Empowering girls in STEM

Diversity and inclusion for girls

Contents

A: Introduction

1. What is STEM?

STEM is an acronym for Science, Technology, Engineering, and Mathematics. The term was initially introduced in 2001 by the US National Foundation (NFS). This foundation previously used the terms “SMET” and “METS” in the 1990s but decided to go by STEM eventually. You may have also heard STEAM, which stands for STEM plus Arts.

STEM is a common abbreviation for four closely connected areas of study: Science, Technology, Engineering and Mathematics. The fields are often associated due to the similarities that they share both in theory and in practice. STEM is an interdisciplinary approach to learning and problem solving that focuses on bringing together these four areas of study.

Advances in science, technology, engineering, and mathematics are projected to be the driving force of the future economic and overall well-being not only for advanced economies but also for growing economies worldwide. (Salami)

STEM education prepares learners to be key contributors to society in our ever-changing world. It is definitely essential for advancing technology, driving innovation, and improving our understanding of the world around us. Specifically, STEM education encourages critical thinking, creativity, and innovation in order to address real-world challenges and develop solutions.

B: STEM Education

1. Adopting STEM practices for teachers is a challenge

Integrating engineering and technology concepts into science and math curricula through engineering design project-based learning has been found to increase students' interest in science, technology, engineering, and mathematics (STEM), however preparing teachers to shift to interdisciplinary teaching remains a significant challenge.

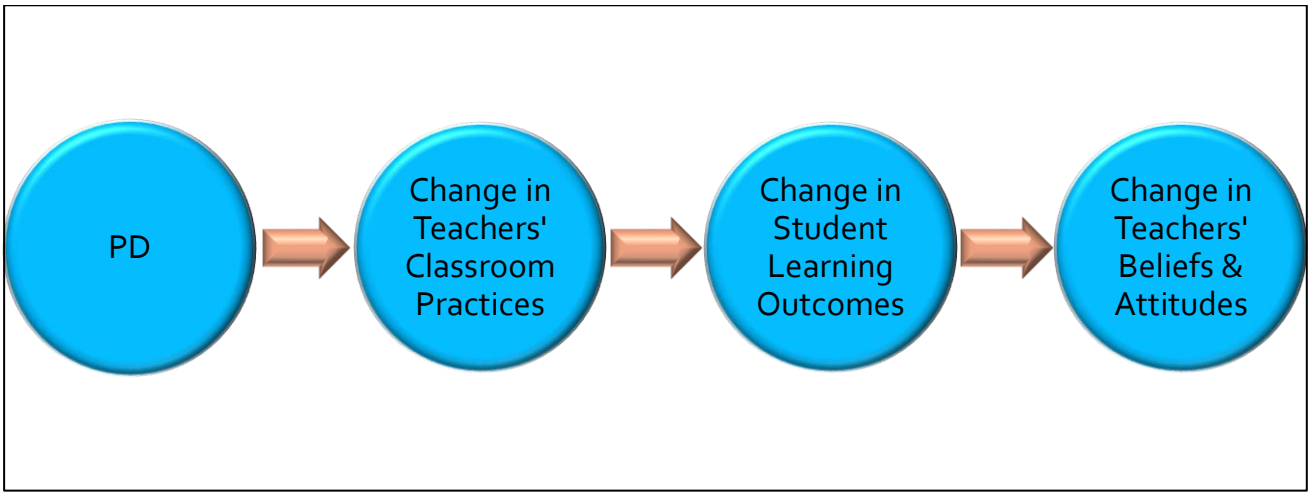
Primarily, teachers need to develop both skills and attitudes toward interdisciplinary teaching. In doing so, professional development (PD) is considered a key component in helping teachers through this transformation process. In an educational environment of accountability, measuring the effects of PD programs on teacher behaviors and capacity is essential but often elusive.

