Preparing a New Generation of STEM Teachers
We all know that school districts across the United States struggle to attract and retain high quality STEM (Science, Technology, Engineering, and Math) teachers. Yet only a few programs operate nationwide that concentrate on preparing STEM educators. UTeach UMass Lowell is one such program.

Launched in spring of 2012 with funding from the Massachusetts Department of Elementary and Secondary Education Race to the Top Award, UTeach is a nationally recognized program. It originated at the University of Texas Austin in the mid-1990s to meet the demand to fill the shortage of high quality middle and high schools STEM teachers. Since its inception, UTeach has continued to grow. Currently there are 45 universities replicating UTeach across the U.S.

UMass Lowell was the first university in New England to replicate this prestigious STEM teacher preparation program, which represents a unique collaboration between the College of Education and two of the largest colleges on campus: Kennedy College of Sciences and the Francis College of Engineering.

The goal of UTeach is to prepare teachers to teach through inquiry-based or project-based instruction. Our program at UMass Lowell is committed to producing young professionals who are not just knowledgeable in their content area, but also proficient in pedagogy. Hence, our teacher candidates are able to design lessons to engage, stimulate, and awaken the innate curiosity of the students they teach, thus providing them with a positive learning experience.

Our First Five Years

Over the five years at UMass Lowell, we have had our fair share of challenges as well as our triumphs. Our biggest challenge has always been recruiting STEM majors into our program. Yet, those who enroll in our introductory methods courses often talk of having memorable moments of teaching and interacting with students in a classroom.

Our triumphs, however, are many. We have had over 200 students participate in our introductory methods courses, we have increased the number of schools and mentor teachers we work with, and we have developed a presence on and off campus. However, our greatest triumph is in preparing STEM educators; and since the local school districts admire the methods we use in our teacher preparation program, they often compete with each other to employ our graduates.

UTeach faculty and staff have had five very productive years at UMass Lowell and we look forward to continue doing what we do best - preparing the next generation of science and math teachers for many more years to come.
A New Generation of America's STEM Teachers
Engineering offers an ideal platform to investigate and solve problems in science, technology, and mathematics and at the same time develop creativity among young people. Unfortunately many school districts in Massachusetts do not have qualified and skilled Engineering teachers, and hence Engineering programs.

Clint Perry stood in front of a class of third graders and asked them if they could name magnetic materials. There was an explosion of enthusiasm as students raised their hands to be the first to be heard.

After listening intently to student responses, and acknowledging each one, Clint smiled and said, “Did you know the dollar is magnetic?”

Within minutes of engaging students, and demonstrating the magnetic properties of a dollar bill, Clint led the third graders through an inquiry to figure out whether a circular magnet or a rectangular magnet was the strongest. It wasn’t the answer to the question that Clint was interested in, it was the process students used to design a method to test their hypotheses.

That was how Clint, in his very first lesson in the UTeach program, planned and implemented a genuine inquiry lesson where the students were enthusiastic about exploring a scientific concept.

Inquiry learning is the heart of UTeach. We pride ourselves in preparing our teacher candidates to think about ways of teaching math or science concepts through the inquiry approach. While some of our undergraduate teacher candidates initially struggle in planning and implementing inquiry-based lessons, a few embrace it whole-heartedly. Clint Perry is one of those very few.

It is always a pleasure to observe the making of an effective teacher. From exploring the strength of magnets, constructing the strongest electromagnet, and even simulating how the depth of a crater on the moon depends on the size, mass, and angle of impact of a meteor, Clint always managed to lead the students in a successful learning experience.

However, Clint’s best lessons were the lessons he planned and implemented while he worked with engineering students at Billerica Memorial High School under the supervision of Matthew Flood.

Clint completed his practicum successfully in Spring 2017 and graduated with a degree in Electrical Engineering and license to teach Engineering. When asked about his teaching experience Clint replied:

“The UTeach courses prepared me for my practicum by developing my skills in designing and implementing lesson plans to a point in which it became very natural. My favorite days were when my mentor teacher was absent and I was teaching the entire day on my own. I learned how to manage my time in the classroom, address student behavior, and motivate certain students.

“I’m looking forward to being a positive influence for students as an Engineering Teacher. Advice I would give to anyone looking to be a teacher is to never give up, and try every approach to make content accessible to students in the classroom.”

Clint knows that he will always end up as a teacher, but he also knows that the best engineering teachers come with experience of having worked as an engineer for a few years.
Michael Manser graduated in 2017 with a Bachelors Honors degree in Mechanical Engineering and STEM Teaching minor. Michael is one of our UTeach Teacher Candidates who will be taking his Practicum post-baccalaureate to receive his Initial Teacher’s License in Technology and Engineering.

