. Students who miss a class session in their section can make it up in another section. If the sessions for different sections meet at the same time, they might be combined when one of the instructors is traveling or ill.*
- *As the mentees go on to teach subsequent courses in the curriculum, they all know what MEB course content they can presume their students have been taught, which can greatly facilitate their course planning. In addition, the mentees are likely to continue using the same research-proven strategies in the subsequent courses since they've previously had a positive experience with those strategies. If they do continue, the strategies eventually become integrated into the department's teaching culture.*
- *Over time, mentees become mentors of others, and the departmental mentoring workload is increasingly shared. The growing number of trained instructors on the faculty coupled with the diffusion of research-validated teaching methods across the curriculum lead to a continuous improvement in the quality of the department's instructional program. In our department, for example, many former mentees have gone on to win university outstanding teacher awards, and several years ago CBE was designated the best teaching department in the university.*

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Different mentees will of course learn different things from their experience. What they learn depends on what they already know about teaching when they begin, who their mentor is, what new strategies they are open to considering, and how much they are capable of absorbing in one year. We asked a relatively recent mentee to reflect on what he learned from his mentorship, and he reported the following:

- *how to deal with unexpected situations (*e.g.*, canceled class, students not getting along in groups,...) and students' requests ("I couldn't hand in my assignment on time because my car wouldn't start this morning," "I can't attend the test tomorrow because my team has a scheduled game,"...)*
- *the importance of academic integrity and emphasizing it to students*
- *how to do active learning*
- *how to design tests that are "gradable"*
- *how to adjust my teaching pace to stay on track with other instructors*
- *how to define expectations for group homework assignments*

Other mentees would undoubtedly come up with significantly different lists.

Mentoring using this model or any other model does not come free. It is time-consuming for both instructors, who must add classroom observations and debriefing sessions to the usual obligations of teaching. Treating mentoring as an uncompensated service task is consequently not a sustainable model, and so mentors should either be relieved of equivalent service responsibilities, given lighter teaching loads in semesters when they are mentoring, or provided with some other form of compensation, all of which involve costs to the department. However, the costs are insignificant on the scale of typical department budgets. They should be regarded as short-term investments that help increase the productivity of new department faculty members faced with time-consuming new course preparations, and long-term investments in improving the quality of the department's teaching program.

A possible concern about this approach is that it might put an unreasonable burden on mentors if many new faculty members are hired at the same time. If that ever occurs, it would be a rare occasion in most departments and would undoubtedly be followed by a fairly long period when no mentoring is required. If it does happen and there are not enough qualified mentors on the faculty, the mentorships can be spread over two or three semesters, perhaps releasing some new faculty members from teaching in their first semester to start working on research proposals. Once the program has been in place for two or three years, there should be enough qualified mentors to keep this situation from arising again.

Another concern that has been raised about the mentoring approach is that it takes good teachers (the mentors) out of the classroom. It doesn't, though—when the mentors are mentoring, they're still in the classroom, except that they're teaching the gateway course more than they might otherwise do. Their doing so greatly benefits the department and its students in the long run, however, and again, the frequency with which they are called on to mentor continues to decrease as the number of qualified mentors increases.

SUMMARY AND RECOMMENDATIONS

For the better part of two decades, the Department of Chemical and Biomolecular Engineering at North Carolina State University has been using its material and energy balance course as a vehicle for mentoring new faculty members in teaching. We believe that on average the mentees have cut several years off the usual learning curve for new teachers. Many of them have gone on to win teaching awards and to mentor some of their more recently hired colleagues, and the overall quality of the department's teaching program has steadily improved. Keys to the success of the program include that the mentors have all been excellent teachers who volunteered to be mentors and were compensated in some manner for their efforts, usually with reduced teaching loads or relief from other service responsibilities. This mentoring model may easily be adapted to any course in any curriculum.

In a previous paper we reported on our initial mentoring experience from the perspective of each partner in the collaboration,[4] covering such topics as preparing for class sessions but not overpreparing for them, observing and debriefing class sessions, scheduling and making up exams, and dealing with student evaluations. We still stand by our recommendations in that paper and suggest that readers look them over. We'll conclude this paper with our final recommendations from the earlier one:

Lisa: *If you're a mentee, seek out a mentor who genuinely cares about working with new instructors. Don't be afraid to ask questions that might reveal your ignorance. After all, you don't know about many of the finer points of teaching—that's why you have a mentor—and you can probably stand to brush up on the course subject matter as well. Seek to give back as much as you receive by providing your mentor with constructive feedback on his or her own teaching. When you teach the course again, use your mentor's course materials as a starting point for yours. After you've developed some confidence, take the initiative in preparing your own lectures and tests, and then ask for feedback.*

Rich: *If you're a mentor, go into the experience with an open mind, prepared to learn as much as you teach. Begin by offering your mentees options for the types and levels of feedback you can provide and let them call the shots, doing your best to honor their requests. Keep your mouth shut during their classes when they get themselves into trouble, no matter how pitifully they look to you to bail them out; be constructive but gentle when giving them feedback afterwards; acknowledge the things they're doing well before you begin critiquing and keep reminding them to think about those things along with their self-perceived flaws. At the end of the year, go out for a celebration dinner. Finally, in a few years, when your mentees start winning teaching awards, talk them into serving as mentors for future faculty hires. When they protest that they don't know how, offer to mentor them in the process.*

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