James McCormick Family Teaching Excellence Institute
College of Engineering, Cornell University
Annual Report: July 1, 2013 - June 30, 2014
Director Kathryn Dimiduk

The James McCormick Family Teaching Excellence Institute (MTEI) has just completed its sixth year. The institute has been supported by a growing endowment from Jim and Marcia McCormick, an initial endowment from Michael Goguen, and "current use gifts" from both of these generous donors.   MTEI is staffed by founding director, Kathryn Dimiduk, PhD, and by half-time teaching support specialist, Eva Luna.

 The overall mission of the institute is to improve teaching across the Engineering College.   This is accomplished in many ways: direct work with faculty on teaching, supporting work developing resources to have available for working with faculty, classroom support, mid-semester student feedback surveys, data gathering and special projects.

New Faculty
The top priority for MTEI has been working with new faculty to help them achieve effective teaching much faster than the old trial and error approach. This includes a two-day intensive teaching workshop that all new faculty members are strongly encouraged or required to attend in one of their first two years, depending on department. Classroom visits by the MTEI director and mid-semester student feedback surveys are offered to all new faculty and are accepted by many. MTEI provides a quick response to classroom problems and teaching issues.   These efforts invested in the young faculty provide long-term benefits to the college, as they have many years of teaching ahead of them. One measure of the success of this approach is that this past spring very few assistant professors had student evaluations on teaching effectiveness that were below 3 on a scale of 1-5. Considering all the new hires in the last few years, it is very encouraging that most young faculty are efficiently becoming effective teachers.   More details are included in the appendix in Figure 1.

All Faculty
In addition to working with new faculty, MTEI works directly with all College of Engineering or Computing and Information Science (COE/CIS) faculty who request assistance in improving their teaching or in experimenting with a new teaching approach. For example, one professor wanted to expand to twenty sections a successful recitation innovation of having all students work problems, in small groups, simultaneously on the chalkboard. MTEI worked with the registrar to assure the department that these sections could be scheduled into appropriate small classrooms and worked with facilities and the classroom upgrade project to ensure that a second small classroom had sufficient chalkboards for this approach.   By providing the right

assistance at the right time, under-utilized small classrooms became a valuable resource that enabled this large course to change the pedagogy in recitations to create a strong active learning experience. Other examples include assisting senior faculty with clicker adoptions, using the teaching technology in a particular classroom, and discussing how to reformulate power point slides to be more engaging.

Classrooms

MTEI is involved in classroom planning and support, and collaborates with facilities and the Classtech Audio-Visual Support group to ensure that classrooms are ready and functioning.   All faculty, senior as well as junior, who teach in an engineering R25 (centrally scheduled) classroom receive an email from MTEI about the characteristics of their classroom and contact information for support personnel. This contact opens the door for discussions about teaching and leads to adaptations of classrooms and enhancing teaching strategies. MTEI provides training to faculty and TAs using clickers, document cameras, and the SMART tablets installed in the larger classrooms. MTEI collaborates with the Academic Technologies group in responding to faculty teaching technology questions and in testing new products that Academic Technologies is considering introducing campus-wide. MTEI created a Teaching Technology Lending Library that provides equipment that is not in a particular classroom. There is an equipment list and reservation form for the equipment available on the MTEI website. This equipment leveraged part of the classroom upgrade money to ensure that faculty who adopted new teaching strategies that made use of a particular piece of equipment could continue to count on having that equipment, even if they later are assigned to another room, without having to provide all equipment in all rooms.

The new Gates Hall has one large lecture hall. MTEI has been heavily involved in testing the new equipment in that hall, testing and revising the instructions for the advanced equipment, and coordinating the scheduling for bringing the classroom online. MTEI has also been part of the planning process for the renovation of Upson Hall classrooms, involved in data gathering and analysis regarding classroom usage, and engaged in discussions with faculty on types of classrooms and teaching methods.

Mid-semester surveys

MTEI ran mid-semester surveys for every class in 3 departments (Mechanical and Aerospace (MAE), Materials Science (MS), and Electrical and Computer (ECE)), individual surveys for additional courses, and several surveys regarding specific teaching initiatives. For each survey, comments were read and a report was generated and sent to the course instructor. If students indicated the course needed improvement, the comments were studied looking for patterns, key concerns were summarized, and several potential action items were identified prior to a follow-up discussion in person or by email with the instructor. The intent of the surveys isn't to make a major change in the middle of the course, but rather to correct things that aren't going

well or to make incremental steps towards bigger changes and experiment with what works for a particular faculty member and course.   This has been an effective mechanism to "touch" many courses and an efficient way to get steps and ideas for improvement into faculty hands when it is still relevant. Often this information is sufficient for faculty to make a change and often the change is retained in future semesters. For some courses and faculty, it is a multi-semester effort to make steps towards an improved course. Being able to identify a small number of changes that a faculty can make successfully and immediately is usually well received by the faculty and appreciated by the students. More extensive changes "for later" can be discussed and one lecture can be jointly adapted (MTEI director and faculty) to try a new approach and start the process of exploring how the faculty might work towards these changes. Often incremental changes are more effective than jumping into a new teaching approach with which the faculty is unfamiliar and has had no practice; sweeping changes mid-semester in a course that is already struggling are less likely to be successful and less likely to be retained in future semesters.

