Session: Iowa's STEM Teaching Endorsement – Higher Education Plan

Part A Iowa's STEM Endorsement (Dr. Kris Kilibarda, Director, Jacobson Institute for Innovation in Education (STEM) and Jacobson Chair, Grand View University)

Iowa Board of Educational Examiners STEM Endorsement Rules

13.28(31) *Engineering.* 5-12.
a. Completion of 24 semester hours in engineering coursework.
b. Methods and strategies of STEM instruction or methods of teaching science or mathematics.

13.28(32) *STEM.*
a. K-8.
(1) Authorization. The holder of this endorsement is authorized to teach science, mathematics, and integrated STEM courses in kindergarten through grade eight.
(2) Program requirements. Be the holder of the teacher-elementary classroom endorsement.
(3) Content.
1. Completion of a minimum of 12 semester hours of college-level science.
2. Completion of a minimum of 12 semester hours of college-level math (or the completion of Calculus I) to include coursework in computer programming.
3. Completion of a minimum of 3 semester hours of coursework in content or pedagogy of engineering and technological design that includes engineering design processes or programming logic and problem-solving models and that may be met through either of the following:
- Engineering and technological design courses for education majors;
- Technology or engineering content coursework.

4. Completion of a minimum of 6 semester hours of required coursework in STEM curriculum and methods to include the following essential concepts and skills:
- Comparing and contrasting the nature and goals of each of the STEM disciplines;
- Promoting learning through purposeful, authentic, real-world connections;
- Integration of content and context of each of the STEM disciplines;

problem-based learning and project-based learning);
- Curriculum and standards mapping;
- Engaging subject-matter experts (including but not limited to colleagues, parents, higher education faculty/students, business partners, and informal education agencies) in STEM experiences in and out of the classroom;
- Assessment of integrative learning approaches;
- Information literacy skills in STEM;
- Processes of science and scientific inquiry;
- Mathematical problem-solving models;
- Communicating to a variety of audiences;
- Classroom management in project-based classrooms;
- Instructional strategies for the inclusive classroom;
- Computational thinking;
- Mathematical and technological modeling.

5. Completion of a STEM field experience of a minimum of 30 contact hours that may be met

through the following:
● Completing a STEM research experience;
● Participating in a STEM internship at a STEM business or informal education organization; or
● Leading a STEM extracurricular activity.

b. 5-8.
(1) Authorization. The holder of this endorsement is authorized to teach science, mathematics, and integrated STEM courses in grades five through eight.
(2) Program requirements. Be the holder of a 5-12 science, mathematics, or industrial technology endorsement or 5-8 middle school mathematics or science endorsement.
(3) Content.
1. Completion of a minimum of 12 semester hours of college-level science.
2. Completion of a minimum of 12 semester hours of college-level math (or the completion of Calculus I) to include coursework in computer programming.
3. Completion of a minimum of 3 semester hours of coursework in content or pedagogy of engineering and technological design that includes engineering design processes or programming logic
and problem-solving models and that may be met through either of the following:
● Engineering and technological design courses for education majors;
● Technology or engineering content coursework.
4. Completion of a minimum of 6 semester hours of required coursework in STEM curriculum and methods to include the following essential concepts and skills:
● Comparing and contrasting the nature and goals of each of the STEM disciplines;
● Promoting learning through purposeful, authentic, real-world connections;
● Integration of content and context of each of the STEM disciplines;
● Interdisciplinary/transdisciplinary approaches to teaching (including but not limited to problem-based learning and project-based learning);
● Curriculum and standards mapping;
● Engaging subject-matter experts (including but not limited to colleagues, parents, higher education faculty/students, business partners, and informal education agencies) in STEM experiences in and out of the classroom;
● Assessment of integrative learning approaches;
● Information literacy skills in STEM;

● Processes of science and scientific inquiry;
● Mathematical problem-solving models;
● Communicating to a variety of audiences;
● Classroom management in project-based classrooms;
● Instructional strategies for the inclusive classroom;
● Computational thinking;
● Mathematical and technological modeling.
5. Completion of a STEM field experience of a minimum of 30 contact hours that may be met through the following:
● Completing a STEM research experience;
● Participating in a STEM internship at a STEM business or informal education organization; or
● Leading a STEM extracurricular activity.

c. Specialist K-12.

(1) Authorization. The holder of this endorsement is authorized to serve as a STEM specialist in
kindergarten and grades one through twelve.

(2) Program requirements.

1. The applicant must have met the requirements for a standard Iowa teaching license and a teaching endorsement in mathematics, science, engineering, industrial technology, or agriculture.