A program about 'Assessing changes in teachers' attitudes toward interdisciplinary STEM teaching' supported by a National Science Foundation Grant, held at Colorado State University, USA, in October 2015. As part of the programme, a research was conducted, the aim of which was to assess changes in attitudes towards interdisciplinary teaching, attitudes towards teamwork, teaching satisfaction and resistance to change. (Salami)

According to the findings of the research, one-year period is not enough for a significant change in attitudes within teachers' PD. The requirement of time and energy to learn the new practices and to plan for implementing them add to teachers' workload, bring a certain amount of anxiety (or a certain stress), so teachers might become reluctant to adopt new practices. Therefore, teachers do not change their practices quickly. Undoubtedly, change requires both time and effort.

Professional development depends mainly on ''teacher attitudes toward several shifts (or many changes) in teaching practices''. This determines the level of their commitment to infuse engineering principles and design into daily classroom practices. To enhance students' perceptions of and interests in STEM, teachers need to develop positive attitudes toward teaching beyond their disciplines, positive attitudes toward collaboration with other teachers, and willingness to change current instructional strategies.

A model of teacher change



Specifically, in this research, a model of teacher change is presented (Guskey, 2002a, b). According to this model, teachers change their beliefs and attitudes toward a new teaching approach or toward a new curriculum after they see it work. Significant change in teachers' attitudes and beliefs occurs primarily after they obtain (or gain) evidence of improvements in student learning. These improvements typically result from changes teacher have made in their classroom practices - a new instructional approach, the use of new materials or curricula, or simply a modification in teaching procedures or classroom format.

2. Benefits of STEM Education

STEM Education is rapidly gaining recognition for its role in shaping the future of education and the global economy. In an ever-evolving world, STEM equips students with essential knowledge and vital 21st-century skills such as critical thinking, creativity, collaboration, and problem solving.

STEM Education offers various benefits, both for students and society as a whole. Not only equips students with the knowledge and skills needed for a wide range of careers but also plays a crucial role in driving technological advancements, economic growth, and addressing global challenges.

The key benefits of STEM Education will be highlight below. STEM Education:

- Increases Innovative Thinking
- Encourages Curiosity
- Inspires Creativity and Ingenuity
- Fosters Collaboration and Communication
- Builds Confidence and Teaches Acceptance of Failure
- Prepares Students for High-Demand Careers

Increases Innovative Thinking

In an era of swift technological and engineering advancements, emphasizing STEM education is crucial for the future. According to the Pew Research Center, STEM employment has surged by an astounding 79% since 1990, surpassing the growth rate of other professions by a significant margin. This is primarily due to the fact that STEM education equips students with the skills to address and prevent contemporary societal challenges through creative problem-solving. By engaging in hands-on experimentation, students acquire fresh perspectives for observing, analyzing, and resolving complex problems. Whether it's in the fields of engineering, computer technology, or basic mathematics, students are empowered to identify obstacles and tackle them with innovative and unconventional approaches.

Encourages Curiosity

Disciplines involving the need for problem solving inherently prompt individuals to ask, "How can we resolve this, and what's the rationale behind its effectiveness?" Cultivating a setting that promotes inquiry serves as a catalyst for kindling a sense of curiosity in students, regardless of their age. Encouraging inquisitiveness not only sparks exploration, imagination, but also fuels the motivation to unearth fresh insights.

Inspires Creativity and Ingenuity

Complicated challenges frequently demand inventive resolutions, prompting students to develop both critical and creative problem-solving skills. STEM-oriented activities that are open-ended encourage creativity by inspiring students to apply their imagination and available resources to interpret the situation. Supporting this, a study conducted by 29 physics teachers in Indonesia revealed that integrating STEM concepts into activities enhanced students' creative abilities.

Fosters Collaboration and Communication

The majority of STEM professions do not operate in isolation. Constructing bridges or validating hypotheses both require collective efforts, as opposed to individual endeavors. Collaborative projects, particularly in STEM areas, offer students the opportunity to work together on intricate issues and develop essential interpersonal competencies. Additionally, these projects provide instructors with insights into their students' abilities in terms of communication, negotiation, and leading group discussions. This peer-to-peer cooperation equips them with the skills needed to excel in any domain where effective communication and positive leadership with people are fundamental.

