

# The University Senate of Michigan Technological University

## Proposal 30-15 (Voting Units: Academic)

### **“Graduate Certificate in Post-Secondary STEM (Science, Technology, Engineering and Mathematics) Education”**

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#### **1. General Description and Characteristics of Program**

The Department of Cognitive and Learning Sciences proposes the establishment of a “Graduate Certificate in STEM (Science, Technology, Engineering and Mathematics) Education.” Students completing this certificate will develop competencies in planning and delivering effective STEM instruction and conducting research on topics related to teaching and learning in the STEM disciplines.

The certificate will be available to all degree seeking students enrolled in the Graduate School at Michigan Technological University as well as non-degree seeking students at MTU. 15 credits will be required in order to earn the certificate. The Graduate Certificate Director will oversee the certificate program.

*Catalog Description*—The Graduate Certificate in STEM (Science, Technology, Engineering and Mathematics) Education provides graduate students and nondegree-seeking students with at least a bachelor’s degree in a STEM discipline with the skills to develop and implement effective STEM instruction and conduct research related to teaching and learning in the STEM disciplines. The certificate is available to all degree seeking students enrolled in the Graduate School at Michigan Technological University as well as non-degree seeking graduate-level students.

#### **2. Rationale**

Developing high-level skills in STEM content areas has become a national priority, as such skills are essential both to improving access to advanced educational opportunities and to workplace success. There is widespread interest in ensuring that more students pursue and succeed in the STEM fields in colleges and universities.

Improvements in undergraduate teaching practices will contribute to the goal of encouraging and enabling more students to persist and earn degrees in STEM fields (see, for example, <http://www2.ed.gov/about/overview/budget/budget13/crosscuttingissues/stemed.pdf>; <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-v11.pdf> ).

Preparing current graduate students and current/future university and community college faculty to develop, teach and study the outcomes of STEM instruction will contribute to the necessary improvements.

This certificate program is aligned with similar graduate certificate (and Ph.D.) programs at other universities that aim to improve STEM teaching and research (see below). Developing such a program at Michigan Tech has the potential to both attract new graduate students who have an interest in STEM education and to better prepare our current graduate students for careers in STEM education.

### **3. Related Programs**

Similar certificate programs are offered at Virginia Tech and Clemson. A number of universities, including Virginia Tech, Clemson, Purdue, Ohio State, University of Minnesota and Dartmouth offer graduate degrees in STEM Education.

### **4. Projected Enrollment**

Over the past several years, a number of graduate students working on education-related projects (e.g., projects funded by the National Science Foundation including an MSP, GK-12, IGERT, etc.) have expressed an interest in enrolling in education coursework that would allow them to earn a specific acknowledgement.

Additionally, current PhD students are finding that prospective academic employers are interested in knowing more about their teaching philosophy and in some cases ask to see a teaching portfolio. At the current time, students in many programs receive no formal training related to teaching and learning, and these students have found themselves at a disadvantage when searching for an academic position because students from other schools are receiving this training.

Finally, students who are serving as GTAs or GTIs at Michigan Tech would benefit from opportunities on campus for professional development and academic growth in the area of education. Having a certificate program available will assist students and advisors in identifying appropriate coursework.

Having a certificate would provide a mechanism for “badging” students who have completed a course of study in the area of STEM education and would help students to prepare portfolios in advance of seeking employment for which training in STEM education is desirable.

Because this certificate program will potentially be of interest to students who wish to conduct education-related research and/or plan to pursue an academic career, it is projected that on the order of 5 students per year will earn this certificate at steady-state.

### **5. Scheduling**

No change in the regular scheduling of the existing courses is anticipated. ED5700 is an online course; the remaining courses are regular on-campus courses. The Department of Cognitive and Learning Sciences will fit the proposed new course, STEM Education Practicum (see below), into their regular scheduling plans.

## **6. Curriculum Design**

A total of 15 credits are required for the STEM Education Certificate. Students must earn a grade of B or higher in each of the courses counting toward the certificate. The only new course that will be developed for the certificate program is ED5860.

