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The Need for STEM Education: Now More Than Ever!

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Abstract

Science, Technology, Engineering, and Mathematics, or STEM, are a part of all our lives and impact us daily. STEM education provides an opportunity to integrate two or more of the disciplines, which often leads to better student motivation and understanding of the materials being covered. Teachers at all grade levels who teach some aspects of STEM in their lessons are encouraged to add this teaching and learning approach into their classrooms. This article briefly discusses the components of STEM and STEM education and reviews important reasons for teaching about STEM. These important reasons note that STEM education is needed for global competitiveness, that it is involved in almost everything in our lives, and that STEM professionals working together will be needed to solve global problems.

Keywords: STEM, STEM education, global competitiveness, global problems, STEM standards, problem-solving, scientific inquiry, engineering design.

In May 2020, history was made in the United States (U.S.) as the National Aeronautics and Space Administration (NASA) teamed up with Space Exploration Technologies Corporation (known as *SpaceX)* to launch two Americans into space. SpaceX is a private American aerospace manufacturer and provided the equipment to launch Americans into space from American soil.

The purpose of this launch was to send American astronauts to the international space station (ISS). It was the first time in nearly a decade that Americans were launched into space from American soil. Previous to this launch, American astronauts were ferried to the ISS on Russian-made space rockets (i.e., Soyuz) (Kelly & Shannon, 2020). In early August 2020, the two NASA astronauts successfully splashed down in the Gulf of Mexico (Aerotech News, 2020).

In early 2020, the COVID-19 virus (i.e., *coronavirus disease,* [SARS-CoV-2]) became a pandemic that threatened global health. At the time of this writing (21 December 2020), there have been more than 17,000,000 cases in the U.S., more than 300,000 people have died from this virus, and the numbers continue to grow alarmingly. Globally, more than 1,600,000 people have died and there have been more than 76,000,000 cases (Johns Hopkins University, 2020). The virus has created a “new normal” around the world that consists of such practices as social distancing, frequently washing one’s hands, and wearing face masks. Currently vaccines by Pfizer and Moderna have been approved and are being distributed in limited numbers. Vaccinations have begun in other countries as well, including the United Kingdom and Germany. However, there are still more than 50 vaccines being tested by research professionals from around the world are working to find one as this virus has impacted lives around the globe (World Health Organization, 2020).

The two different events discussed above have one thing in common, they have demonstrated the need for Science, Technology, Engineering, and Mathematics or STEM professionals to work together. As Bybee (2018) notes in his discussion on 21st Century challenges (e.g., climate change, clean water, the vulnerability of the Internet, and energy efficiency), people seeking solutions to these problems will look at least somewhat to STEM (p. 6).

STEM is a part of all of our lives and impacts us on daily basis. It impacts our food, our transportation, our housing, and how we communicate. For example, a plastic bottle of drinking water has been influenced by each of the disciplines of STEM. *Science* has been involved in purifying the water and its taste. The bottle and cap are results of *technology. Engineering* has been involved in making the machines to fill, cap, and label the bottles. *Mathematics* has been involved in calculating the diameter of the bottle, its thickness, and the amount of liquid it will hold. However, in the water drinking water bottle example, STEM has not worked in isolation; it has required that professionals from all disciplines work together in such areas as design and safety to produce a product (i.e., bottled water) to meet consumer needs and wants. Today, students need to learn about STEM more than ever.

Why STEM Education?

The need for STEM education may best be summarized by the National Science Foundation, which in 2007 noted:

> In the 21st century, scientific and technological innovations have become increasingly important as we face the benefits and challenges of both globalization and a knowledge-based economy. To succeed in this new information-based and highly technological society, all students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past (p. 2).

In the U.S., STEM education is promoted by many states and government organizations. For example, the U.S. Department of Education (n.d.) notes:

> In an ever-changing, increasingly complex world, it's more important than ever that our nation's youth are prepared to bring knowledge and skills to solve problems, make sense of information, and know-how to gather and evaluate evidence to make decisions and these are the kinds of skills that students develop in STEM. (para. 1)

The need for all students (i.e., Primary – Grade 12) to learn about STEM in their studies is now more important than ever. The author suggests that the three main reasons today why all students should learn about STEM are the following:

- It is needed for global competitiveness.