Builds Confidence and Teaches Acceptance of Failure

While it might not be immediately evident, the fact remains that success and failure are intertwined. To arrive at the right solution to a problem, the process frequently involves eliminating incorrect answers. Through experimentation, students come to understand that success is not guaranteed every time, but more importantly, it teaches them to derive valuable lessons from their failures. Embracing failure represents a vital skill applicable in academic settings, professional careers, and our personal lives. What's more, it amplifies

the joy of success. Discovering the solution after experiencing multiple setbacks serves as a source of motivation for students to persist and maintain self-belief, even when the odds appear to be stacked against them.

- Prepares Students for High-Demand Careers

Nurturing a genuine enthusiasm for STEM subjects can steer students towards potentially rewarding and life-altering career paths. According to data from the Bureau of Labor Statistics (BLS), the typical income for individuals in STEM professions amounts to $95,420, which surpasses the national average for non-STEM jobs, standing at approximately $40,120, by more than double. The BLS also projects a robust growth of 10.8% in STEM job opportunities until 2031, compared to a more modest 4.9% increase anticipated for non-STEM vocations during the same period. Regardless of the specific STEM field students are preparing to enter, they can expect to discover promising job prospects along with commensurately high earnings.

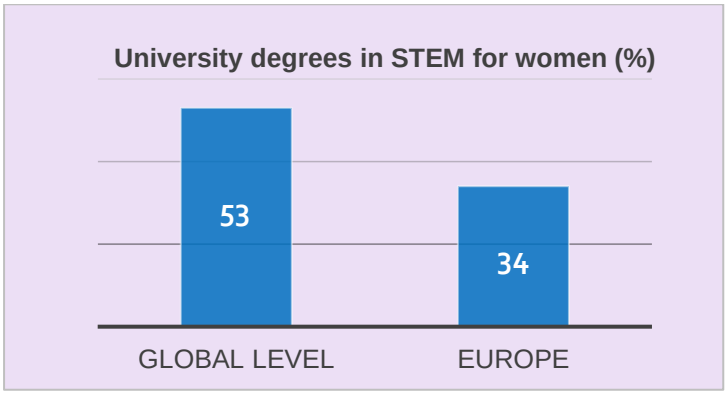
3. Is there a lack of women in STEM fields?

Is there an underrepresentation of women in STEM fields? Despite the expanding opportunities within STEM occupations, there is typically a noticeable gender gap, with fewer women participating compared to men. This phenomenon can be traced back to the disparity in the number of STEM degrees earned by women. Examining the statistics on women and their attainment of STEM degrees is crucial for gaining insights into the composition of these industries and the level of female representation within them.

In spite of the remarkable progress made in recent decades, the global number of female researchers in the field of science is still very small. In July 2019, the average global rate of female researchers was only 29.3% (UNESCO Institute for Statistics). The gap widens as one moves up in ranking. In fact, only 3% of science-related Nobel Prizes have been awarded to women. Some of the higher-income STEM occupations, such as computing and engineering, have the lowest percentages of female participation in their labour force.

Based on recent studies (see articles **2022** and **2023**), women obtain 53% of STEM university degrees at a global level (Sirimanne 2019). However, in the EU only 34% of graduates in these fields are women (Girls Go Circular 2022) and if we look even closer, the STEM degree enrollment of women in Spain represents an average of about 30%. Numbers vary among the different fields but what is most alarming is that only 16% of the STEM professionals in Spain are women.

In 2018, just 41% of the EU's scientists and engineers were women (Eurostat 2020), and just five EU Member States had more women scientists than men: Lithuania, Bulgaria, Latvia, Portugal, and Denmark (Thornton 2019).



4. Main reasons that generate inequality in the technology industry. Why aren't many girls involved in STEM

It is a fact that there is such a gender gap in science, technology, engineering, and mathematics education and occupations. There are some possible causes for this large gap between the genders, and understanding what causes the gender gap is vital in helping close it.

