Learners in the 21st century will be required to exhibit understanding and skills that were unfathomable to us just twenty years ago.

Teachers face many challenging responsibilities. Perhaps most significant is engaging students in profitable learning activities through standards-based education. STEM education is an emerging trend that many believe may help teachers meet this challenge. This article is designed to provide a general overview of STEM education, describe the necessity for its growth, and offer practical examples of STEM in the hopes of inspiring teachers to consider how they might include STEM strategies into their professional development for the purpose of improving their curriculum and instruction. With this knowledge, perhaps teachers will be able to incorporate a new way to reach students.

What is STEM Education?
The National Science Foundation developed the word STEM as an acronym for science, technology, engineering, and mathematics. There are some who may use this acronym as the definition of STEM education. In other words, they would identify STEM by the separate subjects of which it is composed. However, this explanation is inadequate (Bybee, 2010; Salinger & Zuga, 2009). Rather, STEM education should be defined as an integrative approach to curriculum and instruction. It is best understood by removing any boundaries between the subjects and imagining them taught as one (Morrison & Bartlett, 2009).

The degree to which STEM is integrated is dependent upon many factors. A fully integrated STEM curriculum is most easily achieved at the elementary level, where students remain with a single teacher for a large portion of the day. An embedded STEM curriculum is perhaps more feasible at the secondary level. Within a broad context, embedded teaching may be defined as “situated approaches that emphasize the learning of domain knowledge through expert-like activities and authentic problem solving in rich social, cultural, and functional contexts” (Chen, 2001, p. 194). It is the continual, intentional practice of embedding STEM content in a secondary classroom/laboratory that enhances student understanding and application of material.

What Does STEM Education Seek to Do?
STEM’s perceived potential is to fulfill a student’s learning experience by aiding him or her in the ability to transfer learning (Berry, Reed, Ritz, Lin, Hsiung, & Frazier, 2004). Students can solve new problems and draw conclusions based upon previously learned principles applied through science, technology and engineering, and mathematics. It is suggested that implementing teaching strategies, such
as problem-based learning through a STEM curriculum, may reinvigorate students' desires to understand the world around them and engage them in classroom instruction (Havice, 2009).

As teachers, it should disturb us to know students' enthusiasm for their personal education is waning (Havice, 2009). They must be persuaded to reengage in their studies because many students are beginning to lose their natural inclination for learning and development at an early age. Yet students who are being exposed to integrated, problem-solving curriculum display increased engagement and satisfaction and express enjoyment in their classroom performance (Havice, 2009). This is encouraging and cannot be ignored.

Deslauriers, Schelew, and Wieman (2011) confirmed students become enthusiastic when problem-based instruction is incorporated. Their study sought to determine if an unconventional method of science instruction, which asked students to implement teamwork and problem-solving techniques, would compel students to engage in science education. The experiment showed that while students who participated in a traditional classroom setting did well enough on the post-test, those students who participated in the experimental group had better attendance, better classroom engagement, and higher post-test scores (Zambon & Lempinen, 2011).

Deslauriers, Schelew, and Wieman (2011) explain the brain does not process information as a sponge absorbs water. This belief is what has perpetuated the traditional style of instruction that is teacher-led. Rather, the brain learns through association and analysis. Therefore, it is recommended that teachers adopt a variety of methods of instruction, including one in which the students are actively engaged in the learning process. When utilizing an inquiry and problem-based method of instruction, the teacher spurs student creativity through questions, and students respond through collaborative discussion (Zambon & Lempinen, 2011).

Proponents of STEM education argue that its characteristics mirror the findings Deslauriers, Schelew, and Wieman (2011) described. Consider the following traits of a STEM program. First, it is integrated. Using a curriculum centered on principles from science, technology and engineering, and mathematics, students learn to apply previously obtained information to creatively address a problem they have never before encountered. Second, STEM education is inquiry-based. Distinct from the traditional classroom, which is typically lecture-based, a STEM classroom asks students to work together to solve problems by using questioning and answering techniques incorporated with research. Third, STEM incorporates teamwork and instruction in the “soft skills” needed for business and industry (Partnership for 21st Century Skills, 2003). Asking students to practice these skills promotes confidence and gives them insight into their own character as they become aware of personal traits they may not have realized they had, such as leadership skills. Fourth, STEM is appealing. Students enjoy classroom discussion and participation to solve a meaningful problem. Fifth, STEM education is fulfilling. Teachers are able to perceive themselves as facilitators of the learning process and not merely instructors.