- It is involved in almost everything in our lives.
- It is needed to solve global problems.

This article will review each of these in more detail below. However, before examining these reasons, the author will provide a brief review of STEM education, including how it is defined, its components, content standards, and its benefits.

What is STEM Education?

STEM education has been defined in many contexts. However, it typically refers to teaching the components of STEM in an integrated manner, which may help students better learn the topic being presented. It is about teaching the content, practices, and processes that STEM uses to meet human needs and wants and to solve real-world problems. STEM can be taught in most subject areas, but it is perhaps best taught in one of the areas (e.g., science or technology and engineering education) where teachers have had specific training in one or more of the STEM disciplines. Regardless of what level it is taught, STEM education may require teachers to learn (e.g., through professional development) new concepts, content, or practices that may be "outside their area of expertise."

The *Southeast Asian Ministers of Education Organization* (SEAMEO) STEM-ED Center (SEAMEO STEM-ED, n.d.a) provides a good definition of STEM education as:

> a teaching and learning approach, which emphasizes the connections among – or the integration of – knowledge and skills in science, technology, engineering, and mathematics (STEM) to address problems facing our communities as well as larger global issues that require a skilled workforce and knowledgeable citizens who can apply these skills and knowledge to develop solutions. (para. 1)

The *International Technology and Engineering Educators Association* (ITEEA) is a professional organization for technology, innovation, design, and engineering educators. They define what they identify as *Integrative STEM Education* (ITEEA, n.d.). In their definition, they have operationally defined Integrative STEM Education as:

> the application of technological/engineering design-based pedagogical approaches to intentionally teach content and practices of science and mathematics education through the content and practices of technology/engineering education. Integrative STEM Education is equally applicable at the natural intersections of learning within the continuum of content areas, educational environments, and academic levels (Wells & Ernst, 2012/2015), (as adapted from Wells/Sanders program documents 2006-10). (para. 1)

In addition to STEM education, the literature may mention the need for STEAM education (i.e., adding the arts to STEM) or even the need for STREAM education where the "R" may refer to Reading, "wRiting," or Research. The author contends that all of these (i.e., the arts, reading, writing, and research) are important, but that they are all inherent in STEM Education. For example, when designing a consumer product, the designers and engineers will not only make sure it functions correctly but that it is aesthetically pleasing (i.e., following good art and design principles).

Effectively teaching STEM Education begins with a good understanding of the components of STEM. The ITEEA *Standards for Technological and Engineering Literacy - STEL* (ITEEA, 2020, p. 21) describes them as follows:

> **Science** involves the investigation and understanding of the natural world.
>
> **Technology** is the modification of the natural environment through human-designed products, systems, and processes to satisfy needs and wants.
>
> **Engineering** is the use of scientific principles and mathematical reasoning to optimize technologies in order to meet needs that have been defined by criteria under constraints. (*Engineers create technology!* - Author added).
>
> **Mathematics** enables communication and critical analysis and how we make sense of the human and natural world using numbers and computational reasoning.

STEM education is not a class, it is a culture that instructors build in their classrooms. It is an integral part of today's jobs and past jobs (Wood, 2020). The National Science Teaching Association (NSTA, n.d.) takes a position that it is "an experiential learning pedagogy in which the application of knowledge and skills are integrated through in-context projects or problems focused on learning outcomes tied to the development of important college and career readiness proficiencies" (para. 1).

STEM education is a teaching and learning approach that presents students with real-world problems and challenges to solve. It is student-centered learning where instructors serve as mentors to help guide students in finding solutions to their problems or answers to their questions. STEM education helps develop analytical skills in students. Doyle (2020) notes that analytical skills "refer to the ability to collect and analyze information, problem-solve, and make decisions" (para. 1).

In the U.S., there is no national curriculum and each state typically has a department of education that directs the curriculum offerings. However, most states recognize the importance of STEM in their states and more than half of them have developed websites that provide resources to support STEM education (e.g., see https://www.pta.org/docs/default-source/files/programs/stem/2017/math-night-toolkit/stem-families-resources-stem-by-state.pdf).