There is frequently an argument to state that women are not biologically designed for STEM. Although there are biological differences between male and female, this do not provide proof and explanation for the lack of women in STEM. There are plenty of famous women in STEM who prove that they are equally as capable as men are. Moreover, countries with *less* gender equality curiously have more women in STEM. You would expect the opposite trend to prevail.

Study after study finds (Corbett, 2015) that women have ability, good grades, and high-test scores in STEM subjects, and yet women are turning away, or being pushed away, from engineering and computing fields. A theme that overarches much of the research on this topic is that women often feel as if they do not fit or belong in these fields. Research into this perceived lack of fit provides a complex picture of social and environmental factors influencing and interacting with individual motivations and values that are, in turn, also influenced by the wider culture.

Main reasons that generate inequality.

<u>Gender Stereotypes</u>

STEM fields are frequently perceived as more masculine, and, from a very early age, many parents and teachers tend to underestimate the abilities of girls in these areas. According to Charles & Bradley (2009), men are naturally talented in engineering and math-intensive fields while women are naturally talented in more expressive and human-centred fields.

Gender stereotypes tend to place greater social value on men and evaluate men's competence as greater than women's (Ridgeway 2001). One specific area in which men are stereotypically deemed more competent than women is Mathematics. Parents' and teachers' expectations for children's mathematical achievement are often gender-biased and can influence children's attitudes toward math (Gunderson et al., 2012; Varma, 2010). One can easily assume that this conclusion is also valid for all fields related to Mathematics that is STEM, in general.

Scarcity of Role Models

Globally, a gender gap is detected in the number of female inventors regarding international patent applications. According to the latest data from WIPO (World Intellectual Property Organization), only 27.8% of the patents developed in the region include at least one female inventor, very close to the global average (30.5%).

There is a deficiency of prominent female figures in STEM fields within literature, media, and popular culture, leaving girls with few sources of inspiration and role models.

Male-Dominated Cultures

Given the lower representation of women in STEM education and careers, it tends to perpetuate more rigid and unwelcoming environments that lack support and inclusivity for women and other minority groups. It is often observed that women must demonstrate their capabilities in a more demanding manner than men.

Female researchers continue to be underrepresented at the highest levels of professional careers and remain a minority in many STEM fields. This finding suggests that the overall workplace culture and environment in technical industries may not be working for women, whether or not they are in technical roles.

As past decades have shown, simply trying to recruit girls and women into existing engineering and computing programs and workplaces has had limited success. Catalyst (2014) found that women in business roles at technical companies, tend to leave at higher rates than their male peers do (53 percent of women compared with 31 percent of men after their first post-MBA job). This finding suggests that the overall workplace culture and environment in technical industries is challenging for women, whether or not they are in technical roles. For example, Latin America and the Caribbean is one of the two regions

that achieved parity regarding female and male researchers (45% of all researchers are women).

However, female researchers continue to be underrepresented at senior levels in their professional careers and remain a minority in many STEM fields in most countries in the region (Bello, 2020).

Limited Exposure

Some girls may not have adequate opportunities to engage with STEM subjects and activities beyond the classroom. Access to extracurricular STEM programs and resources can be restricted in certain communities.

According to the World Economic Forum, women are typically given smaller research grants and find it harder to obtain venture capital for science and technology startups (World Economic Forum, 2017). Furthermore, women are dramatically underrepresented in S&T-based companies because of numerous barriers, even though these areas are central determinants of national productivity and, therefore, of development.

5. How to promote girls engagement in STEM

Promoting girls' engagement in STEM (Science, Technology, Engineering, and Mathematics) fields is crucial for fostering diversity and ensuring equal opportunities in these industries. By demonstrating that there are active people working to help girls be more involved, we fight the sexism and stereotypes that girls may experience in these fields.

Therefore, educators need to implement a variety of initiatives focused on getting more women into STEM. They need to put technology and engineering in the hands of their students and especially girls to spark their interest and most importantly show them possibilities in the world of technology.

Strategies to encourage girls to pursue and stay engaged in STEM.