Why STEM Education?
STEM education advocates argue it serves to benefit the economy by enticing more students into the study of STEM fields following secondary education. Over the past decade, China and India have grown as leading producers of engineers and technicians. In 2008, China generated 500,000 engineers and India 200,000. In comparison, the United States supplied 70,000 engineers to the workforce (Hughes, 2009). This trend is disconcerting to United States business and industry leaders and politicians alike. While the population totals are disproportionate, it is alarming to see the numbers of graduating engineers so low in the United States. This is significant because it is the engineering and technological fields that help drive the economy.

Innovation and invention are influential forces in the economy. These skills cannot be developed apart from an education system that prepares students to fulfill these demands. However, under the traditional method of classroom instruction, rather than attracting students to participate in STEM-related fields, we are seeing a growing disinterest in STEM majors. In fact, the United States is trying to reverse a decline in the student graduation rate from secondary schools. Currently, we are ranked 18th out of 24 industrialized nations in graduation rates, and falling. Twenty years ago, the United States was first among industrialized nations in percentage of population with a high school diploma and first with a college degree. Today, the United States ranks ninth in the percentage of population with high school degrees and seventh for college degrees (National Research Council, 2010). To be competitive in the global market, the United States must have a highly qualified workforce proficient in mathematics and the general sciences (National Academies Committee, 2010). However, this will not be realized without a reformed educational system and an educated society.
It is our school's responsibility to prepare students for the 21st century, and STEM skills are what they must have (Havice, 2009). STEM education is becoming the logical tool to impart these skills at the secondary level, and even at the primary level. Through exposure to STEM knowledge and practices, students will enhance their understanding and perhaps more students will participate in STEM-related careers.

How is STEM Education Being Implemented in the United States Today?

STEM has been a growing initiative for the past two decades, and states are attempting to make significant strides in its implementation. For example, Hawaii established a STEM academy on the island of Kauai through a pilot program based at the Kauai Community College, which will serve two public schools. Furthermore, they created the FIRST (Fostering Inspiration and Relevance through Science and Technology) program at the University of Hawaii College of Engineering, which is designed to create project-based learning programs for students in Grades 4 through 8. In conjunction, they planned a FIRST teacher training program at the University of Hawaii to develop middle school teachers' skills and knowledge in the STEM curriculum, with an emphasis on wireless communication (S.T.E.M., 2009).

Likewise, in an effort to create a quality workforce for his state, Minnesota Governor Pawlenty called for an increased rigor and relevance for science and mathematics curriculums. Pawlenty explained, “...too many of our students have been shut out of technology and engineering, and we must do a better job of offering higher-level science and math courses in high school that prepare students for college work and STEM careers” (Pawlenty, nd, para. 4). Similarly, just as states are promoting STEM education, school districts and classroom teachers are as well.

For instance, the Jackson County School District in Georgia has collaborated with the University of Georgia to encourage mathematics and science teachers to integrate subjects from Grades 6 to 12. Through regularly scheduled meetings and workshops, teachers are working to assist students by creating a continuum of knowledge both horizontally between subjects and vertically between grades. The project reports a significant improvement in state standardized testing scores at the middle school level. Students in secondary school showed improvement in algebra and geometry (Foutz, Navarro, Hill, & Thompson, 2011).

Classroom endeavors in STEM education are being implemented more frequently as well, such as in the study conducted by Zhe, Doverspike, Zhao, Lam, and Menzemer (2010). High school students participated in a ten-week summer program created to increase interest and self-confidence in the STEM fields. Four hands-on research projects were presented to the students. They were: Testing and Characterization of Modern Steel Components, Development of a Smart Balloon, Hybrid Car Powered by Water and Sunlight, and Strain Gage Sensor for Mechanical Infrastructure Health Monitoring.