Although there is no national curriculum in the U.S., professional organizations and associations have developed international or national standards that identify the content to teach. Today most states will review these standards as they develop curriculum offerings for their state. The content to teach in these STEM standards can be freely accessed on the Internet. National/International content STEM standards include the following:

- **Science.** *Next Generation Science Standards (NGSS)*: https://www.nextgenscience.org
- **Technology and Engineering.** ITEEA *Standards for Technological and Engineering Literacy: Defining the Role of Technology and Engineering in STEM Education (STEL)*: https://www.iteea.org/stel.aspx
- **Mathematics.** *Common Core State Standards Initiative*: http://www.corestandards.org/Math

Moving STEM education forward will require a strong collaboration of those involved. Recently major national/international organizations involved in STEM education (i.e., Advance CTE, the Association of State Supervisors of Mathematics, the Council of State Science Supervisors, and the International Technology and Engineering Educators Association) published a joint document entitled *STEM^4: The power of collaboration for change* (n.d.). In this document, they identified three main principles to drive and implement outstanding STEM education research and practices. To help move STEM education forward in P-12 education, these principles provide stakeholders with sound advice to follow. The three main principles noted in the report to drive STEM education include Principle 1: STEM education should advance the learning of each individual STEM discipline, Principle 2: STEM education should provide logical and authentic connections between and across the individual STEM disciplines, and Principle 3: STEM education should serve as a bridge to STEM careers (p. 3).

Scientific Inquiry and Engineering Design

Important in the teaching of STEM education are the practices associated with scientific inquiry and engineering design that provide students with investigative hands-on learning experiences. Students learn best "by doing" and when they engage in scientific inquiry and engineering design, they are often better motivated to learn the materials being presented and gain a deeper understanding of how STEM is integrated. Well-designed STEM education activities promote doing, problem-solving, and using 21st Century skills such as the 4C's (i.e., critical thinking, communication, collaboration, and creativity) that have been promoted by P21's Frameworks for 21st Century Learning (Battelle for Kids, 2019), among others. They can also be used to promote empathy, systems thinking, and teaching students about the global world they live in (Kaiser, 2020).

Engineering design and science inquiry share several similar features, but there are some differences, especially when considering the constraints related to solving the question asked (science) or problem presented (engineering), (LinkEngineering, n.d.). As Sneider (2015) notes, "if they are trying to answer a question, they are doing science. If they are trying to solve a problem, they are doing engineering" (p. 3). However, both engineering design and scientific inquiry promote student learning of key analytical skills such as doing research and analyzing data. Shown in Figure 1 is a comparison of the practices of engineering design and scientific Inquiry

Scientific Inquiry in the most basic sense involves asking questions about how something works in the natural world and collecting evidence to propose explanations related to the experience (e.g., finding out at what temperature water boils at different elevation levels). Important in scientific inquiry is the collection, analysis, and interpretation of data. Teachers who use scientific inquiry in the classroom present students with scientific questions that spark their curiosity and creativity to find answers related to natural phenomena using scientific practices (e.g., scientific methodology) (National Research Council, 2000).

Engineering design is a problem-solving approach to solve real-world problems and challenges presented to students. Scientists investigate the natural world and engineers create technology. There are many engineering design process models, but most involve similar steps that require students to define and research the problem, propose solutions to the problem, build and test prototypes related to the problem and present their solutions. When teachers present engineering design challenges to students, they let them know that it is all right to fail and that there are typically many different solutions to the problem presented.

Figure 1

Comparing the Practices of Engineering Design and Scientific Inquiry

Practice *Engineering Design*	**Practice** *Scientific Inquiry*
Focus: Identifying and solving problems in the real-world; Developing/creating new products, processes, and systems.	Focus: Asking questions in the natural world; Developing new theories; Explaining phenomena.
Research: Collecting research data related to the problem or challenge.	Research: Collecting research data related to the observed phenomenon.
Working under criteria and constraints.	Working under the laws of nature.
Proposing solutions; Building a model or prototype;	Proposing explanations; Testing a hypothesis; Performing an experiment under controlled conditions
Collecting and analyzing data; Testing and redesign as needed.	Collecting and analyzing data.
Sharing results (e.g., the prototype).	Sharing results (e.g., drawing a conclusion).