MTEI Events
A list of MTEI workshops, presentations and events are included in the appendix. This includes a workshop/discussion at a Civil and Environmental Engineering (CEE) department faculty lunch which sparked an interest in CEE making more use of MTEI services and potentially joining the mid-semester feedback surveys.

Proposals
MTEI submitted six proposals for Assisted Listening Systems (ALS) in classrooms to an internal Cornell funding source. Four of these proposals were funded, which will not only provide the ALS systems, but also enable the addition of microphones and speakers to rooms where previously they could not be added without triggering American Disability Act (ADA) issues. These systems should be installed in early fall, thus solving the hearing issues that were reported in several classes in spring 2014.

MTEI has contributed to the education component of several proposals in the past year. This has included working with multiple young faculty on their CAREER proposals (involving a workshop, individual discussions, reading and commenting on proposals and thereby enhancing their teaching plans and innovations, and letters of support). MTEI collaborated on an NSF Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES) proposal (led by professors Amit Lal and Michael Thompson) that was funded; MTEI will assist with adding active learning to the class that will be created for the proposal and with assessment efforts. MTEI contributed, and is named on, one of the Engineering Research Center proposals (led by Amit Lal) that Cornell just submitted, an American Association of Universities (AAU) STEM Education Systemic Improvement proposal that was a finalist but not funded, and was one of the co-creators of an NSF Improving Undergraduate STEM Education

(IUSE) proposal (led by Vice-Provost for Undergraduate Education Laura Brown and joint with the Cornell University Center for Teaching Excellence (CTE)). If this proposal is funded, Laura Brown has assured that resources will be reasonably allocated between MTEI and CTE.   MTEI is leading the assessment component of a funded NSF TUES proposal on embedding Finite Element Analysis (FEA) simulations across the Mechanical and Aerospace Engineering (MAE) curriculum (led by senior lecturer Rajesh Bhaskaran). This assessment has improved the teaching of simulation in multiple MAE courses.

Networking, External Connections, Continued Learning
MTEI continues to maintain a rich awareness of current and new pedagogies and teaching methods, teaching technology tools, innovative classrooms, and teaching support models through reading, attending workshops and conferences, active membership in the American Society of Engineering Educators (ASEE) and the Finger Lakes Faculty Development Network (FLFDN) and a network of colleagues at Cornell and other schools. The MTEI director is an officer in the ASEE St. Lawrence section and is bringing the section conference on engineering education to Cornell in spring 2016. MTEI led the creation of Cornell's poster on Improving STEM Education for the AAU conference this summer in collaboration with CTE (see Figure 2 in the Appendix).

Data Analysis and Metrics
The mid-semester surveys and final teaching evaluation surveys run by the college are also useful tools for looking for patterns in types of courses or classrooms that need further consideration. For example, including questions on simulations and computer modeling across the MAE curriculum indicated that later courses using FEA simulations weren't providing new learning on the simulations; sharing this information and the resulting discussion with the appropriate instructors led to raising the bar and the simulation support in those classes with consequently increased learning.

MTEI has also been analyzing teaching data looking for potential teaching metrics that could be reported to the Engineering College Council (ECC), per James McCormick's recommendation. Data from the student experience survey indicates teaching is going well, but that survey is only run every 5 or so years and only asks one or two general questions on teaching; thus it is neither a good yearly metric nor is it specific enough to drive thoughtful teaching improvements. Teaching evaluation data provides a partial measure but only captures what students see, not some of the "bigger picture" issues of content relevance and pedagogy strengths and weaknesses. Teaching evaluation data is also limited by the key questions on teaching effectiveness and course effectiveness being relative to other faculty and courses rather than absolute questions and absolute standard of excellence or learning. In principle the average should be quite stable over several years regardless of whether overall teaching improves or not; significant improvement overall could lead to a temporary bump in scores as

older students compared with prior teaching, but then new students would expect this level and the new standard would become average, with an accompanying drop in scores even though the overall teaching quality is higher. Data from the FE exam typically indicates 100% pass rates and shows high effectiveness on the overall Cornell programs in the departments whose students take the exam, but has no head-room to show improvements and only some students take this exam. GRE exam scores aren't available. Mid-semester feedback data is focused on where improvements are needed in a formative rather than an evaluative sense. Thus we do not currently collect data that would be an appropriate metric of teaching effectiveness to regularly report to the ECC on teaching effectiveness. The goal of a metric to measure teaching effectiveness is still worthwhile, but it will require either revising an existing survey such as the end-of-semester course evaluations or a new data gathering effort.

