Teaching vs. Research: Perspectives from a 4th Year Assistant Professor

Jason M. Keith
Department of Chemical Engineering
Michigan Technological University
Houghton, MI 49931

Abstract

This paper describes the experiences of a chemical engineering assistant professor over the first four years of his academic career, particularly the balance of teaching, research, service, and outside life. The paper will describe the following topics:

- tips for success in the classroom, in the lab, and at home
- things that went wrong
- things that went right
- points of advice the author would have liked to have known when starting as a professor
- identifying a mentor
- who to ask / who not to ask for help

Although the author is a chemical engineering faculty member, the discussion will be of interest to all junior faculty and all senior faculty who want to help their new hires succeed.

Introduction

The challenge that faces almost every new faculty member is the same: get tenure. However, aside from stating that you are expected to teach, do research (also called scholarship), and perform service, colleges and universities rarely tell the new faculty member what is required to achieve this goal. All you can probably expect is that a new professor will have to do more than the last person who got tenure due to the "sliding scale phenomenon." Usually, the new hire usually hears something like, "Welcome to the Department. We're glad to have you here. Here are the keys to your office. Your lab is down the hall. Good luck."

This paper is meant to provide some friendly advice to professors on the tenure track or to people who want to help the new faculty member be successful, and will begin with a list of tips for success at teaching, research, service, and professional life. It will be interspersed with the author's personal narratives which address issues such as: things that went wrong, things that went right, points of advice a professor would have liked to

have known prior to starting their faculty job, how to identify a mentor, and finally who to ask for help and who not to ask for help.

None of the material in this paper can really be considered "new." They are things that the author has encountered while a professor that can be used to get off to a good start towards tenure.

Teaching Tips for the New Professor

Tip #1: There are numerous opportunities within ASEE to learn how to improve teaching. One of the best ways is by attending the annual conference. Almost all of the people in attendance care about teaching, and are very friendly. In three years at the ASEE conference the author has seen only one heated debate after a paper presentation, as opposed to a couple per year at the American Institute of Chemical Engineers Annual Meeting.

While attending the ASEE conference, try to identify one idea to implement into your classes. Do not try to do everything at once. As an untenured professor you cannot invest that much time. However, by changing one thing per year over a three or four year period, you will have significantly changed your course.

Even if you are an introvert, try to network at the conferences – for example, go to poster sessions and talk with someone whose work is interesting, or give a poster and talk to people walking around your poster. You will find that you will make friends and be able to chat with them at future meetings.

Tip #2: Attend the National Effective Teaching Institute (NETI). This is a three day workshop focused on improving teaching skills which is run the weekend before the ASEE meeting. A nominating application is required. It is customary for college deans to nominate and fund the participant's attendance. The NETI institute that the author of this paper attended also had several tenured professors in attendance looking for some new ideas or ways to refine their teaching skills.

NETI is usually run by three experienced educators. When the author attended the workshop in June 2001, it was run by Chemical Engineering Professors Richard Felder of North Carolina State University and James Stice of the University of Texas. Also moderating was Education Designs, Inc. President Rebecca Brendt. The workshop was very interactive. The participants learned how to be better teachers by doing things and working with each other to achieve goals. Ironically, these are some of the key suggestions to help your students learn material in your course!

Some ideas that the author has taken from attending ASEE and NETI conferences are summarized below.

Tip #3: Try to teach the same course more than once. By now you have probably taught college or university level courses and are aware of the time and effort required to

prepare your lecture notes. You do not want to have to prepare a new set of lecture notes each semester. Ask your department chair if you can teach the same course four or five years in a row. You will still have to invest time to generate homework and exam problems and hold office hours, but the extra time that you save will allow you to focus on your research and scholarly activities.

Tip #4: Recycle homework problems from previous years that you have taught the class. You do not have to use all of the problems from last year, and you do not have to generate a completely new homework set. The author usually assigns three or four problems in a homework set, and one or two of them are new problems. Obtaining a solution manual for the textbook that you are using is also a valuable time-saver.

At the author's university there is an extensive greek system where two-thirds of students are engineering majors. It is likely that all the fraternity and sorority houses have a comprehensive set of graded course materials. By generating new problems each time a class is taught, you prevent students from using the scoop files too much.