While it is possible for many science and math majors to complete the UTeach program during four years, it may not always be possible for the engineering majors. They often struggle to fit in engineering courses with taking time out to do their practicum following a four-year degree pathway. Hence, we allow students to complete their degree and with a STEM Teaching Minor, which include all the UTeach courses aside from the Practicum. This is one of the unique features of the UTeach program here at UMass Lowell.

**Realizing a Dream**

Michael’s desire to follow a career in teaching began while he was still in high school, but he was also passionate about engineering. So when he arrived for orientation at UMass Lowell and found out about the UTeach program, where he could follow his passion and his interest, he knew UMass Lowell was where he wanted to be.

Prior to being placed in a third grade classroom for his very first teaching event, Michael’s experience of ‘teaching’ was in one-to-one tutoring. “Teaching is very different to Tutoring!” he exclaimed.

While Michael enjoyed his experience in the UTeach program, he recalls two of the most memorable moments – his first lesson in the first UTeach methods course, STEP 1, and his experience taking students out on a field trip to the Tsongas Industrial History Center (TIHC) in the last UTeach methods course, Project-Based Instruction (PBI).

**STEP 1 – The First UTeach Methods Course**

In STEP 1, Michael learned about designing and implementing Inquiry-Based lessons. His first lesson was a lesson he designed with his partner on sound. The lesson was an adaptation from Full Option Science System (FOSS) kits by Delta Education. In this lesson the third graders explored sounds made by a variety of objects falling on different surfaces. The lesson was so well planned and implemented that Michael decided to write this lesson up to be published in the pre-service teacher section on the peer-reviewed journal Science Activities.

Michael recalled the process of publishing this paper. It was a longer process that he expected because of the number of times he had to revise the paper. But at no point during those revisions was he discouraged. He says, “I think they were all valuable revisions. All the feedback from all the reviewers definitely made me think about the lesson and how it was presented.”

**PBI – The Last UTeach Methods Course**

PBI develops the teacher candidates’ ability to design a unit of work through a project, with a field trip component. Michael worked with his partner, Matthew D’Angelo (math major), and students from Greater Lowell Technical High School on a project combining finance aspects of math with engineering design. Then at the TIHC during the field trip, the students were challenged to design and build a car to carry a bobbin to the top of a ramp.

**Future Plans**

Whilst pursuing his undergraduate studies, Michael applied for and received a scholarship through the American Society for Engineering Education. This scholarship requires him to work for them upon graduation. However, Michael was able to get this scholarship extended to cover his Masters’ degree in engineering with a concentration in Energy. In addition, he also received permission to carry out his Practicum in Spring 2017 as part of the Masters’ program. Then upon completing his Masters, Michael is expected to work at Natick Army Labs doing engineering research to fulfill his scholarship obligations. After that Michael’s plan is to secure a job as an Engineering Teacher.

**Engineers of Tomorrow**

If universities are to graduate top engineers for industries, then they would need to attract top engineering students from high schools. However, if schools do not have effective engineering teachers, then students will not be able to experience quality engineering lessons to motivate them enough to study engineering at the university level. This is a vicious cycle.

The Francis College of Engineering at UMass Lowell attracts top engineering students into their engineering programs. Working closely with faculty advisors from the College of Engineering, UTeach’s goal, as a teacher preparation program, is to recruit and prepare effective high quality engineering teachers to help struggling school districts.

Clint Perry was the first engineering major to graduate from UMass Lowell with engineering certification. In Spring 2018, we will see Michael Manser graduate. Slowly but surely, UTeach at UMass Lowell is preparing quality engineering teachers.

Still in the pipeline are the following engineering majors, at various stages of completing the UTeach courses, who will one day be the future engineering teachers.

- Michaela Gimas (Chem/Bio Engineering)
- Dalia Davila (Chemical Engineering)
- Colin Eklund (Chemical Engineering)
- Maxwell Nutter (Chemical Engineering)
- Rakesh Buchan (Civil Engineering)
- Brianna Sorensen (Civil Engineering)
- Samuel Beverage (Computer Engineering)
- Patrick Fee (Computer Engineering)
- Emily Jenkins (Computer Engineering)
- Andres Widhalm (Computer Engineering)
- Matthew Thomas (Mechanical Engineering)
- Elijah Gerrior (Mechanical Engineering)
The courses we offer in the UTeach program at UMass Lowell are unique in their own way. Though they still uphold the objectives and goals set out by the original course designers at the University of Austin, Texas, we have tailored them over the years to meet the needs of Massachusetts state requirements and the needs of our partner school districts. So while we still teach content through pedagogy, each one of the courses in the UTeach UMass Lowell program reflects the strengths and experience of the faculty at the College of Education.