- Exposure and Education
- Female Role Models
- Supportive Educational Environments
- Encouraging Practical Learning with Real-World Relevance
- Collaborative Learning
- Parental Involvement
- Career Exploration
- Recognize and Celebrate Achievements:

Exposure and Education

Early exposure in STEM activities is the key to sparking interest in STEM among school girls. Foster participation in STEM-related extracurricular activities, such as science clubs, coding camps, or robotics teams. A variety of programs can be implemented during them. For example, interactive experiments, museum visits and watching video clips of famous athletes, consultants and scientists sharing their views on coding. By these activities, girls can develop a curiosity and fascination for the world of science, technology, engineering, and mathematics and get a taste of the possibilities available to them. The next step for

them is to try their hand at it by tackling the basics of coding (or more advanced skills) depending on student ability.

Female Role Models

Featuring successful female role models in STEM fields provides tangible evidence that women can excel in these areas. Girls benefit from seeing relatable figures who have overcome challenges and achieved success in STEM careers, inspiring them to pursue their own passions.

Therefore, emphasize the accomplishments of women in science, engineering, and technology as inspirational figures. This can be achieved by inviting female STEM professionals to share their ideas and experiences with girls, either in person or through virtual events. To find such professionals ask friends who have college-age STEM students, talk to parents, and contact nearby museums and colleges. Seeing a woman, a software engineer, explaining physics, adds to girls' awareness (or realization) that there are possibilities for them in STEM fields.

Supportive Educational Environments

A continued increase in women pursuing careers in the fields of science, technology, engineering, and math begins in the classroom. By adopting activities and experiments into the learning process, girls have opportunities to see how science can relate to their world and they can actively engage with STEM concepts. This interactive approach fosters a deeper understanding and appreciation for the practical aspects of science, technology, engineering, and mathematics.

Establishing inclusive classrooms and learning environments that promote a sense of value and encouragement for all students interested in STEM subjects is also important. Educators need to make a concentrated effort to keep girls engaged in STEM by providing an encouraging environment in the classroom and daring them to look for opportunities outside of the classroom as well. That is, girls must be provided with mentors and teachers who can offer guidance and support.

Encouraging Practical Learning with Real-World Relevance

Relevance and real world learning in the classroom or homeschool is so important for students, not only to engage in learning but for them to care about the content. Fostering an authentic learning environment for your students is critical. Focusing on concepts that are part of the life and the real-world, part your students' lives beyond the walls of the classroom, helps them find purpose in the experience, which is at the heart of experiential learning. Promote interactive, experiential education in STEM disciplines to enhance the engagement and accessibility of these fields for girls. Foster problem-solving and critical thinking abilities by having girls work on STEM projects and experiments that address real-world problems and concerns that matter to them.

Collaborative Learning

Creating collaborative learning environments promotes a sense of community and support among girls interested in STEM. Working together on projects not only enhances their understanding of the subjects but also builds a supportive network that encourages their continued involvement in STEM fields.

Collaborative learning involves working as a group to solve a problem or understand an idea. Used in the classroom, this learning style ensures students remain engaged in content while thinking critically and sharing ideas with their peers. Therefore, cultivate teamwork and collaboration in STEM activities to boost confidence and communication skills. More specifically urge girls to work together on STEM projects and share their experiences. Collaborative Learning helps students learn fast, improves problem-solving skills, inspires creativity, creates trust and encourages engagement.

Parental Involvement

It is widely accepted that there is a positive impact of parental involvement in schools. Under parental contribution, there is increased control and motivation in the child as relatives are involved in the process of completing educational tasks. It is crucial to engage parents and caregivers in supporting their daughters' STEM interests by providing resources and guidance. So, encourage parents to expose their children to STEM activities and potential careers.

Involving parents and the community in STEM initiatives creates a broader support network. When parents and community members understand the importance of STEM education for girls, they contribute to fostering an environment that encourages and celebrates girls' achievements in these fields.