Because exams are usually returned to students, it is impossible to recycle exam problems. However, you can still use old exams as homework or as study guides. The author posts last year's exam on the class website. This allows students to see what types of questions the instructor thinks are important, but also puts all the students on an even playing field since not all of them have access to the scoop files. However, final exams are sometimes kept by course instructors since they are graded after the students have left for break. I keep my final exam and have used the same problems two or three times (out of four years teaching the course).

Tip #5: If you are teaching a class for the first time, try to get notes from your colleagues who have taught the class before. You might also want to refer to your notes from undergraduate or graduate school. These sources let you see what was done in this class before. Another timesaver is to not prepare all of your lectures in Microsoft PowerPoint. It is time-consuming and students are usually bored when you just read the slides to them.

Tip #6: Try to teach courses that relate to your research. If it does not directly relate, try to find some course material that can be applied to your research. You can usually generate a lecture within the class about your research. This serves three purposes. It shows the students that the material they are learning about is important. It also shows the students that you have enthusiasm for the course material. Finally, it opens the door for a student to approach you about undergraduate research or graduate school. All of these purposes serve to improve your teaching ratings and perhaps give your research program a boost as well.

Tip #7: If your university has teaching assistant support, try to get a teaching assistant for your course. This is more important in courses with a large number of enrolled students because the teaching assistant can grade homeworks and help with grading the exam problems. The teaching assistant can also teach the class if you are out of town. (Be sure to give the student a clear copy of your notes to teach from.) It may also be desirable to

have one of your graduate students as the teaching assistant (especially if you do not have any active grants but still have students that need financial support). This way you have control over their teaching and research duties.

If your university does not have teaching assistants, try to ask for funds to get an undergraduate student who took your course (and preferably one who got an A the year before) to help you with homework grading. Use your startup funds if you have to. Student graders get paid about $6 an hour. Your time is a lot more valuable (probably in excess of $50/hour when including fringe benefits and/or overhead).

Tip #8: If your university has a graduate program, be sure you can (during your pre-tenure probationary period) have the opportunity to teach both undergraduate and graduate level courses. It is desirable at most institutions to have demonstrated quality teaching. This is best accomplished through teaching required undergraduate classes, and getting good evaluations in the course. At the same time, institutions that have graduate programs are going to require a high level of research and scholarly activity. Showing versatility by teaching a core graduate course or an advanced elective in your field of work makes you more valuable to your department or institution and their strategic plan.

Tip #9: Try to ask your chair or dean for a lighter teaching load since you will be expected to be one of the most active researchers in the department.

Tip #10: Do not overdo it. Limit yourself to a certain amount of time to prepare a lecture (perhaps one or two hours). When you have spent that much time, stop, and go on to something else (like a grant proposal or journal paper). Spending more time will not improve the course much but take away from other important work. (This is called the law of diminishing returns.)

Tip #11: The following is a list of in-class teaching tips that the author has used to improve his teaching and (more importantly) the quality of student learning.

- Tell jokes or a stories in class – studies have shown that students have an attention span of about 10 or 20 minutes, after which they do not retain course material. By telling a short story or joke, this tends to get a student's attention. After the story or joke is over, you can refocus the students on the lecture, and have their interest for another 10 or 20 minutes.

  The author has a 2 year old dog and a 1 year old son. During class I talk about what they are doing or a funny story related to something they did. I also tell them stories recounting my experiences in high school, college, or graduate school, or from working at the grocery store.

- Use the concept of one minutes quizzes – on the first day of class the author asks the students to fill out a notecard with their name, hometown, favorite tv show, favorite sports team, etc. Then on the second day of class I show them the results and tell them about myself.

After the first exam I give out a small sheet of paper to the students and ask them to write down if the exam was short, long, or just right; if the exam was easy, hard, or just right; if the exam was fair, unfair, or just right; if the homeworks prepared or did not prepare them for the exam. They can also write down additional comments. The next day of class I show them the results. We then discuss the results of the survey as a class. This tends to let the students feel some ownership in the course. If they feel that you value their opinion (and if you really do), it will mean a lot to the students.

When students come to my office, I interview them for feedback. What do you like about the class? What do you not like about the class? I try to incorporate their suggestions into the course. Even though the students may not be receiving the grade that they wanted, they still feel that sense of ownership in the class. As a result, they tend to participate more. Sometimes, this can increase their grade by the time finals are over. By showing you care you will get better teacher ratings.