New Initiatives Being Explored and Developed
MTEI also has several new initiatives that have just been started or are in the exploratory or early development stages.

- Assessment of the impact of pedagogy changes in the physics curriculum on the engineering common curriculum
- Continued involvement in planning for the renovation of classrooms in Upson Hall. This includes working with the design team, surveying faculty regarding classroom needs/preferences and current teaching approaches, and adapting college policies to optimize the use of the new rooms for effective teaching.
- Reporting on the lowest performing teachers to the dean for sharing with department chairs. Following up as requested with the weak teachers.
- Assisting with the development and assessment of e-courses
- Developing a series of events/workshops for faculty that help them explore a range of more engaging lecture pedagogy: active learning, inquiry based teaching, collaborative learning and finally the more specialized problem based learning. Over several years the goal would be for most faculty to include some active learning approaches and for a subset of faculty to have moved further into inquiry based teaching and collaborative learning. Problem based learning may be relevant for only a few courses and faculty.
- Enhancing support for using best practices in group work (assigning groups, trouble-shooting problems, peer and self-evaluation of groups)

Conclusion
Overall MTEI has had a very good year which included working with 166 distinct faculty, reaching most of the new faculty hires, participating in the exciting prospect of classroom renovations, continuing collaborative efforts to support teaching innovation through proposals and individual initiatives, and working with faculty intensively on a selected subset of courses.

Appendix: Additional data and figures.

A) **Table 1: Unique MTEI faculty contacts** (consults, workshop attendees, substantive email and phone discussions) from July 1, 2014 – June 30 2014. Note that this is one year's contacts, not a running total from Jan. 2010 as previously reported. Some of these are single contacts and quite a few represent an ongoing and longer term effort and involvement. Overall MTEI interacted with well over half of the teaching faculty in the college.

Unique MTEI faculty contacts (includes a few non-engineering faculty*)	July 1, 2013 – June 30, 2014	
Total contacts	166	
	Individual consultations	76
	Mid-semester feedback surveys	104
	Workshop attendees	~60

* 3 physics faculty members who are leading the project to re-structure the calculus-based physics sequence that engineers take using a research-based active learning pedagogy, 3 Information Sciences professors, and a few science professors who attended a workshop, and a few professors in departments shared between engineering and another college and whose appointment are in the other college.

B) **MTEI Teaching Technology Lending Library:** 18 pieces of equipment were checked out in the past year. Equipment is usually checked out for a semester so it impacts an entire course. This equipment includes document cameras, portable projectors, annotation tablets, room speakers, clicker bases, a loaner set of clickers for training or outreach, and an iPad for developing lab simulation apps. An Assisted Listening System has been funded and will be added to the list.

C) **Table 1: MTEI Student Feedback Surveys run in Fall 2013 and Spring 2014**

	Fall 2013	Spring 2014
Department-wide Mid-Semester Survey		
Mechanical and Aerospace Engineering	26	29
Materials Science Engineering	14	17
Electrical and Computer Engineering	33	25
Individual/Special Mid-Semester Survey	7	9
Others	4	6
Total	84	86

D) **MTEI Events and Presentations**
- New faculty MTEI introduction

- New faculty 2-day teaching workshop
- 1 day workshop on Groupwork, (joint with the Center for Teaching Excellence)
- Teaching equipment demonstration for Computer Science (joint with Academic Technologies)
- Mechanical and Aerospace Engineering department lunch discussion on classrooms
- Civil and Environmental Engineering department lunch presentation on active learning and MTEI services
- CAREER proposal (education component) workshop
- Presentation to department directors and chairs on teaching evaluation scores
- Presentation to department directors and chairs on assigning student groups
- Half day workshop on MTEI for Mercy College
- Poster for American Association of Universities conference

E) Teaching Effectiveness of Assistant Professors Hired Since MTEI's Founding

As more young faculty are hired and time has passed, the number of courses taught by this cadre of assistant professors has, as one would expect, increased fairly steadily. However, the number of problem courses has held fairly steady rather than increasing proportionately, with the exception of spring 2013 when both the number of courses and the number of problem courses both jumped noticeably. Figure 1 graphs the data for faculty hired since MTEI was founded in fall 2008.

F) Poster for the American Association of Universities (AAU) Conference in Washington, DC

MTEI led the creation of the Cornell University poster for the AAU conference, in collaboration with the Center for Teaching Excellence. The poster showcases some of Cornell's efforts to improve Science, Technology, Engineering and Math (STEM) education, laid out according to AAU's recommended framework of Cultural Change, Scaffolding, and Pedagogy. The poster is included as Figure 2, with MTEI efforts identified.