The author agrees with Jolly (2017) who notes that “STEM develops a set of thinking, reasoning, teamwork, investigative, and creative skills that students can use in all areas of their lives” (paras. 5-9). She also provides six characteristics of great STEM lessons that should be considered as instructors develop STEM curricula and learning experiences. These characteristics note that STEM lessons:

- should focus on real-world issues and problems;
- are guided by the engineering design process;
- immerse students in hands-on inquiry and open-ended exploration;
- involve students in productive teamwork;
- apply rigorous math and science content the students are learning;
- allow for multiple right answers and reframe failure as a necessary part of learning.

She further notes that an online search of "STEM lessons" will yield plenty of results. Today there are many examples of websites that provide good STEM lessons. Here is a sampling: Teach Engineering (https://www.teachengineering.org), Design Squad (https://pbskids.org/designsquad), NASA's Beginning Engineering, Science and Technology (https://www.nasa.gov/audience/foreducators/best/index.html), STEM Works (http://stem-works.com), Science Buddies (https://www.sciencebuddies.org), Engineering Go for it (http://teachers.egfi-k12.org), and Microsoft Education (https://www.microsoft.com/en-us/education/education-workshop).

Benefits of STEM Education

There are many benefits associated with STEM education. The author believes that those who learn STEM in an integrated approach are provided with an opportunity to see the "big picture" (i.e., how STEM is connected to the concepts or practices being learned). For example, in a STEM learning activity about wind power, students may be asked to build a wind turbine. In this activity, students will learn about renewable energy (science), and the consequences related to building wind turbines in a community (impacts of technology). Given a design challenge (engineering) with identified criteria and constraints, students will be asked to design and build a wind turbine (technology). Students will work in groups to build a prototype that creates blades to maximize the efficiency of their turbines. The wind turbine could be developed to either generate electricity via a motor (i.e., converting kinetic energy to electrical energy) or lift a weight via a drive shaft. Both models can be used to calculate the number of watts generated by the students' blades and the speed at which the turbine generates mechanical energy (science). Students can test their designs (collect and interpret data) by adjusting the size (area – math) of the blades, the shape, angle, and length of the arm (radius - math), to analyze which designs work most efficiently (Northeastern University Center for STEM Education, n.d.).

Others further identify the benefits associated with STEM Education. For example, The National Inventors Hall of Fame (n.d.) discusses the idea that STEM-based education teaches children more than science and mathematics concepts; it helps them develop real-world learning applications and needed 21st Century skills (e.g., technological literacy, problem-solving, critical thinking, collaboration, decision making, and leadership). Furthermore, Lynch (2019, paras. 2-9) notes the following benefits of STEM Education:

- It fosters ingenuity and creativity. Without ingenuity and creativity, the recent developments in artificial intelligence or digital learning would not be possible. These technologies were created by people who learned that if the human mind can conceive it, the human mind can achieve it.
- It builds resilience. Students learn in a safe environment that allows them to fail and try again.
- It encourages experimentation. Without a little risk-taking and experimentation, many of the technological advancements that have occurred in the last couple of decades would not have been possible. STEM encourages students to "try it and see what happens."
- It encourages teamwork. STEM education encourages students to work together (collaborate) in teams to find solutions to problems, record data, write reports, give presentations, etc.
- It encourages knowledge application. In STEM education, students are taught skills (e.g., problem-solving) that they can use in the real world and this motivates them to learn.
- It encourages the use of technology. STEM learning teaches kids about the power of technology (e.g., computers, 3-D printers, data collection devices, etc.) and to embrace them instead of being hesitant or fearful.
- It teaches problem-solving. STEM education teaches students how to solve problems by using their critical thinking skills (e.g., by brainstorming many solutions to a given problem).
- It encourages adaptation. STEM education teaches students to adapt the concepts and practices they learn to new problems, issues, or challenges that they face.

Another important benefit of STEM education is that it can introduce students to career opportunities in STEM. STEM jobs help keep a nation competitive and create new goods and services through research and development that can improve the overall quality of life.