- Use the picture roster – my university sends me a picture roster for my class. I study this for 5-10 minutes each night during the first week of classes. If you do not have a picture roster, take pictures of your students with a digital camera. Then, when students come to my office, I try and greet them by their name. Students like when their professor knows who they are. I have done this with a class of over 80 students, so it is possible.

- Use the concept of think, pair, share – partway through your lecture ask a question of the class, and then tell them to discuss with one or two people sitting next to them for one or two minutes. After this time is over ask the class for some answers to the question. By participating students tend to retain the material better, and they are now refocused for the next 10 or 20 minutes of lecture.

- Be creative – students like creativity from a professor instead of boring "textbook" problems.

  A month long project is part of the fundamentals of heat and mass transfer course that I teach. I try to come up with a silly name for the chemical they are making. Since the Detroit Red Wings are the favorite sports teams of students attending my university, they work for the Steve Yzerman Chemical Company. (Steve Yzerman is the team captain and one of the most loved players on the team.) They have an assignment to produce Di-Red Wing Ether, Red Wing Acetate, or a drug patch to cure Avalanche-itis (the Avalanche are a big rival of the Red Wings). Students love it and end up putting in pictures of hockey players with their report.

  On an exam problem students needed to "estimate the mass transfer for flow over a flat plate." Instead of calling it by this relatively boring name, the problem was rephrased to "estimate the mass transfer for flow over a puppy tongue, which could be considered as a flat plate." I also showed a picture of my dog with the

tongue hanging out. Getting the dog to sit still with the tongue hanging out was a good form of exercise and a break from work.

- Give away prizes – one idea which I am going to try this year is to get rid of some old stuff by putting it into the prize pool. I will call on a randomly selected student to answer a question (the questions are asked at a frequency of one or two times per week) and give out prizes to the students who get the answers right. Asking questions of a random student is an easy way to grade for attendance and the prizes are a way to bribe the students to attend class.

Things That Went Right: Teaching

The author takes teaching very seriously and puts in extra effort towards his teaching program. Most notably, this includes answering questions from students even when it is not officially "office hours." The author has also used all of the items from tip #11 during class. Students have rewarded the author by giving high teacher evaluations and voting him the departmental outstanding teacher in 2002. The author also contacted some of his students for support letters for his mid-term tenure reviews and received very good letters which will (hopefully) help his evaluation.

Things That Went Wrong: Teaching

The main course that the author teaches has a reputation for being a "hard course." Thus, despite being fair, he gives out grades that are lower on average than those given by his fellow professors. This probably has affected his teacher evaluations, but they are still very good evaluations. However, it might be better for an untenured professor to be an "easy" teacher if you need a boost in your evaluations.

While grading a test the author gave a student zero points on a problem because it appeared that there was nothing on the page. I indicate this by drawing a long red line through the blank space. Later, the student brought in the exam with a nearly correct solution. After looking closely at the page it appeared the student solution may have been written above the red ink. Rather than go through a long disciplinary process the author decided to not count the problem for or against the student. I suggest photocopying pages of an exam where less than 50% of the points are earned on a problem.

Research Tips for the New Professor

Most new faculty are probably familiar with the phrase "winning the teaching award is the kiss of death when it comes tenure time." This probably is not the case but it does indicate that teaching alone will not guarantee tenure. The number one expectation of a faculty member is to perform research or some other form of scholarly activity. The following are some tips to the new professor as they begin their research career.

Tip #1: Squeeze another paper out of your previous work – When you arrive at a new faculty job you usually have just finished your PhD or a post-doc. You have a rather

narrow but deep knowledge of a particular area, and may be the world expert in the area. You should determine if you can write one or two papers with minimal effort or data. If you need data, ask a colleague from your old lab or your advisor to help you get it. The reason for trying to get an "easy" publication is that you only have a six year tenure clock. Consider the following hypothetical scenario:

Suppose that you get a graduate student in your first year as a professor. In the first year, this student will spend a lot of time taking classes. This may be okay because you will probably be inefficient at teaching in the first year. By summer, the student may start to warm up on research. Most likely, near the end of the second year the student might finish with an MS degree (or be on track for their PhD) and have worked with you to prepare a journal manuscript. If things go well, the paper is published a year later (at the end of tenure clock year 3). Sometimes, this process can take even longer. That is a big gap between your last paper as a PhD and your first as an Assistant Professor! If you can get a paper or two written up in short order, it will have your new affiliation, show others in the field you are still active, and be published within this time gap.