Figure 1 shows the teaching effectiveness of new faculty hired since MTEI's founding in fall 2008. The data is from question 8 on the end-of-semester course evaluations: Rate the teaching effectiveness of your lecturer compared to others at Cornell (1=worse than average; 5=much better than average). Note that, this question is comparative to other Cornell faculty, not absolute.

Courses Taught by Assistant Professors Hired Since MTEI's Founding in August 2008
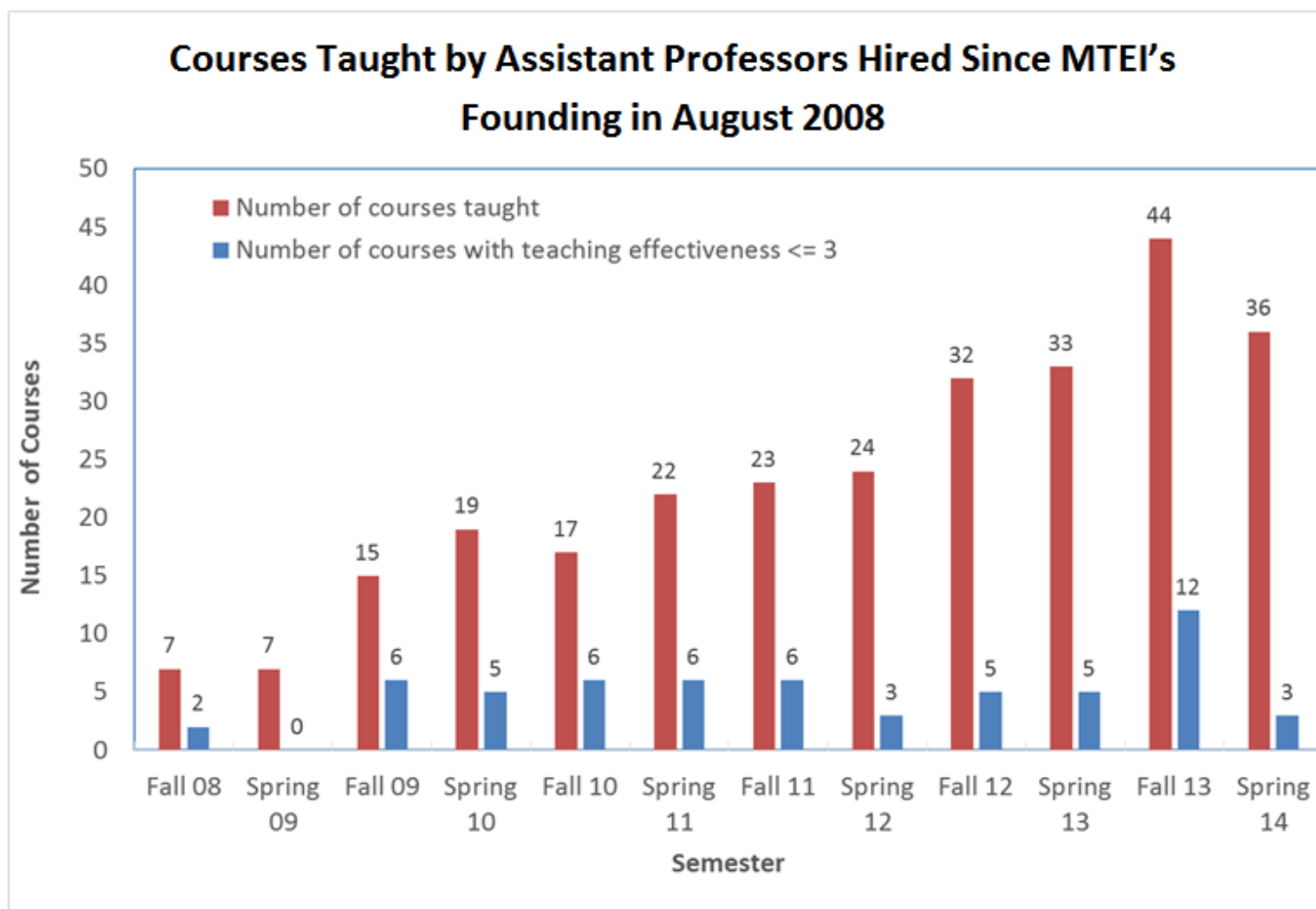
Figure 2. AAU Poster of systemic efforts to improve STEM teaching at Cornell. The poster includes MTEI efforts as well as efforts at the university level. For clarity in this report, MTEI only efforts are boxed in solid black and programs that MTEI and CTE each run are boxed in dashed black.