The Need for STEM Education

STEM is Needed for Global Competitiveness

The need for STEM education arose from many countries' realizations that to stay competitive in the global economy, a STEM-educated workforce would be needed. For example, in the U.S., STEM has been recognized as a national agenda item: In 2018, the National Science and Technology Council's (NSTC) Committee on STEM Education (CoSTEM) released *Charting a Course for Success: America's Strategy for STEM Education,* which is a five-year strategic plan for STEM education (National Science and Technology Council, 2018). The strategic plan presents a vision for a future where all Americans will have lifelong access to high-quality STEM education and the U.S. will be the global leader in STEM literacy, innovation, and employment. The three major goals associated with the plan include the following:

- **Build Strong Foundations for STEM Literacy** by ensuring that every American has the opportunity to master basic STEM concepts and to become digitally literate.
- **Increase Diversity, Equity, and Inclusion in STEM** and provide all Americans with lifelong access to high-quality STEM education, especially those historically underserved and underrepresented in STEM fields and employment.
- **Prepare the STEM Workforce for the Future**—both college-educated STEM practitioners and those working in skilled trades that do not require a four-year degree—by creating authentic learning experiences that encourage and prepare learners to pursue STEM careers (p. v).

The goals listed above are important for all nations to consider as they develop and deliver STEM education. In addition, the report notes the importance of developing partnerships between schools and local businesses to bolster work-based learning and encouraged helping students learn STEM concepts through project-based learning, solving real-world problems, and boosting digital literacy. The term "digital literacy" has many interpretations. Heitin (2016) notes that the *American Library Association's* digital-literacy task force defines it as "the ability to use information and communication technologies (ICT) to find, evaluate, create, and communicate information, requiring both cognitive and technical skills" (para. 4).

In Europe, the *European Schoolnet* has recognized the importance of STEM Education. The European Schoolnet is a network of 34 European Ministries of Education and has noted that "skills in STEM are becoming an increasingly important part of basic literacy in today's knowledge economy" (European Schoolnet, n.d.). They have been involved in more than 30 STEM education initiatives, including *The STEM Alliance* (http://www.stemalliance.eu) that brings together industries, ministries of education, and education stakeholders to promote STEM and STEM careers to young Europeans and address anticipated future skills gaps within the European Union and *Scientix* (http://www.scientix.eu) that promotes and supports a Europe-wide collaboration among STEM teachers, education researchers, policymakers, and other STEM education professionals.

In ASEAN, (i.e., the *Association of Southeast Asian Nations*) it appears the teaching of and need for STEM education are still emerging. For example, Chen (2017) notes that ASEAN promotes multilateral cooperation, economic growth, and social progress, and to be a key player in the marketplace must promote developing a STEM workforce. In 2019, the World Economic Forum released the report entitled *ASEAN Youth Technology, Skills, and the Future of Work*. Based on a survey of 56,000 youths aged 15-35 years old from six countries the report noted that "ASEAN youths believe they are more competent in soft skills than in hard skills," and ASEAN youth regard their weakest skills as those in the STEM areas (e.g., technology design, data analytics, and math and science (p. 14). However, the report noted the strong desire from ASEAN youths to work in the technology sector. If their desire is to work in the technology sector, ASEAN countries must continue to recognize the importance of STEM education and prepare its youth in the STEM subjects.

SEAMEO is a collaboration of the 11 Southeast Asian education ministers, who have acknowledged the importance of STEM and in 2019 established the SEAMEO Regional Centre for STEM Education (SEAMEO STEM-ED) in Bangkok, Thailand. This center can help prepare youth in many ASEAN countries as the goals of the center are to develop, maintain, and continuously strengthen capacities in STEM education, serving as a regional knowledge repository and creator through high-quality research in STEM education both in Thailand and within the SEAMEO region (SEAMEO STEM-ED, n.d.b)

The importance of STEM education seems to be recognized around the globe. In addition to the U.S., Asia, and Europe, STEM is recognized as being very important in most countries today. For example, the Australian Government regards high-quality STEM education as critically important for their current and future productivity, as well as for informed personal decision making and effective community, national, and global citizenship and have developed a strong set of *School STEM Initiatives* to increase engagement in STEM (Australian Government, n.d.).