It is also important that you do some of your own research early on in your career. This will keep you sharp technically, but is also a good idea because (as you will soon find out) graduate students are expensive! What better way to do some research than to extend your existing knowledge into a journal article.

This idea-to-article time can increase by at least another year or two when you account for the following:

- find the correct funding solicitation (with a due date up to 6 months later)
- write a proposal (maybe 1 month)
- get the proposal funded (6 months later if funded the first time, 18 months later if you revise the proposal after receiving comments)
- recruit a student to work on the project
- start the project and actually do the research

Tip #2: Set a plan and stick to it – to get tenure you will most likely be expected to do new scholarly work outside of your background. This will involve the long process of writing proposals, getting them funded, working with graduate students to help them learn how to do research and get their degree, and writing papers.

Think carefully about your research plan from your job application and consult your chair to identify an area for you to focus on. Start small with one area (and one graduate student) and set a plan to build up to what you feel the optimum number of students you want to work with when you are ready to apply for tenure. This will probably have to be at least a couple of students in one or two major research areas.

After you have your area chosen, look at your startup package. Usually the money within the package is unrestricted. If you have $50,000 you could buy a fancy piece of equipment or support a graduate student for two years (if the stipend is $15,000 and the tuition is $10,000). Your plan will help you decide what to do with your funds. Try to get

teaching assistant positions for your graduate students. It will save your startup grant a lot of money and allow you to buy that key piece or equipment for your lab.

Many proposals require some sort of matching funds (also called cost share). Try to get some from your university, college, or department. They will often agree to give you funds. Ask your department chair to lobby on your behalf. If you are still unsuccessful consider using your startup funds. A savvy young researcher can double their startup funds in this way.

Tip #3: Look for young faculty awards and seed grants – it is difficult to get a large grant without first establishing yourself. One way to do this is to get small grants. A lot of them have low page limits (5 pages or less) and can be written relatively quickly (in a day or two). The success rate is sometimes higher, too! Showing that you have some funding in a research area can often be the key to getting more funding. Ask your chair (or mentor) to help you find the right funding opportunities.

Write on the chalkboard in your office a list of a couple of funding opportunities you want to pursue and their deadlines. Set timelines for submitting papers and for graduating your students.

Tip #4: Look for collaborations – take some time to study the web sites of your fellow faculty within your department and college. You may find someone doing work in an area you have some knowledge in. Then, ask your chair (or mentor) if the person is good to work with.

It is okay to collaborate with other professors, but beware. If asked by someone else, you should probably say "yes" at first, to show that you are a team player. However, you will probably be closely evaluated based on your own work and not that of your established collaborator. Once you have a couple projects going, you are now in a position to say "no" to collaborative requests. I suggest that less than half of your projects should be of a collaborative nature.

Tip #5: Be willing to make sacrifices – sometimes you will have to choose between something you want to do but do not have funding for, or something that might not be your favorite subject area, but funding is available. Take the funded project. You can do the stuff you want to do once you have tenure.

Tip #6: Graduate your students – to get tenure some of your graduate students will have to finish their degree. Work with them to graduate 1 semester quicker than your department average. Tell them when you are recruiting them to work with you that you will graduate them quickly. Most students usually like that. Also, graduating students early will save you startup or research funds.

Tip #7: Work with undergraduates - invite top undergraduates from your class to work with you in the summer for pay or during the school year as "undergraduate research." Not only are undergraduate researchers are relatively inexpensive compared to graduate

students, working with them also helps meet the university or college mission of preparing students for lifelong learning.

Tip #8: Be social - go to lunch at the cafeteria with your fellow professors. Get to know them. You may find common interests that lead to a collaboration. Also, it is harder for a department to not be "in your corner" for tenure if they know you as a real person and not as a thick stack of paper.

Tip #9: Ask for help – ask your department chair for help in becoming a good professor. More importantly, you should also find someone (one or two people) that is friendly, has similar interests as you, etc. to serve as mentors. In a small community you may find someone that lives near you. You might find someone with a child the same age as yours. You and your potential mentor might own dogs. The key is to find someone that is easy to talk with. Then, go to lunch with them, show them your proposals, show them your papers, get them on your student's thesis committees, and maybe collaborate with them on research.

The author has two mentors. One has two Chocolate Labrador Retrievers that are sisters of my dog. We also have similar down-in-the-dumps personalities (think of the character Eeyore.) The other mentor has two young children and is one of my research collaborators. You can get all sorts of advice (including non-university issues such as spirituality, your marriage, raising kids, training dogs, etc.) from your mentor.