Career Exploration:

Girls can explore various STEM careers through internships, job shadowing, work placements or career fairs, in order to enrich their prospectives and opportunities. For these features, it is important to have variety so that students can see a wide range of backgrounds. Also, offer information on scholarships and educational pathways to make STEM education more accessible.

Recognize and Celebrate Achievements:

Celebrate the accomplishments of girls in STEM and acknowledge their efforts and successes. Also, give them the opportunity to showcase their projects and research through presentations or competitions. In this way, girls are more encouraged and recognize that they have the potential to succeed in a STEM field.

By implementing these strategies and fostering a supportive and inclusive environment, we can help girls develop a passion for STEM and pursue careers in these fields with confidence and enthusiasm.

6. Examples of inspirational role models in STEM

It is important for girls to have positive role models and learn from people who have pursued careers in STEM fields. This is the key to developing such habits that will motivate them to engage in such fields.

1. Dr. Sylvia Earle (Marine Biologist)

Dr. Sylvia Earle is an American marine biologist and oceanographer known for her extensive research on marine ecosystems. As an explorer-in-residence at the National Geographic Society, she has been a tireless advocate for ocean conservation and the protection of marine biodiversity.

Honors & Awards (some of them)

- 2018: Doctor of Science from the University of Edinburgh
- 2020: Aurora Expeditions announced their expedition ship would be named the *Sylvia Earle.*
- 2023: Stibitz-Wilson Award from the American Computer & Robotics Museum

2. Dr. Grace Hopper (Computer Scientist and Navy Rear Admiral)

Dr. Grace Hopper was a pioneering computer scientist and a U.S. Navy Rear Admiral. She played a crucial role in the development of early computers and programming languages, including COBOL. Dr. Hopper's contributions laid the foundation for modern computing.

Honors & Awards (some of them)

- 1964: Hopper was awarded the Society of Women Engineers Achievement Award, the Society's highest honor. Hopper was one of the founding members of the Society of Women Engineers.
- 1973: Elected to the U.S. National Academy of Engineering.
- 1982: American Association of University Women Achievement Award and an Honorary Doctor of Science from Marquette University.[58]
- 1991: Elected a Fellow of the American Academy of Arts and Sciences.[67]
- 1992: The Society of Women Engineers established three annual, renewable, "Admiral Grace Murray Hopper Scholarships"[68]

- 2009: The Department of Energy's National Energy Research Scientific Computing Center named its flagship system "Hopper"
- 2021: The Admiral Grace Hopper Award was established by the chancellor of the College of Information and Cyberspace (CIC) of the National Defense University to recognize leaders in the fields of information and cybersecurity throughout the National Security community.[78]

3. Eleni Charitonos (Mathematician-First Cypriot Analog Astronaut-Space Generation Advisory Council)

Eleni Charitonos has a degree in Mathematics and Statistics. She is the First Cypriot Analog Astronaut and she is officially working towards becoming an astronaut. Eleni successfully completed two analogue astronaut missions, the first being at LunAres in Poland for 19 days. The most important step in her career up until now is her participation in a 33-day mission at HISEAS, on the Mauna Loa Volcano in Hawaii simulating life on Mars. She was also a Deputy Manager of the 6th European Space Generation Workshop in Cyprus in April 2022. Her contribution to the space community was honoured with the National UKSEDS “Student of the year” award.

4. Lucia Kucerova (Oncologist, Biochemist)

Lucia Kucerova is a Principal Inverstigator at Translational Research Unit in Slovakia. She is an experimental oncologist with more than 20-years of experience in tumor cell biology and cellular therapies, co-author of more than 60 publications. She started new line of research focused on the role of the mesenchymal stromal cells in the tumor microenvironment and strategies to revert chemoresistance. Also, she built well-coordinated research group using my management and supervisory skills as a group leader and PhD student supervisor.

Honors & Awards

- Winner of the award L’OREAL-UNESCO For Women in Science 2017 in Slovakia.
- Scientist of the Year 2014 of the Slovak Republic, category Women Scientists.

