

Noyce Master Teaching Fellowship Project (2018-2023)
(NSF award #1758243)

Preparing Digitally-Rich STEM Master Teachers for Digital Conversion in K-12 Schools
University of Rochester

Project Description

Overview

The proposed Track 3 Master Teaching Fellowship (MTF) project focuses on developing a special cadre of 20 math and science master teachers, preparing them to leverage technology to increase student engagement and improve instruction in math and science classrooms, and to lead their districts in digital conversion efforts – a comprehensive process that provides each student with a tablet or laptop and integrates the use of these devices with a Learning Management System (LMS) and digital resources to enhance student learning. Twenty math and science teachers will be recruited from six high-need small school districts (including three primarily rural districts) that are members of the Western New York Digital Conversion Consortium, benefiting from this network of districts already sharing resources across upstate New York. Each MTF will engage in a 5-year program involving 41 credit hours of graduate coursework accompanied by related mentored experiences, which will include receiving an Advanced Certificate in Digitally-Rich Teaching in K-12 Schools registered with the New York State Education Department. This project directly connects to the NSF Strategic Plan for 2014-2018 by “integrating education and research to support development of a diverse STEM workforce with cutting-edge capabilities,” and to the Noyce program’s role as “central to discovering, studying, and promoting pathways for STEM teacher education through research and development” (p. 4, RFP). This project supports the development of a strong STEM workforce in two ways; by positioning STEM master teachers to lead district-wide digital conversion efforts, and by increasing student engagement, comfort, and competence with technology, thereby creating a secondary STEM workforce pathway for students. The project is also especially timely, given the financial incentives provided by NYS through its recent SMART Schools Bond Act (2015), which led many districts to purchase technology without a solid plan to deploy the equipment and train staff and students in their use.”

Digital Conversion has shown considerable success in improving student achievement in several districts across the country, and New York State has recently supported schools to purchase technology through its SMART Schools Bond Act. However, more needs to be done to explore **how** digital conversion, and technology more generally, can help us move towards the specific changes in math and science instruction called for by the most recent national standards. Our goal in this project is to develop a cadre of math and science teachers that can fully utilize digital technology in their teaching, and also understand what it takes to replicate those results across their district – thus enhancing the potential of digital conversion to offer the kind of STEM learning opportunities promoted by Common Core and New Generation of Science Standards.

Each Fellow will engage tuition-free in an intense 5-year program involving graduate coursework and related mentored experiences, leading to an Advanced Certificate in Digitally-Rich Teaching in K-12 Schools. Interested Fellows will also be eligible for a total of 8 full scholarships to pursue NYS certification as School Building Leader and School District Leader – as a way to prepare them for administrative positions that could increase their impact on their district’s Digital Conversion and decisions about STEM education. Each Fellow needs to commit to a 5-year service requirement in high-need schools that includes beginning to provide services

such as mentoring colleagues and providing professional development, in addition to teaching and engaging in activities related to their training. Each Fellow will receive a supplemental stipend of \$10,000 a year for each of the five years of the project (but anyone who does not fully comply with the 5-year service requirement will have to pay back half of the supplemental stipend received from the grant up to that point).

The project will benefit from the lessons learned from implementing previous Phase I and Phase II MTF projects awarded to the University of Rochester (which have involved a total of 39 Fellows), while also presenting major differences from these projects due to the additional focus on Digital Conversion and on developing a regional model that can best serve small districts mostly located outside of a major metropolitan area. Given the distance between partners, as well as the focus on leveraging digital technologies for STEM learning, the project will also involve the Fellows in extensive and innovative uses of synchronous and asynchronous online experiences in a variety of contexts.

The project will capitalize on the combination of the following competitive advantages:

- An established partnership between the University of Rochester and a high-need small suburban district (East Irondequoit Central School District) that has been engaging in a successful digital conversion for the past 4 years and was recently recognized by the National School Board Association (NSBA) as a national model site;
- New York State's recent launch of new math and science state standards, which are consistent with Common Core and New Generation Science standards at the national level;
- The infrastructure provided by the Western New York Digital Conversion Consortium, recently launched by Warner and East Irondequoit;
- An Advanced Certificate in Digitally-Rich Teaching in K-12 Schools, recently developed by Warner and already approved and registered with the New York State Education Department;
- Warner's experience in designing and offering a variety of very effective online courses;
- Preliminary results from a concurrent NSF-funded grant (SYNC-ON), designed to develop new ways to leverage synchronous online learning to deliver high-quality professional development and coaching to mathematics teachers in rural schools;
- An established long-term partnership between the UR Warner School of Education, the UR College of Arts and Sciences, and the Rochester Museum and Science Center, in two previous MTF projects.