The first methods course that the UTeach program promoted since its inception at UMass Lowell was Step 1: Inquiry Approaches to Teaching, which allowed our potential teacher candidates to get a taste of what teaching is like by working with elementary grade students. This course was then followed by STEP 2: Inquiry-Based Lesson Design with middle school experience. Both were 1 credit courses. However, many of our undergraduates who took these courses preferred it if they were at least 2 credits. Hence we put together a brand new course combining aspects of STEP 1 and STEP 2 and offered it for the first time this year as a 3 credit course titled Introduction to STEM Teaching.

Below are the courses offered in our UTeach program here at UMass Lowell, and the recommended sequence.

**Courses**

**Faculty and Staff**

Dr. Anita Greenwood was the dean of the College of Education when UTeach came to UMass Lowell. She was actively involved in fundraising and designing the program for UMass Lowell. She also instructed on Knowing and Learning. She is still a co-PI of the program.

Dr. Ken Levasseur is a math professor at the Kennedy College of Sciences. He is currently a co-PI of the program. He was also the instructor of the UTeach course Functions and Modeling, which is offered as a math elective.

Dr. David Kazmer is a plastic engineering professor at the Francis College of Engineering. He is currently a co-PI of the program. He was also a co-instructor of the UTeach course Project-Based Instruction.

Dr. Michaela Colombo is the chair of the College of Education. She is also the current instructor of the course Teaching English Language Learners. This is a course required by the Massachusetts state for teachers as part of the teacher licensure.

Dr. Michelle Scribner-MacLean is a professor at the College of Education and the current instructor of Project-Based Instruction.

Dr. Jennifer Gonzales-Zugasti is a math professor at the Kennedy College of Sciences and the current instructor of Functions and Modeling.

Dr. Eliza Bobek is a Clinical Assistant Professor at the College of Education and UTeach student Advisor. Among her many roles with the UTeach program, Dr. Bobek also arranges student internships and coordinates the STARS (Student Teaching Apprentices Reaching out to Schools) program. She is the current instructor of the UTeach course Introduction to STEM Teaching, Knowing and Learning (which is also a Social Science General Education requirement course), and Research Methods.

Dr. Sumudu Lewis is a Clinical Assistant Professor at the College of Education and UTeach student Advisor. Among her many roles with the UTeach program, Dr. Lewis arranges Practicum Placements of the UTeach Teacher Candidates and facilitates UTeach Ambassadors. She is the current instructor of the UTeach courses Introduction to STEM Teaching, Perspectives on Mathematics and Science (which is also an Arts and Humanities General Education requirement course), and Interactions and Equity.

Robin Hall is the Program Assistant who oversees the day-to-day running of the program by assisting the faculty instructors and students. Among her many roles with the UTeach program, she keeps up-to-date data on students who have passed through the program, ensures that students and mentor teachers receive payments, and ensures that the materials and kits used in teaching methods courses are organized and replenished.
For the first three years, the grant covered the purchasing of resources, paying mentor teachers, and other day-to-day costs. However, once we were off the grant, we were fortunate to receive funds through donations from private individuals to large corporate donors. We thank the following businesses and foundations, endowed scholarships, and individuals for their generous donations over the last five years:

**Businesses and Foundations**
- Cabot Corporations
- Greater Lowell Community Foundation
- KRONOS Incorporated
- Parker Foundation
- Red Hat of Westford
- United Technologies

**Endowed Scholarships**
- Alice Fleury Zamanakos Endowed Scholarship Fund for Teaching
- Class of '54 State Teacher's College Endowment Fund
- Dorothy M. and Rita C. Leary Scholarship
- Eleanor Priestley '40 Memorial Endowed Scholarship Fund
- FitzPatrick Family Endowed Scholarship Fund
- George Tsapatsaris '77 Endowment Scholarship Fund
- Jane '69 and Charles Gourlis Endowment Scholarship Fund
- John and Janis Raguin Family Endowment
- Joseph J. and M. Jean Donnelly Education Scholarship Fund
- Margaret Holland Barrett Teaching Scholarship Trust Fund