In Africa, where nearly 17% of the world's population lives (Worldmedia, n.d.) STEM education is still evolving as the region is challenged by such things as poverty, poor health, lack of infrastructure, and food insecurity, which are traceable to Africa's low investment in science, technology, and innovation (ADEA, n.d.). UNESCO's 2017/18 Global Education Monitoring Report entitled *Accountability in Education: Meeting our Commitments* notes that "only 22% of primary schools in sub-Saharan Africa have access to electricity" (p. 226) and very few have internet access (p. 380) (UNESCO 2017/2018). In its discussion on STEM education in Africa, STEMpedia (2019) recognizes the importance of STEM education and notes that Africa "has the potential to contain some of the world's fastest-growing economies, but it can only compete with the rest of the world if it invests in STEM education for young people (p. 1). This is supported by the Association for the Development of Education in Africa (ADEA) and their Inter-Country Quality Node on Mathematics and Science Education (ICQN-MSE) unit who has developed strategic objectives that promote STEM Education. These objectives are 1) Promote African-led mathematics and science education platform to advance the adoption of policies and practices including ICT integration in education, 2) Foster regional cooperation in the utilization of interventions and practices to strengthen individual, institutional, and societal capacities to advance STEM education, and 3) Leverage diverse sustainable partner networks for STEM education to promote exchange and knowledge sharing among educators in Africa (ADEA, n.d., para. 10) and if realized, they can help advance STEM education in Africa.

Technology is more than computers and the Internet. Technology is about modifying the natural world to meet human needs and wants. A popular technology today is the smartphone, but technology (e.g., an ax or spear) has existed since the beginning of humankind. Technology is part of STEM and it changes rapidly. With these changes come new STEM careers that may appeal to students and help to keep a country globally competitive. To learn about these new jobs, teachers should keep informed about new technology and their related careers. For example, Duggal (2020, paras. 4-27) provides a discussion of eight new technology trends for 2020 that students may find appealing in which to pursue a career. These trends include:

- Artificial Intelligence (AI);
- Machine Learning;
- Robotic Process Automation or RPA;
- Edge Computing;
- Virtual Reality and Augmented Reality;
- Cybersecurity;
- Blockchain;
- Internet of Things (IoT).

STEM is involved in Almost Everything

STEM is ubiquitous and impacts almost all aspects of our lives. Students who learn about STEM and how it is integrated become informed consumers who can make knowledgeable decisions about the goods and services they use or may someday come to rely on. For example, STEM is involved and necessary in the development of new electronic products and systems (e.g., smartphones, wireless networks, computers, and artificial intelligence). STEM makes possible safe and efficient transportation systems that move people and goods locally and globally, communication systems to keep us informed, and all aspects of healthcare require workers who possess good knowledge and skills in STEM.

The basics people need to survive are food and shelter. The production of both require knowledge and skills in STEM, especially to ensure our safety. Agriculture (i.e., “the art and science of cultivating the soil, growing crops, and raising livestock,” [National Geographic, n.d.]) provides us with food and is reliant on STEM to make sure our food is safe and abundant for all. Today’s agriculture production provides us with foods, fuels, fibers, and raw materials (Chait, 2020), and STEM is typically needed in all aspects of production. For example, students who learn about STEM and its role in agriculture may be able to better understand the making of “plant-based meat substitutes,” the problems associated with pesticides and fertilizers, or how farming in water (i.e., hydroponics and aquaculture) can be used in food production.

The building of shelters relies heavily on workers who have good STEM knowledge and skills. The building of houses, apartments, condominiums, or hotels requires STEM professionals to develop and build safe structures and install systems (e.g., electrical, water, waste, communication, and heating and cooling) to meet daily living needs.

STEM is involved in almost everything. From cooking and cleaning, to making movies, or building cell towers, STEM has touched some aspect of it. Today's education at all levels should introduce students to the role of STEM in their lives and introduce them to STEM-related careers.

STEM is Needed to Solve Global Problems

In 2018 the world witnessed a Thai boys' soccer team trapped in a cave in Northern Thailand that became flooded. That incident became a world-wide story as STEM professionals from around the world came together to solve the problems of getting the 13 trapped team members out of the flooded cave. It took the knowledge and practices of science, technology, engineering, and mathematics to safely get all the members of the team and their coach out of the cave and it was successfully achieved. In the rescue of the trapped team, lots of STEM knowledge and practices were used. For example, technology and engineering were needed to pump water out of the cave, bring fresh oxygen to the team, and set up ways to communicate with the team. Science was used to study the geology of the cave, for example using technology such as drones, zoom lenses, and thermal cameras to create 3-D aerial maps (Mirchandani, n.d.).

