

Integrated STEM Teacher Professional Development

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Abstract: *In recognition of teachers concern and confidence in teaching their diverse rural students about Science, Technology, Engineering and Mathematics (STEM) subjects, the potential for positive influences on students learning, and the likely lack of K-12 teacher preparation in STEM; we (iSTEM) developed and implemented professional development summer institutes for K-12 teachers to help prepare them and their students for the challenging career requirements of a highly technical global workforce. Our STEM summer institute used a combination of keynote presentations, group activities, content strands, hands on activities, and field trips to enhance educators' knowledge, awareness, and comfort with design and STEM education. We assessed an array of associated variables to research the effectiveness of our summer institute. Our research has revealed significant increases in comfort teaching STEM ($p < .01$) while developing a replicable professional development process. The iSTEM summer institute professional development program has been replicated and scaled across the State of Idaho and shared nationally while helping teachers better prepare students. The iSTEM team will present a workshop describing the benefits of the iSTEM summer institute program, sharing research findings, sharing benefits of enhancing teacher professional development in STEM subjects, and potential of replicating this process. In this workshop, participants will also engage in activities to help them better understand how a STEM related topic can be integrated across the curriculum to include concepts generally taught in the isolate disciplines of science technology, engineering and math.*

Keywords: Teacher, Professional, Development, Integrated, STEM

1.iSTEM Workshop Description

Global workforce requirements are rapidly becoming more sophisticated, technology has become integral, and all indications are that science, technology, engineering and mathematics (STEM) literacy will become even more vital to individual's employability, career success, decision making capacity, and their ability to contribute to the economic success of both national and global economies. It is clear that STEM serves as a critical driver in the global market and workplace. Many countries and industries face common problems of knowledge gaps in their STEM workforce; far too few students enter rigorous programs of study and many entering the workforce lack the flexible, agile, skill based technological capacity to compete in modern job markets. An effective mitigation to reduce the potentially crippling workforce knowledge gap is to accelerate student achievement in STEM disciplines while ensuring that the curriculum is accessible, relevant, and integrated across the curriculum. Research has shown that student achievement in STEM will generate the workforce talent and innovative thinkers who will create new ideas, products and industries of the 21st Century. Further, increased emphasis on K-12 STEM education must begin early in every student's learning trajectory build enthusiasm, STEM literacy, and competency.

In recognition of these challenges, the Idaho STEM (*iSTEM*) team focused on ensuring STEM literacy through education by developing highly effective STEM teachers, who have both deep content knowledge in STEM subjects and mastery of pedagogical skills and 21st century practices required to teach integrated STEM curriculum. We implemented inquiry-based, problem-solving approaches requiring well developed pedagogical content knowledge. Challenges addressed by *iSTEM* included overcoming limited teacher education science and backgrounds and supporting a broad understanding of STEM while bringing STEM to Idaho's classrooms.

In recognition of the instructional and curricular ties to STEM, potential for positive influences on students learning, and the likely lack of K-12 teacher preparation in STEM; we developed and implemented very successful 4 day professional development summer institutes for K-12 teachers focused on enhancing STEM skills and teacher confidence. Our *iSTEM* summer institutes used a combination of keynote presentations, group activities, content strands, and field trips to enhance the attending educators' knowledge, awareness, and comfort with STEM education. To research the effectiveness of the *iSTEM* summer institutes, we assessed an array of associated variables and have documented the results in peer reviewed articles and papers. Our research has revealed significant increases in comfort ($p < .01$) and knowledge of the design process ($p < .01$) and substantially deeper communication of various STEM subjects (Nadelson, et al, 2012). The results of the instruments and data collected and collated are further described in the "*i-STEM Summer Institute: An Integrated Approach to Teacher Professional Development*" (Nadelson et al, 2012). *iSTEM* gathered regional and industry support while bringing in a group of stakeholders comprised of business, industry, non-profit, community-based organizations, government, K-12 educators, and higher education who have joined together to develop and implement an *i-STEM* statewide network initiative to enhance STEM Education in Idaho. By combining the research about how people learn, best instructional practices, and cognitive psychology; the structure and outcomes of the *i-STEM* professional development model has been successful in reaching nearly 1000 K-12 teachers in Idaho the past 3 years, bringing STEM exposure to more than 30,000 students annually.

Our research details evidence of how the structure and content of the summer institute has influenced the participants' comfort with teaching STEM, efficacy for teaching STEM, content knowledge of STEM, scientific inquiry and engineering design implementation in STEM, and perceptions of STEM. Additionally we posit that how STEM is conceived, defined, and taught varies widely and thus, we have developed a common curricular focused definition of STEM for our participants. We found trends that reflect a lack of knowledge with STEM related content and a lack of comfort with teaching STEM; specifically addressing these trends in the *iSTEM* summer institutes. In our project, we recognized the domain specific focus on STEM and at the same time convey and encourage an integrated perspective of STEM.

The *iSTEM* summer institute professional development program has been replicated and scaled across the State of Idaho, is being shared nationally, and has the potential to help many teachers prepare students. The *iSTEM* team is proposing to present a workshop/showcase describing the benefits of the *iSTEM* summer institute program, sharing research findings, sharing the benefits of enhancing teacher professional development in STEM subjects, and the potential to replicating this process.

2. *iSTEM* Workshop at STEM2012

The *iSTEM* team will present a workshop describing the benefits of the *iSTEM* summer institute program, sharing research findings, sharing the benefits of enhancing teacher professional development in STEM subjects, and the potential to replicate this process. In this workshop, participants will also engage in activities to help them better understand how STEM related topics can be integrated across the curriculum to include concepts generally taught in the isolate disciplines of science technology, engineering and math.

References

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