**Individuals**

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**Scholarships**

**Internships**
- UTeach STARS Program
  - Fall 2016: Matthew D’ Angelo
  - Spring 2017: Rakesh Buchanan

**Scholarships**
- Alice Fleury Zamanakos Endowed Scholarship Fund for Teaching
  - Brianna Sorensen
  - Rachel Adragna
  - Ariel Leva
- Eleanor Priestley '40 Memorial Endowed Scholarship Fund
  - Christine McCarthy
- Mary Curtin Alden Endowed Scholarship Fund
  - Alexander Eden
- Margaret Holland Barrett Teaching Scholarship Trust Fund
  - Thomas Heywosz
- Joseph J. and M. Jean Donnelly Education Scholarship Fund
  - Dalia Davila
- FitzPatrick Family Endowed Scholarship Fund
  - Ralph Saint Louis
- Dorothy M. and Rita C. Leary Scholarship
  - Lynasy Heng
- Joseph J. and M. Jean Donnelly Education Scholarship Fund
  - Dorothy M. and Rita C. Leary Scholarship
- Mary Curtin Alden Endowed Scholarship Fund for Teaching
  - Thomas Heywosz (Math Major), the recipient of the Margaret Holland Barrett Teaching Scholarship Trust Fund
- FitzPatrick Family Endowed Scholarship Fund
  - Ralph Saint Louis (Biology Major), the recipient of the Alice Fleury Zamanakos Endowed Scholarship Fund
- Eleanor Priestley '40 Memorial Endowed Scholarship Fund
  - Lynasy Heng (Engineering Major), the recipient of Alice Fleury Zamanakos Endowed Scholarship Fund for Teaching
The unique aspect of the UTeach program is that it is built around providing our potential teachers with classroom experience as they prepare for a career in teaching. Hence, we rely on the expertise of classroom teachers to provide feedback to these young teachers after they had completed their teaching events.

When we first began in 2012 we worked with only two school districts - Lowell and Methuen and 8 mentor teachers. Over the last five years as the program grew, we reached out to Billerica, Chelmsford, Lawrence, Dracut, Tyngsborough, and Tewksbury. We now enjoy a strong symbiotic partnership with all these school districts. They have come to know UTeach UMass Lowell as a program that prepares effective, competent, and high quality teachers. However without the support of the administrators and the guidance of a team of amazing and caring classroom teachers, our program may not be as effective as it is today.

Mentor teacher workshops originally began as ‘training sessions’ to inform the mentor teachers about the UTeach program and relate their roles and responsibilities as a mentor. However, over the years we changed the structure of these meetings to professional development workshops. Hence at these workshops, which we hold every year, the mentor teachers not only learn about the program and our mission, they also experience first-hand a complete inquiry-based lesson. In addition, these workshops also provide opportunities for teachers from different school districts to come together to share best-practice, an opportunity some rarely get to experience.

Mentor Teacher Workshop (below)
Teachers carrying out an investigation to decide which surface allows a coin to move furthest. The investigation involved the teachers designing a creative method to test their hypotheses.
The UTeach Experience

Over the last five years we have had many students come and try out what teaching is like. While not all of those who tried out our introductory courses decided to pursue a career in teaching, they more or less enjoyed the UTeach experience.

Here are the highlights of the last five years of the UTeach Experience.

Ashley Bretton and Matthew Desmond at the UTeach Conference in Austin 2013

First cohort of STEP 1 students - Spring 2012 Megan Vilcans (left) is now a biology teacher at Lowell High. Megan was unable to complete all the courses in the program, and went through the Masters' route to get her license. Also in this photo are Danny Packard (right) and Nick Rossetti (back-left). Both are now math teachers at the Greater Lowell Technical High School and at Lowell High School respectively.

Brad Marshall in STEP 1 2013 - Scaling up Barbie. Brad is scheduled to complete his Practicum to be a math teacher in Fall 2017.

That time we received 35 Android Tablets and $65000 to infuse mobile technology into STEP 2.

Harrison Donahue winning the first place in the STEP 1 poster presentation.

The UTeach Ambassadors organized and held the first Coffee House event in Pasteur 106 with music by Matthew D'Angelo and Clint Perry.
Course Enrollment and Completion 2016 - 2017

Every year UTeach at UMass Lowell present our profiles. These profiles indicate areas of growth in students by major and ethnicity, our collaborations with partner school districts, and allocation of funding we receive by our generous donors. The charts for Spring 2017, created by UTeach Program Assistant, Robin Hall, are shown here.

Top left chart compares the numbers of students enrolled in UTeach courses during the academic year 2016 and 2017. The three pie-charts present student level data for 2017 based on a total of 89 students currently at various stages of the UTeach program.

The charts below present the on-campus and off-campus internships showing the numbers of student participants in each.

Collaboration with school districts to provide mentor teachers for our students in the UTeach methods courses is crucial for our success as a teacher preparation program. The charts below show the numbers of teachers who participated as mentor teachers and the total from each of our partner school districts.

Finally, the last two charts given below show our spending. The chart on the left shows the amount spent on stipends for mentor teachers, UTeach faculty advisors and school district advisors, and practicum supervisors. The chart on the right shows the amount we have spent on providing internships to our students.