Tip #10: Try to find out about tenure – one good idea is to ask your chair and other people in your department about conference papers (both in your technical field and within ASEE). Expect mixed results. I personally have heard that they do not count, that they count for half a publication, and that they count as a full publication. Guessing that they do count for something, the author has tried to present a couple of technical and ASEE conference papers per year. If anything, it gives you visibility among peers that may be called upon to write letters about your scholarly work.

When you go up for your mid-term review, letters are usually written about you from your departmental tenure committee, department chair, college tenure committee, and dean. Find out how to get copies of those letters. They usually offer some advice that will help you revise your plan to get tenure.

Tip #11: Have some fun – you probably could make a lot more money working in industry. Try to remember that you picked your job because you wanted to do it, and live out your dream!

Things That Went Right – Research

The author's background is in theoretical analysis and computer modeling of heat and mass transfer problems. He was able to take a couple of ideas he had from his thesis and turn them around into two manuscripts. The work was done and the papers were both

written in a couple of weeks during the summer after the author's first year as a professor. They were both published a year and a half later.

The author was approached by another professor to work with on a few proposals and research projects. The proposals were funded and the grants supported a couple of graduate students. One of the students was co-advised by the author, and the other was solely advised by the author. The co-advised student got his MS and published two conference papers. All of these things help the author's scholarship record.

Things That Went Wrong - Research

The author probably did more than the lion's share of the work advising the joint student discussed above. The author also picked up another student after their previous advisor left the university for another job. The project was unchanged with the other professor as a co-advisor. This was a disaster! The student was unmotivated, the author wasted useful funds on supporting the student, and although the student finished their degree, there is little "publishable" work contained within the thesis. The key point is to remember is to not stretch your bounds too far.

Service

The third but usually overlooked pillar of the three-legged tenure stool is service. You should do some service for your department and may be asked to do some at the college or university level. A strong service record will usually not help you, but a poor one will hurt you. Here are some tips to help you fill in the service portion of your resume.

Tip #1: Ask for a light service load – as an untenured faculty your record will be judged more on the number of papers you have published instead of the number of committees you have served on. Try to get one less committee than is required by the tenured faculty.

Tip #2: Volunteer for departmental committees that you are interested in. Avoid the ones that take up a lot of time and generate extra pressure (such as ABET coordinator).

Tip #3: Keep university service to a minimum. One committee is okay, but ask your chair to protect you from too great a service load outside the department.

Tip #4: Consider trying to turn your service work into an ASEE paper on assessment, curriculum improvements, etc.

Tip #5: Do not volunteer to be chair of the committee - let the tenured faculty do this.

Tip #6: Try to participate in service outside of the school you work at. Some ideas include:

- try to get on an NSF review panel – contact your program manager and offer your services

- review journal articles that are sent to you, even if not directly in your area. Once you get two or three on your resume, be more selective in saying no.

- offer to chair technical sessions at ASEE and professional society. The best way to do this is to go to planning meetings and lunches.

Things That Went Right – Service

The author has served on about three departmental / university committees per year. Most notable are service to the departmental assessment committee and being coordinator of the departmental seminar series. The author turned his work on the assessment committee into an ASEE paper. The author used the coordinatorship of the seminar series to invite several guest speakers to come visit his university. The guests are well known people in the author's field and are acquaintances of the author. It is hoped the guests will become more familiar with the author's research and teaching programs during their visit. The author will also ask them if they would be willing to write a support letter when his tenure application is turned in.

The author has become active in the chemical engineering and new engineering educators division of ASEE and the catalysis and reaction engineering division of the American Institute of Chemical Engineers. Not much went wrong in the service area (with the exception of time lost in boring meetings).

Conclusion

This paper has suggested ways to get off to a good start as a professor with respect to teaching, research, and service. Remember that there are no set guidelines or criteria to reach tenure. Your best bet is to find help within your department or college. Ask your chair for help, but realize they are busy managing a department. You should seek out a mentor to give you more specific advice.

JASON M. KEITH
Jason Keith is an Assistant Professor of Chemical Engineering at Michigan Technological University. He received his PhD from the University of Notre Dame in August 2000. Jason teaches a new elective design project in alternative fuels and fuel cells and the required junior level Transport / Unit Operations II course. Jason has been married for 3 years, his dog "Pennant" is two years old, and his son Andrew is one year old.