2. The applicant must hold a master' s degree from a regionally accredited institution. The master' s degree must be in math, science, engineering or technology or another area with at least 12
hours of college-level science and at least 12 hours of college-level math (or completion of Calculus I)to include coursework in computer programming.

(3) Content.

1. Completion of a minimum of 3 semester hours of coursework in content or pedagogy of engineering and technological design that includes engineering design processes or programming logic and problem-solving models and that may be met through either of the following:

● Engineering and technological design courses for education majors;

● Technology or engineering content coursework.

2. Completion of 9 semester hours in professional development to include the following essential concepts and skills:

● STEM curriculum and methods:

- Comparing and contrasting the nature and goals of each of the STEM disciplines;
- Promoting learning through purposeful, authentic, real-world connections;
- Integration of content and context of each of the STEM disciplines;
- Interdisciplinary/transdisciplinary approaches to teaching (including but not limited to problem-based learning and project-based learning);
- Curriculum/standards mapping;
- Assessment of integrative learning approaches;
- Information literacy skills in STEM;
- Processes of science/scientific inquiry;
- Mathematical problem-solving models;
- Classroom management in project-based classrooms;
- Instructional strategies for the inclusive classroom;
- Computational thinking;
- Mathematical and technological modeling.

- Engaging subject-matter experts (including but not limited to colleagues, parents, higher education faculty/students, business partners, and informal education agencies) in STEM experiences in and out of the classroom;
- STEM research experiences;
- STEM internship at a STEM business or informal education organization;
- STEM extracurricular activity;
- Communicating to a variety of audiences.

● Leadership in STEM:

- STEM curriculum development and assessment;

- Curriculum mapping;
- Assessment of student engagement;
- STEM across the curriculum;
- Research on best practices in STEM;
- STEM curriculum accessibility for all students.

3. Completion of an internship/externship professional experience or prior professional experience in STEM for a minimum of 90 contact hours.

Part B Iowa STEM Teaching Endorsement Partnership Proposal to NSF (Dr. Jeff Weld, Executive Director, Iowa Governors STEM Advisory Council)

Over the last three years Iowa has assembled many components of a systemic STEM reform initiative. Exemplary STEM curricula is being delivered to pre-K through 12 learners; specialty classrooms and schools are marrying business and education interests; citizens are multi-messaged on the STEM priority sweeping the state; great teachers of STEM are being celebrated and showcased; STEM enjoys strong bipartisan support of the state?s elected officials; and STEM enrollments at the postsecondary level are spiking. However, a critical piece of the puzzle eludes Iowa as it does the rest of the nation: a high fidelity system of STEM teacher production that leverages existent assets and unites all stakeholders.

The goal of this Iowa STEM Teaching Endorsement Partnership (I-STEP) is to create a top quality STEM teaching program for undergraduates to access anywhere in Iowa by leveraging community colleges, independent colleges and universities, public universities, and the state?s licensing agency in an inter-institutional consortium by which everyone contributes from their strengths, as able, to prepare outstanding candidates for the STEM classrooms of Iowa. The vision and effect to result from this goal will be a diverse STEM workforce and STEM literate graduates who will benefit from and contribute to the advancement of the STEM fields in Iowa. A significant side-benefit will be an unprecedented web of collaboration for sustainable preparatory programs at multiple institutions across the state.

A series of partnerships and programs form a favorable foundation for Iowa to craft, assess, and disseminate this solution. First, for over a year the state?s community colleges and four year/graduate institutions have been committing ?STEM Champions? to monthly meetings led by the Governor?s STEM Advisory Council. The STEM teaching pathway is their consensus rallying point to collaborate. Second, a committee of the STEM Council worked with the Board of Educational Examiners (BOEE) to forge the STEM Endorsement for teachers in December 2013. This proposed consortium is invited by the BOEE to develop consistent standards to guide models that may arise across the state. Third, current NSF awards led by Weld (PI) inform this proposed work: an inter-institutional Robert Noyce Scholars program, an I-TEST STEM teacher externships program, and an MSP-RETA statewide STEM evaluation program. And fourth, a triad of evaluation centers representing Iowa?s public universities collaborates to measure STEM Council effects and is on board for I-STEP as well.

Strategies proposed for the I-STEP solution include: 1. The creation of a higher education consortium leading to buffet-style courses and experiences toward a STEM endorsement, unbound by geography or institutional limitations; 2. Standardized expertise across institutions through the common experience of faculty professional development in STEM pedagogy; and 3. Best-practice STEM experiences for prospective candidates in the form of industry externships.