Was the summer camp perceived as beneficial? There were 33 applicants who participated in the summer camp, of whom 21 were qualified to apply to college. All 21 applied and were accepted to college. Of the 21 who had decided on their major, 18 had selected a STEM major (Zhe, Doverspike, Zhao, Lam, & Menzemer, 2010). Thus, the camp was viewed as a tremendous success.

On a smaller scale, programs have been developed that incorporate robotics into the curriculum. Robotics is a technology that is increasing in demand by the private, military, and government sectors (Mosley, Liu, Hargrove, & Doswell, 2010). Creating practical application of academic material through robotics projects makes lessons exciting for students. Sites such as http://botbrain.com/index.html offer classroom sets of LEGO kits and curriculum suggestions to enhance teacher's STEM instruction.

Currently, technology and engineering educators who use curriculums such as Engineering by Design™ or Project Lead the Way are working with material that aligns with essential mathematics and science standards compatible to student grade levels. Activities incorporate hands-on, problem-based delivery techniques to introduce students to existing technologies, improve current technological methods, and encourage job skills pertinent to today's job markets. However, efforts to improve curriculum mapping must continue. While teachers incorporate mathematics and science content compatible to students' grade level, there is still a potential for students to not directly relate their current mathematics or science lesson to the issue being addressed in their technology and engineering class. STEM serves to bridge this gap. When technology and engineering educators incorporate recently learned mathematics and science content into the technology and engineering curriculum to address a current social issue, then STEM principles are being applied, and student understanding is enriched.
How does this look in a technology and engineering classroom? Technology and engineering students could be asked to design and develop a playground model to be presented to a local city council that not only promotes physical activity but enhances students’ education. Technology and engineering students could design and build model equipment based on a theme such as a replication of a particular biome. Playground equipment that resembles a tropical forest may encourage young children to climb like monkeys or sneak through tunnels like tigers. The equipment can meet regulations and intrigue children into participating. Pulleys, zip lines, climbing walls, and tunnels can be strategically placed on synthetic turf, which promotes useful water drainage to create an aesthetically pleasing playground. Socially, students are addressing childhood obesity issues through inspiring outdoor activity by designing and creating a playground that invites children to play. Academically, students are utilizing STEM content to generate their design.

How can technology teachers use these principles in their classrooms to excite students to learn about STEM fields and careers? Here are some suggestions:

• Incorporate professional development and personal learning activities that will enhance your ability to instruct as a STEM educator.
• Create student clubs and organizations centered on STEM activities.
• Join professional organizations, such as the International Technology and Engineering Educators Association (ITEEA), which provide teacher support and ideas.
• Research STEM projects that you are capable of producing in your class.
• Finally, become a master of STEM education and encourage others to do the same.

What is the Future of STEM Education?
The future for STEM education is exciting. Schools and teachers are seeing the benefits of implementing a curriculum that is applicable and relevant to students. Incorporating problem-based instruction effectively requires training; thus, administrators are beginning to endorse professional development and education initiatives for teachers in an effort to implement STEM programs in their schools. Technology and engineering educators are witnessing the potential for increased value to their fields. With a growing emphasis placed on the need for more technological and engineering understanding, now is an ideal time to reevaluate current technology and engineering education curriculums to ensure they meet this demand. If such curriculums included applicable science and mathematics information through technology and engineering, educators could become significant assets to the education system by generating a unique appreciation for specialized STEM knowledge through carefully designed programs.

Conclusion
STEM education is an integrated approach to education for the purpose of instilling creative problem-solving techniques in students and the development of future innovators. STEM education enhances a student's learning experience through application of general principles and practices. When incorporated properly, it should inspire creativity, inquisitive thinking, and teamwork. Furthermore, STEM education offers a viable solution to a potential threat due to a lack of fully qualified workers who can contribute to the global economy.

As teachers, it is important that we are knowledgeable about the demands on our students. Learners in the 21st century will be required to exhibit understanding and skills that were unfathomable to us just twenty years ago. Technology teachers have the responsibility of preparing students to be actively engaged in future endeavors. We cannot adequately meet that demand apart from an application of STEM education principles.

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