The grant is quite substantial (up to \$3M over the five years of the project), but it stipulates that at least 60% of the funds be used for supplemental stipends and tuition for the Fellow, and it also requires a 50% match (of which at least half should be cash contributions).

Commitments required of and made by Warner:

- Be responsible for designing and delivering the training program, with input and support from all the partners;
- Coordinate the Fellows' recruitment and selection process;
- Offer a tuition waiver for 50% of the required coursework (which can be considered as an in-kind cash contribution, and thus will satisfy the minimum requirement);
- Monitor completion of program and service requirement by all Fellows, and manage repayment when needed;
- Be responsible for the execution of the external evaluation and for reporting to NSF;
- Contribute some additional in-kind resources (personnel time; etc.) to cover for the majority of the required match.

Commitments required of and made by the University of Rochester's College of Arts, Sciences and Engineering:

- Identifying a faculty member who will act as co-PI for the project (including serving on the project's leadership team) and liaison with the College (which will include proactively identifying other STEM faculty in the College that could enrich the Noyce Scholars' experience, and connecting them with the project's leadership team as needed)
- College co-PI's participation in the Fellows' selection process;
- Contributing to the delivery of the training program by providing expert consulting on STEM content as needed, occasional guest lectures and lab experiences, and being otherwise available to support and/or enrich the experience of individual Noyce Fellows;
- Providing on-going feedback about the program and suggestions for improvements.
- Contribute information as needed for program evaluation and reporting.
- Contribute in-kind a small portion of the co-PI's time during the academic year.

Commitments required of each of the partner districts:

- Take a leadership role in recruiting and selecting Fellows from their district;
- Ensure that Fellows from their district can conduct the required training activities (including providing release time for monthly Leadership Seminar meetings);
- Provide Fellows with opportunities to put their learning into practice to support the district's efforts to improve STEM teaching practices as well as Digital Conversion efforts more generally (ex: have some Fellow serve on the district Digital Conversion team or other leadership groups; engage them in coaching and/or PD of colleagues when sufficiently trained; etc.);
- Contribute information as needed for program evaluation and reporting;
- Contribute some non-cash in-kind resources (ex: administrators' time; space; subs; etc.) – target of \$5,000/year per district.

Commitments required of each of Fellow:

- Fully participate in all the activities constituting the 5-year training program;
- Beginning to provide services such as mentoring colleagues and providing professional development, in support to their districts' efforts to improve STEM teaching practices
- Provide services to support the district's Digital Conversion efforts, consistent with the program's expectations;
- Comply with the 5-year service requirement in high-need schools; this requirement will be automatically met if a Fellow completes the training program and stays in the same district for the five years of the program; if for whatever reason a Fellow leaves before the end of five years, s/he has to (a) continue to participate in the training and (b) either provide documentation that s/he is completing the service requirement in another high-need district OR pay back half of the supplementary stipend received up to that point;

Training program for UR Noyce Master Fellows

Based on our past experiences, we have designed the training program for Fellows so that they begin by focusing for the first two years on their own practice as “digitally-rich” math and science teachers (consistent with the new state standards), and then each of the following years they add another layer of complexity to their role as “master teachers” (as coaches/mentors, professional development providers, and agents of change, respectively).

Each year, the program will comprise of three complementary and interrelated components:

- *Customized graduate courses:* These are 3-credit Warner graduate courses that will be taught to the Fellows as a cohort, so as to be able to tailor the course content and pedagogy to the specific goals of the MTF program, while maintaining graduate coursework expectations and rigor. Some of these courses will be new courses designed specifically for this group, while others will be an adaptation of existing Warner courses.

All of these courses will be offered hybrid-online; this will minimize the time Fellows will need to spend travelling, and even more importantly provide fellows with rich opportunities for “online experiences as learners” without losing the benefits of face-to-face interactions.

- *Mentored field experiences:* As the Fellows take courses, they will be expected to put into practice what they are learning by engaging in experiences that complement their regular responsibilities (such as co-designing and implementing summer camps for students at the Museum, offering professional development to other STEM teachers, or participating in specific aspects of digital conversion in their district with a special focus on STEM implications). The specific nature of these experiences will be identified each year to be consistent with the chosen focus and related coursework. A member of the project leadership team will be assigned to each Fellow as a “mentor” to support their engagement in and learning from these experiences. The mentor’s role will be to help as needed in organizing these experiences (so that they can be most productive), be a resource and sounding board for the Fellow, and occasionally be present in the implementation of these experiences as an observer and/or co-facilitator.
- *Leadership seminars:* These are half-day monthly meetings for all Fellows and mentors, facilitated by the PI and other members of the project leadership team, that are intended to build upon and integrate the Fellows’ concurrent coursework and mentored practice experiences. While centered on the master teacher role that is the focus for each year (i.e., teacher, coach/mentor, professional development provider, and agents of change, respectively), these seminars will aim more generally at developing the Fellows’ capacity to assume leadership roles as “digitally-rich” STEM master teachers, and discussing implications of specific digital conversion initiatives in their district for STEM.