Knowledge of science was also needed to develop the compressed air for the rescuers to breathe and was needed in the development of the sedatives used to relax the trapped team members for their journey out of the cave. Mathematics was used to measure water flow rates, time, and distance. As Uppuluri (2018) notes, "the power of science and technology made it possible for this team to be brought to safety" (para. 6).

There are many global problems the world faces that will require STEM professionals to solve. The most pressing at the time of this writing is the global coronavirus disease (COVID-19) pandemic where STEM professionals from around the world are working to find a vaccine. However, this is not the only global problem the world faces. For example, in 2008 the National Academy of Engineering (NAE, n.d.) identified *14 Grand Challenges for Engineering in the 21st Century.* These challenges (e.g., make solar energy economical, provide energy from fusion, provide access to clean water, or engineer the tools of scientific discovery) are still relevant today and most will require STEM professionals from around the world to find solutions to the problems.

The Bill and Melinda Gates Foundation (n.d.) has identified a set of global grand challenges to solve global health and development problems (e.g., increasing demand for vaccination services) and most of these problems will need to be solved by STEM professionals working together to develop innovative solutions to the problem. Also, the United Nations (n.d.) has listed a set of global issues (e.g., food and water) and a set of 17 global goals (https://www.globalgoals.org) that the world needs to address and most of these will require knowledge and skills in STEM. Hutt (2016) from the World Economic Forum lists 10 key global challenges (e.g., food security and healthcare) that will require cooperation from STEM professionals to solve. Nebehay (2020) discusses how the United Nations notes that natural disasters (e.g., drought, floods, earthquakes, tsunamis, wildfires, and extreme temperature events) have surged in the past 20 years and that they are likely to continue to wreak havoc in the world. World disasters will continue to challenge STEM professionals to develop proper warning systems and ways to quickly deliver help to those affected by the disaster.

Those who teach some aspects of STEM should introduce STEM-related global problems into the curriculum for students to solve. For example, Gentile and Hoke (2011) looked at global problems as a framework for integrated STEM learning in the first year of college and note that "the major scientific challenges of the twenty-first century will require interdisciplinary teams to collaborate using tools from a variety of disciplines" (para. 1). To address this situation, they developed a first-year course called Integrated Quantitative Science (IQS) that incorporated first-semester content in biology, chemistry, physics, mathematics, and computer science. Although there were some challenges, they viewed the course as successful as the course deliberately integrated the STEM disciplines in the context of global issues, both in the classroom and in the undergraduate research experience.

Conclusion

Today, STEM is involved in almost all aspects of daily life. Beginning at an early age, students need to learn about STEM and how it impacts their lives. Learning about STEM may help students better understand the topic being presented and get them interested in pursuing a career in a STEM-related field.

Teachers who include some aspects of STEM in their lessons must accept the challenge of making STEM integrated into their teaching and learning experiences. STEM integration is a method of teaching that purposely tries to show how the areas of STEM are connected and it promotes the use scientific inquiry and engineering design by instructors in the development and delivery of lessons that often challenge students to find solutions to real-world problems.

Most primary – grade 12 teachers, whether they realize it or not, are very likely teaching some aspects of STEM in their curriculum and lessons. The author challenges them to learn more about the concepts and practices of STEM and integrate them into the materials being presented. For example, having students complete a hands-on real-world engineering design challenge is not only motivating and fun, but it can help improve student learning. It can also help students develop the problem-solving and other 21st Century skills they need to compete and survive in the global economy while integrating science, mathematics, and technology.

The author believes that the need for STEM education is now more important than ever and has offered reasons why all students (i.e., Primary - Grade 12) today need to learn about STEM in their studies. The reasons presented include that STEM education is needed for global competitiveness, that it is involved in almost everything, and that STEM professionals working together will be needed to solve global problems. Also important is how STEM education promotes student learning of key analytical skills that will be needed to compete in today's (and tomorrow's) global economy.

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