These role models have made significant contributions to their respective fields, breaking barriers and inspiring future generations, including school girls, to pursue careers in STEM.

7. Designing STEM activities

STEM majors are considered some of the most challenging and demanding majors, as they require a strong foundation in math and science as well as a masterful display of critical thinking and problem-solving skills. The best STEM lessons require students to interact with the concept with their hands, whether it be through designing, building, creating, role-playing, or any other inventive and discovery-based process. To be most effective, hands-on activities should mimic a real-world scenario as much as possible.

The focus of STEM activities should be on developing students' problem-solving abilities. For their success teachers not only should they teach the necessary skills and concepts but also engage and excite students. In addition, they should guide and assist students to take the lead working through the project.

Steps in designing STEM activities:

- Start with a real-world problem around a topic you will be teaching
- Determine the project criteria and constraints
- Help students identify the challenge
- Encourage teams to develop their own ideas about how to solve the problem
- Guide teams to choose one idea to test and then create their prototype
- Facilitate the process of prototype testing and evaluation
- Involve teams in communicating their findings
- Redesign if there's time.

Start with a real-world problem around a topic you will be teaching

To effectively engage students in STEM and devise a compelling STEM lesson plan, initiate the process by anchoring it in a tangible real-world problem. This problem can be a current news event, a community challenge, or an issue confronted by a specific industry. Shaping the lesson around a real-world problem helps students grasp the significance and relevance of the concepts they are learning. It also encourages creativity and critical thinking as students endeavor to formulate solutions for the problem.

Determine the project criteria and constraints

Before immersing into a STEM project, it is essential to outline the project's specific requirements and constraints. This involves delineating project objectives and any restrictions or boundaries, such as available resources and time limitations. For instance, if the project involves constructing a bridge, the criteria and constraints may encompass a designated budget, accessible materials, and weight-bearing requirements. By establishing these parameters in advance, students can channel their efforts towards meeting project objectives while honing their problem-solving and critical thinking abilities.

Help students identify the challenge

To engage students, present the challenge in a captivating manner. Craft a scenario that captures their interest and introduces the problem. Utilizing resources like YouTube videos, skits, or attention-grabbing methods can be beneficial. Ultimately, ensure that students comprehend the challenge and feel appropriately challenged.

Encourage teams to develop their own ideas about how to solve the problem

Prior to allowing students to brainstorm solutions, establish specific criteria and constraints. For instance, a criterion might be the cost-effectiveness of their airbag system. Questions like the precise quantities of each chemical needed to inflate the airbag optimally should be considered. Constraints could include a limited supply of acetic acid and sodium bicarbonate. Crucially, encourage students to generate multiple ideas for solving the problem, emphasizing that there are often multiple valid solutions, not just a single correct answer. This step distinguishes genuine STEM learning from standardized

laboratory experiments. Once ideas are on the table, students can choose one to explore further, all while fostering effective teamwork and monitoring participation, sharing, and respect.

Guide teams to choose one idea to test and then create their prototype

Encourage teams to choose one idea for testing and create a prototype accordingly. For instance, they may select the airbag system they believe has the most cost-effective chemical ratio and a device for transporting the passenger egg. Allow them to delve into the construction of a prototype for their airbag system while ensuring effective team collaboration.

Facilitate the process of prototype testing and evaluation

Teams should conduct tests on their prototypes and gather data regarding their performance. The extent of testing may vary based on the data to be collected. Subsequently, teams should analyze their data and assess how well their prototypes align with the established criteria.

Involve teams in communicating their findings

Encourage teams to display their data and facilitate a collective decision-making process within the class to determine which construct proved most effective and why. For example, if students present their projects to the class, each of them engages in the activity in a productive way.

Redesign if there is time

The goal of redesigning a project is to create a better experience for students and improve its usability. After teams have had the opportunity to learn from one another, grant them the chance to redesign their constructions with the aim of enhancing their performance. During this process, students will communicate their weaknesses and strengths, learn from their mistakes and adopt the good practices of other projects.