More details about the training program follow:

- ***YEARS 1 & 2: Focus on digitally-rich STEM teaching.*** For the first eighteen months, Fellows will focus on their own teaching practice to create math and science instructional experiences for their students that are consistent with national and state standards, what we know about how people learn best and high-leverage teaching practices, and Understanding by Design (UbD) and Universal Design as key approaches to instructional design, while also capitalizing on digital technology as most appropriate. This will involve a sequence of three semester-long courses that will also meet all the coursework requirements to obtain an Advanced Certificate in Digitally-Rich Teaching in K-12 Schools: (1) Foundations of STEM Teaching & Learning Foundations; (2) Digitally-Rich Teaching and Learning in K-12 Schools; and (3) Integrating Technology in Math and Science Instruction. Each of these courses will be offered in a hybrid-online format, meeting in person about once every other week, and substituting the other meetings with a combination of synchronous online sessions and asynchronous online activities. Concurrent with this coursework, Fellows will participate in “demonstration lesson” conducted by East Irondequoit and other expert “digitally-rich” teachers (either in person, or remotely by taking advantage of strategies developed by the SYNCON project), as a way to see how these approaches play out in practice. Fellows will also engage in innovative “digitally-rich” STEM scaffolded experiences in their own classrooms, as well as learning experiences in non-traditional settings - such as summer camps, after-school programs and/or museum exhibits - capitalizing on the partnership with the Museum. Some of these mentored experiences will be structured so as to also meet the requirements for the Practicum included in the Advanced Certificate in Digitally-Rich Teaching in K-12 Schools.
- ***YEAR 3: Focus on STEM coaching.*** While continuing to improve their own content and pedagogical knowledge as well as teaching practice, with an emphasis on leveraging digital technology, in their third year Fellows will also prepare for and take on the role of coach or

“mentor” for student teachers and colleagues. This will involve first a course on Communication and Counseling Skills offered by a counseling faculty, which previous Fellows found very useful. This will be followed by a new course on content-based coaching, which will build on the approach developed by Lucy West and colleagues, while also adding a component on “distance coaching” using digital technologies based on the preliminary findings of the SYNCON project. Concurrently, Fellows will engage in mentored practices such as reviewing innovative instructional materials with colleagues, collaboratively planning STEM lessons, and/or mentoring student teachers. Once again, Fellows will be expected to conduct some of these experiences “remotely”, so as to put into practice what learned in the course about leveraging technology to support their coaching activities.

- **YEAR 4: Focus on STEM professional development (PD).** While continuing to work on their practice as digitally-rich STEM teachers and coaches, in Year 4 Fellows will also prepare for and begin to take on the role of professional development provider in settings such as summer institutes and other events involving teachers from local schools and/or UR pre-service teachers. Fellows will take a new course on designing and facilitating STEM professional development, to be adapted from a more general Warner course so as to focus on digitally-rich math and science teaching and to include a component about online PD. Existing professional development offerings provided by the various partners will provide contexts for these mentored experiences associated with this course.
- **YEAR 5: Focus on STEM reform and digital conversion.** Finally, while continuing to work on the previously described dimensions, in the last year Fellows will focus explicitly on what it takes to successfully promote systemic reform in their district, with a particular emphasis on digital conversion and its implications for the teaching of math and science. During this final year, Fellows will no more take courses, but rather begin to transition to the role of more “independent” change agents in their district, with the expectation that each district will engage them in influential teams and activities related to Digital Conversion. To prepare for this work, though, they will take their final course on Leadership and Organizational Dynamics the previous spring semester.

Advanced credentials option

It has been our experience across both Phase I and II that some Fellows found it valuable to also pursue NYS certification as a school leader at the building and district level, so as to be able to take on administrative positions such as department chair or curriculum coordinator, and be more impactful as agents of change. Therefore, we are proposing to give the option to a few interested fellows to pursue the additional 6 courses and administrative internship required to obtain NYS certification as school leaders. Four of these courses will be offered hybrid-online during the summer break, and thus could be taken in the summers at the end of Year 3 and 4; the remaining two courses can be taken during the school year in year 4, and the administrative internship can be completed over Year 5.

