STRATEGIC GROWTH OPPORTUNITIES IN STEM (SCIENCE, TECHNOLOGY, ENGINEERING AND MATH) EDUCATION

Diane Boothe and Ross Vaughn

Boise State University

USA

BOISE STATE UNIVERSITY

Beyond the BLUE

BeyondtheBlue.BoiseState.edu

Introduction

What is the STEM Agenda?

- The increased emphasis on STEM (science, technology, engineering, and mathematics) education is evident across all levels of education today
- The motivation behind this new emphasis is to increase the number of graduates pursuing STEM careers, which is critical to the economic prosperity of society

Goals for Postsecondary Institutions to Meet STEM Job Needs

Given the high rate of STEM job growth and the difficulty businesses experience in filling STEM positions, many states are urging their colleges and universities to increase the number of degree and certificate holders who can enter STEM fields

Why STEM Education Is Important

- Critical for economic prosperity
- STEM jobs are among the highest paying and fastest growing
- Individuals with STEM degrees experience lower unemployment rates
- STEM education provides a competitive edge and innovative capacity

STEM Salaries Are Above the National Average

The top 10 bachelor degree majors with the highest starting salaries in the United States are all in STEM fields

STEM Knowledge Bolsters Employment Security

- STEM jobs are growing much faster than other job categories
- Supply of STEM workers lags behind the demand
- STEM jobs have grown three times faster than non-STEM jobs over the past 10 years
- Unemployment in STEM fields is lower than in other fields

STEM and Innovation

- Much of our economic growth in the last 50 years has come from technological innovation
- STEM workers create ideas that become commercialized and yield additional jobs
- STEM knowledge is transferable and useful in contexts outside the traditional STEM occupations

The Payoff

- Growing a STEM workforce is sound economic development strategy
- The STEM workforce produces innovation that leads to new business and jobs
- STEM education provides individuals with higher wages and employment security
- The STEM workforce has a strong impact on a nation's competitiveness and economic growth

Current Weaknesses in STEM Education

Failure to motivate student interest in math and science

- In most K–12 systems, math and science subjects are disconnected from other subject matters and the real world
- Students often fail to see the connections between what they are studying and STEM career options

Seeing Connections

" When students discussed their career ambitions, many did not connect their aspirations with required high school math and science coursework, suggesting a need to help students see the relevance of upper-level math and science coursework in secondary school and beyond."

—**From *The Opportunity Equation (2007), Carnegie Corporation of New York***

Shortfall of Qualified Math and Science Classroom Teachers

- A shortfall in the numbers of qualified math and science teachers in the classroom is a chronic problem in the K–12 system
- Many classrooms are staffed by teachers with neither a certificate nor a degree in their assigned subject area

Implementing the STEM Agenda

Adopt Rigorous Math and Science Standards

- Stress not only procedural skill but also conceptual understanding
- Ensure that students are learning and absorbing the critical information they need to succeed at higher levels
- practice applying mathematical ways of thinking to real-world issues and challenges; in short, prepare students to think and reason mathematically

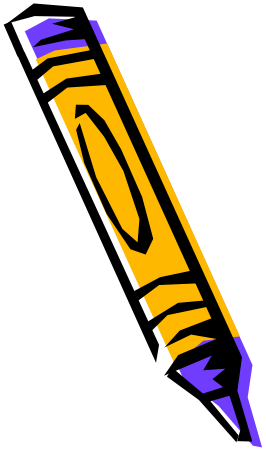
Recruit and Retain More Qualified and Effective Teachers

- Utilize financial incentives
- Provide support systems
  - Professional development in subject-content areas
- Improve institutional conditions
  - student behavioral problems
  - effectiveness of the school leadership and administrative support
  - the availability of classroom resources
  - the degree of faculty input into schoolwide decisions
  - the degree of classroom autonomy held by teachers

Enhance the Quality and Supply of STEM Teachers

Upgrading the training of teachers before they enter service is particularly important: this helps them acquire the hands-on skills to ensure that students learn and apply math and science knowledge.