Conclusion

In summary, STEM education is essential for individual success, economic growth, and addressing global challenges. It equips individuals with the skills and knowledge needed to thrive in an increasingly complex and technology-driven world.

STEM learning prepares professionals who can transform society with innovation and sustainable solutions. It foster students to find success in their future careers, by building skills that extend far beyond those needed in traditional science fields. Hence, they become more employable and ready to meet the current labor demand. Quality STEM experiences will empower students to pursue varied interests, move into any industry with valuable skill sets and become a confident problem solver in any area of life.

STEM education goes beyond school subjects. Each STEM component brings a valuable contribution to a well-rounded education. It encompasses the whole range of experiences and skills that governs the way we think and behave. Combining science, technology, engineering and mathematics, STEM education helps us to solve the challenges the world faces today and therefore to understand them in depth.

However, women are underrepresented both in STEM jobs and in STEM undergraduate degrees. In addition, girls' interest in STEM generally declines as high school progresses. Therefore, there is a need to encourage and support women in STEM. The most crucial contribution towards this direction comes from teachers and for that reason they should be informed and trained on STEM fields.

Further Reading:

Beede, D. et al, 2011. Women in STEM: A Gender Gap to Innovation. Available from: https://www.researchgate.net/publication/228196398_Women_in_STEM_A_gender_gap_to_innovation

Bello A, 2020. Women in Science, Technology, Engineering and Mathematics (STEM) in the Latin America and the Caribbean Region. Available from: https://lac.unwomen.org/sites/default/files/Field%20Office%20Americas/Documentos/Publicaciones/2020/09/Women%20in%20STEM%20UN%20Women%20Unesco%20EN32921.pdf

Catalyst, 2014. High potentials in tech-intensive industries: The gender divide in business roles, by A. Beninger. New York, NY: Author.

Charles, M., & Bradley, K., 2009. Indulging our gendered selves? Sex segregation by field of study in 44 countries. Am. J. Sociol. 114

Corbett, C., 2015. Solving the Equation. The Variables for Women's Success in Engineering and Computing. Available from: https://www.aauw.org/app/uploads/2020/03/Solving-the-Equation-report-nsa.pdf

Eurostat, 2020. *Women in science and technology* [Online]. Available from: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200210-2 [Accessed 9 February 2022].

Girls Go Circular, 2022. Available from: https://eit-girlsgocircular.eu/ [Accessed 9 February 2022].

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. Sex Roles, 66(3–4), 153–66. doi:10.1007/s11199-011-9996-2.

Guskey, T. R., 2002 (a). Does it make a difference? Evaluating professional development. Educational Leadership, 59(6), 45–51.

Guskey, T. R., 2002 (b). Professional development and teacher change. Teachers and Teaching: Theory and Practice, 8(3), 381–391.

Ridgeway, C. L., 2001. Gender, status, and leadership. Journal of Social Issues, 57(4), 637–55. doi:10.1111/0022-4537.00233.

Salami Al et al. 2015. Assessing changes in teachers' attitudes toward interdisciplinary STEM teaching. Available from: https://www.researchgate.net/publication/284077298_Assessing_changes_in_teachers'_attitudes_toward_interdisciplinary_STEM_teaching

Sirimanne, S., 2019. *How can we STEM the tide of female graduates leaving science?* [Online]. World Economic Forum. Available from:https://www.weforum.org/agenda/2019/09/stem-women-gender-equality-science-technology-engineering-mathematics [Accessed 9 February 2022].

Thornton, A., 2019. Gender equality in STEM is possible. These countries prove it. World Economic Forum. Available from: https://www.weforum.org/agenda/2019/03/gender-equality-in-stem-is-possible [Accessed 9 February 2022].

Varma, R., 2010. Why so few women enroll in computing? Gender and ethnic differences in students' perception. Computer Science Education, 20(4), 301–16. doi:10.1080/08993408.2010.527697.

WIPO., 2019. PCT Yearly Review 2019: The International Patent System. Geneva: WIPO.

World Economic Forum., 2017. The Future of Jobs. Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution. WEF.