We have budgeted grant funds to cover half of 8 full scholarships for this option, with the Warner School providing the additional tuition waiver as an in-kind contribution.

NOTE: Much of the coursework completed by the Fellows could count later towards an Ed.D. program for Fellows interested in eventually pursuing this degree.

Table 1: MTF Program at a Glance

Year. Focus	Course (semester - # credits)	Mentored practice
1&2. Digitally-rich STEM teaching	<ul style="list-style-type: none"> • <i>LS: Implementing digitally-rich STEM Teaching</i> (yearlong+ summers-7) • <i>Foundations in Teaching & learning STEM</i> (Spring Y1-5) • <i>Digitally-rich Teaching</i> (Fall Y2-3) • <i>Integrating Technology in Math & Science Teaching</i> (Spring Y2-3) 	<ul style="list-style-type: none"> • Observations of digitally-rich “demonstration classes” • Innovative digitally-rich STEM teaching in informal settings (in supporting/primary roles) • Innovative digitally-rich STEM teaching in own class • Analysis of own videotaped lessons (including some personal experience of being coached online)
3. STEM coaching	<ul style="list-style-type: none"> • <i>*LS: Implementing STEM Coaching</i> (year-long + summer-4) • <i>Counseling & communication skills</i> (FY3- 3) • <i>STEM Coaching</i> (SpY3-3) 	<ul style="list-style-type: none"> • Innovative digitally-rich STEM teaching in own class and/or informal settings • Offer demonstration classes • Mentoring/supervising a student teacher • Working with colleagues on digitally-rich STEM innovations for their classes • Participating in high quality STEM PD in a supportive role
4. STEM PD	<ul style="list-style-type: none"> • <i>LS: Implementing STEM PD</i> (yearlong-4) • <i>Designing STEM PD</i> (FY4-3) • <i>Leadership & organizational dynamics</i> (SpY4-3) 	<ul style="list-style-type: none"> • Innovative STEM teaching; demonstration classes • Mentoring student teachers/colleagues • Guest speaker in methods courses • Co-facilitating STEM PD
5. STEM reform & Digital Conversion	<ul style="list-style-type: none"> • <i>LS: Implementing systemic reform</i> (yearlong-4) 	<ul style="list-style-type: none"> • Innovative STEM teaching; demonstration classes • Mentoring student teachers/colleagues • Designing and facilitating STEM PD • Working on STEM innovations and digital conversion at the school & district level

Fellows’ recruitment and selection

Recruiting: As done successfully in our last MTF project, we will devote the first semester of the grant to the recruitment and selection of Fellows, to both ensure the best possible cadre and improve retention. The opportunity to apply for a Fellow position will be offered to all math and science teachers in the partners’ districts. This opportunity will be advertised through a flier complemented whenever possible by presentations at faculty meetings; we will also proactively request nominations from principals and other administrators in each partner district, as well as STEM educators in the region. Building on what we learned from the challenges encountered in our first MTF project, and the changes that were successfully implemented in our second MTF project, we are planning to include the following components in our recruiting process to attract a committed and diverse pool of applicants:

- **Offering a free “digitally-rich STEM teaching workshop” as part of the recruiting process:** This required workshop will be designed to give applicants “a taste” of the kind of experiences they will engage in before they make a 5-year commitment. We expect that, as it happened in Phase II, this free PD opportunity will attract more informed and committed applicants, as well as provide valuable information to the selection team.
- **Testimonials from previous Fellows:** As part of the required workshop, we will have a panel of Fellows from our Phase I and II grants sharing their experiences. These testimonials will also be recorded and included in the recruiting materials.

- **Reviewing videos of classroom teaching as well as interviews of promising applicants:** As done in Phase II, in addition to an interview with a subset of the leadership team, the most promising applicants will be asked to submit a video of their teaching and this video will be evaluated using the Reformed Teaching Observation Protocol [RTOP], a published instrument designed to measure “reformed” teaching, to ensure that these observations are rigorous and consistent, as well as to collect baseline data for all participants.
- **Extending the recruiting period by starting the training program in January:** Again this was a modification employed in Phase II that proved very beneficial to allow time for applicants to better understand the commitment involved, and for project staff to finalize the design of program to best tailor it to the participants.