STEM Education Initiatives at Boise State University



- IDo**Teach**
- **DMT** – Developing Mathematical Thinking
- **STEM** Central Station
- i**STEM**
- Sy**STEM**ic Solution
- Master's degree in **STEM** Education
- Looking beyond US borders

IDoTeach

Consistent with the Boise State University commitment of innovation, leadership, and program excellence, the university has committed to *IDoTeach*, a UTeach replication effort.

- The primary goal of IDoTeach is to increase the quality, quantity and diversity of STEM teachers graduating from Boise State

Continued…

IDoTeach

- Designed to improve the institutional effectiveness in graduating more math and science teachers
- Integrates elements that include:
  - *learning facilitator program*
  - *teacher preparation pathway in the engineering curriculum*
  - *summer research experiences for teachers*

Developing Mathematical Thinking

- Developing Mathematical Thinking (DMT) is a Mathematics Science Partnership grant funded by the National Science Foundation (NSF)
- Promotes best practices and curricula in math teaching at the elementary and middle school levels
- Has realized significant gains among the students whose teachers participate in this training

Continued…

Developing Mathematical Thinking

- Focused on developing teachers' understanding and ability to teach mathematics, which then translates into developing students' mathematical understanding
- Week-long institutes during the summer and meetings with DMT project staff one day each week through the academic year

Continued…

Developing Mathematical Thinking

- The teachers engaged in professional development, observed lessons taught by DMT staff, and received reflective feedback after their lessons had been observed
- Focus:
  - *how students' develop mathematical ideas over time*
  - *how teachers build learning environments to best promote this process*
- In the first three years of the project's existence, students and teachers demonstrated positive changes in the DMT schools

Continued…

Developing Mathematical Thinking

- Teachers:
  - *demonstrated increased knowledgeable about mathematics, better insight into how students develop mathematical ideas and, as a whole, were more excited about teaching mathematics*
- Students:
  - *were also enthusiastic about math time and are more capable of solving difficult problems with understanding*
- This initiative has resulted in more students proficient on the Idaho Standards Achievement Test for each grade level from second through sixth

Continued…

STEM Central Station

- A center designed to promote research and educational strategies to enhance STEM initiatives and support learning partnerships for students and faculty in a centralized station
- Coordinates grant-related and other STEM programs on campus and throughout Idaho
- Goal is to further develop emerging STEM education best pratices to help overcome a national dearth of qualified teachers in STEM-related subjects and entice more students to pursue those areas of study

Continued…

STEM Central Station

- The underlying theme of the project is student self-authorship, an educational framework in which students immerse themselves in genuine experiences such as research, teaching kindergarten through 12th grade students, and intellectually engaging with peers and faculty.
- Personally identifying as a scientist, engineer, mathematician or STEM teacher enhances student learning and success
- Involves faculty across campus by promoting and supporting faculty understanding of student-centered teaching methods in STEM courses and the inclusion of students in research

SySTEMic Solution

- The Center for Teaching and Learning provides a wide range of workshops and confidential consulation services for faculty
- Summer workshops for K-12 science educators

Noyce Scholarship

- Increasing quantity, quality, and diversity of STEM education graduates at Boise State University is achieved through multiple paths that attend to a range of needs through:
  - *tutoring*
  - *academic advising*
  - *tuition assistance*

Master's degree in STEM Education

- This degree is designed to address a growing national emphasis on student improvement in STEM subjects and to meet the high demand for qualified high school STEM teachers
- Because increased emphasis in being placed on mastery of STEM education, we intend to foster success and inspire teachers to engage their students by giving them the tools and resources that they need to develop their expertise

Looking beyond US borders

- There is an abundance of math and science majors in Korea who are interested in securing teaching positions in the public schools
- Boise State University is strengthening partnerships and exchange agreements with several Korean universities to bring Korean STEM education students to Boise State, as well as sending our students to Korea

BSU College of Education Partners

- Japan
- Taiwan
- Peru
- Mexico
- Uruguay
- Italy
- Korea

Conclusions and Recommendations

Commitment
Positive Impact
Qualified STEM Educators
Recruit and Retain