ED5110      Psychological Foundations of Education (2)

ED5100      College Teaching (1)

ED5700      Introduction to Education Research (2)

Teaching Methods (one of the following or approved equivalent course):

- ED4720      Methods of Teaching Science (2)
- MA4905      Methods of Teaching Mathematics (2)
- PH4710      Methods of Teaching Physics (2)

Statistics (one of the following or approved equivalent course)

- MA5701      Statistical Methods (3)
- PSY5210      Advanced Statistical Analysis and Design I (4)
- SS5004      Statistics for the Social Sciences (3)

ED5860      STEM Education Practicum (2-5 credits)

Together, these courses will provide students an overview of current research and issues in STEM teaching and learning, knowledge of and practice in developing lessons that engage STEM students in inquiry and sense-making, and practical experience in STEM teaching, curriculum development, or research. As interest and participation in the certificate program grows, it is anticipated that CLS or other departments may develop courses that could be approved as alternatives to one or more of the courses listed above. For example, a department might develop a content-specific teaching methods or practicum course to better meet the needs of its students if that department serves a population of students of sufficient size. Another possibility is developing an integrated STEM teaching methods course that focuses on integrating content and scientific practices across the STEM disciplines. As a key component of the program, the STEM Education Practicum provides practical experience in STEM teaching, curriculum design, assessment, and/or research. Modeled after a “student teaching” experience, students will work closely with one or more faculty mentors to develop the skills necessary to engage in high-quality STEM education instruction or research. All students completing a practicum will also attend a seminar led by a CLS faculty member; this seminar will promote students’ reflection on the experience, focusing on connections between the work in the practicum and research-based strategies to improve teaching and learning.

## 7. New Course Descriptions

### **ED5860 STEM Education Practicum (2-5 credits, may be repeated with different focus)**

This course provides practical experience in teaching, and/or education research, and/or assessment in a STEM discipline, under the supervision of one or more faculty mentors. A teaching practicum will include teaching or mentoring undergraduate students in a STEM content area. A research practicum will involve working with a faculty member on a STEM education research project. An assessment practicum will involve work with STEM assessment activities. A seminar is a required component of all practicum experiences; the focus of the seminar is reflecting on the practicum experience and making connections between the students' work and research-based strategies to promote teaching and learning. Non-degree seeking students will be required to complete two practicums with different foci.

## 8. Model Schedule Demonstrating Completion Time

We anticipate that degree-seeking students will take one course toward the certificate each semester. Courses are offered on the following schedule, which will allow degree-seeking students to complete the certificate in 4-5 semesters. Non-degree seeking students could complete the certificate in as little as 2 semesters.

### **Fall Courses**

ED5110  
ED5100  
ED5700  
ED4720  
MA5701

### **Spring Courses**

ED5110  
ED5100  
MA4905  
PH4710

**Courses Offered on Demand:** PSY5210, SS5004, ED5860

## 9. Library and other Learning Resources

Students in this program will need only the library and other learning resources presently available to all enrolled students.

## 10. Faculty Resumes

The following faculty contributed to the development of this proposal and will serve this program. Their vitas are available at

<https://drive.google.com/a/mtu.edu/folderview?id=0B7awkpcWWsEjemtVUzJUemUySzA&usp=sharing>

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## **11. Equipment**

No additional equipment is needed.

## **12. Program Costs**

The only additional cost associated with this certificate program is offering the ED5860 STEM Education Practicum course. We do not anticipate that this course will be offered in the Year 1. This course will become part of the Department of Cognitive and Learning Sciences' regular teaching schedule in Years 2 and 3. The Department is in the process of hiring a new STEM Education faculty member who will support this program, along with other new and ongoing education initiatives. We anticipate that the program will have a positive effect on enrollment in the existing courses, since the enrollment in most of these courses are not typically at capacity.

Some faculty in other departments may be asked to mentor students during the practicum. We anticipate, however, that the students enrolled in this program will be able to positively contribute to faculty members' work in teaching, curriculum development, assessment, and research.

## **13. Space**

No additional space is required.

## **14. Policies, Regulations, and Rules**

Credits earned for this certificate may also be applied toward a single graduate degree at Michigan Technological University.

## **15. Accreditation Requirements**

None.

## **16. Planned Implementation Date**

Fall semester 2015.