Selection process

Interested math and science teachers in the partner districts will be asked to provide the following documentation as part of their application:

- Cover letter including the reasons for their interest in the program and evidence of their qualifications, as well as their commitment to the project.
- Curriculum Vitae or Resume.
- Copy of transcripts and score received in the NYS Content Specialization Test (CST).
- Artifacts to illustrate their approach to teaching and student outcomes.
- Contact information of individuals who could provide a recommendation – and whenever possible a letter of recommendation from those individuals.
- *(if requested)* Video of self teaching a full class period.

All applications received will be reviewed by the leadership team along with a representative of each of the district partners to create a short list of promising candidates for each district, based on:

- Completed Master’s degree.
- Strength of subject matter background *(based on transcripts and NYS Content Specialty Test)*
- Evidence of innovative teaching practices, including uses of technology, and impact on student STEM learning *(based on artifacts provided and recommendations)*
- Past involvement and performance in STEM and/or technology professional development and reform efforts *(as documented in cover letter, CV, artifacts and recommendations)*.
- Other evidence of high quality STEM teaching and leadership potential *(as documented in cover letter, CV, artifacts and recommendations)*.
- Commitment to participate in all project activities and maintain their district employment *(as state in cover letter and supported by recommenders)*.

Short-listed applicants will be interviewed by members of the leadership team, observed by the evaluator using RTOP, with the final selection capitalizing on the additional information thus gathered.

UR key personnel and their roles

Dr. Cynthia Callard, Executive Director of the Center for Professional Development and Education Reform at the Warner School of Education (Center hereafter), will direct and oversee all project activities as the **PI**, a role she has played since 2012 in Phase I and II MTF projects. An experienced math teacher and professional development provider, and also the co-PI of the NSF-funded DRK-12 SYNCON project, Callard will be the lead facilitator of all the Leadership Seminars, co-teach the first course on STEM Teaching & Learning (as she did in Phase II), and be ultimately responsible for education components of the project and reporting to NSF.

Dr. Dave Miller, Assistant Professor at Warner, will be a co-PI and **project coordinator**. Dr. Miller has prior experience with instructional technology as the PI of three SBIR grants awarded

by the U.S. Department of Education, which focused on designing and leveraging a learning management in K-12 settings system. Dr. Miller has also participated as a consultant in the Digital Conversion Team that launched digital conversion at East Irondequoit, has been a leading member of the team of faculty that designed and has been teaching the sequence of courses to prepare online instructors at Warner, and contributed to launch the K-12 Digital Consortium. Dr. Miller will be teaching or co-teaching the courses related to digitally-rich teaching and digital conversion, providing support to both the leadership team and partner districts on issues related to digital conversion, and serving as the main liaison with the partner districts.

Dr. Mike Daley currently splits his time as an Associate Professor of Environmental Science at Lasell College in Boston, where he teaches online science undergraduate courses, and as Assistant Professor in the Center for Professional Development and Education Reform at Warner, where he is involved in professional development and coaching of K-12 science teachers. As one of the STEM **co-PIs** for the project, Daley will be responsible for all science education components of the project, as well as co-teach the new technology-rich STEM teaching course and serve as mentor for about half of the science Fellows.

Dr. Raffaella Borasi, Professor and currently the Dean of the Warner School of Education but returning to a faculty position by the start of this project, and a mathematics educator with extensive experience in directing NSF-funded projects, will be another **co-PI** – a role she already played in Phase I and II. She will co-teach the first course on digitally-rich teaching (as she did in Phase II) and serve as a mentor for a few of the math Fellows. Her previous role as dean puts her in a unique position to coordinate the complex staffing and cost-sharing required for this project.

Dr. John Kessler, Associate Professor in the Earth and Environmental Science Department at the UR, will also serve as **co-PI**. Dr. Kessler has been the PI of prior NSF grants, and has research and outreach interests that well complement the rest of the project leadership team. He will serve on the project's leadership team, acting as liaison with the College of Arts, Sciences and Engineering – which will include participating in the selection process, providing direct support in the design and/or implementation of specific aspects of the training programing, proactively identifying other STEM faculty in the College that could enrich the Noyce Scholars' experience and connecting them with the project's leadership team as needed.

*Michael Occhino, a former 22-year veteran science teacher in the Rochester City School District and currently the Director of Science Education Outreach in the Center, will also be a member of the project leadership team, and will co-facilitate the Leadership Seminars (a role he played in Phase II), co-teach some of the courses, serve as mentor for about half of the science Fellows, and support the project in other capacities.

*Stephanie Martin, a former teacher for 14 years and current Director of Math Education Outreach in the Center and a member of the SYNCON team with Callard, will also be a member of the project leadership team, and will co-facilitate the Leadership Seminar (a role she played in Phase II), co-teach some of the courses, serve as mentor for the math Fellow working in middle school and support the project in other capacities.