

BUSINESS PARTNERSHIPS TO ADVANCE STEM EDUCATION:

Building a Bridge to Homegrown STEM Talent

Focus on Teachers

Report

Prepared by: Sofia Buttacavoli, José Martí MAST 6-12 Academy

Contributor: Ann G. Bessell, Ph.D. University of Miami Evaluation Team

Program

Designed and Conducted by the Council for Educational Change

Funded by the Committee for Economic Development

This issue brief is based on research funded by the Bill & Melinda Gates Foundation.

The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

Business Partnerships of José Martí MAST 6-12 Academy

Educational Partners

Ben Sheppard Elementary: JM-MAST invites the Pre-MAST students to participate in lab experiments at the school on a regular basis in order to promote STEM in elementary.

Council for Educational Change: The CEC has assisted JM-MAST in obtaining partnerships, managing the grant, offering advice and promoting the school.

Committee for Economic Development: The CED provided JM-MAST with a generous grant for the Business Partnerships to Advance STEM Success (B-PASS).

Florida International University: Faculty of JM-MAST participated in professional development focusing on The Common Understanding of STEM and Instructional Strategies for all subject areas. Students participate in the FIU Annual Honors College Research Conference.

LARC Technology Institute: Established the website for the JM-MAST/B-PASS grant information and implementation. LARC has provided: students with hands on workshops; teachers with professional development on web design; free computer repair to faculty, staff, parents and students of JM-MAST.

Miami Dade College-North Campus: MDC has selected JM-MAST to participate in the FCCAgE/USDA Florida Caribbean Consortium for an Agriculture Education Grant which has enabled our students to build and maintain an herb garden. MDC offers many field trips to our students who participate in presentations and lab experiments at the college. MDC has also provided professional development to faculty on STEM across the curriculum.

June 2013
Miami, Florida

Supportive Partners

Cleveland Clinic: JM-MAST students participated in the eXpressions™ award-winning educational initiative that utilizes creative expression to engage high school students in the exploration of science and medicine.

Ford Motor Company: JM-MAST students participated in the Driving Skills for Life which is part of Ford's long-standing commitment to teen driver safety.

Junior Achievement of Miami: JM-MAST students participated in JA personal finance and recognized the fundamental elements for their personal finances: earnings, saving and investing, budgeting, credit risk management and giving.

Miami Science Museum: Students of JM-MAST participated in the National Youth Summit focusing on contemporary environmental issues and the legacy (as well as lessons learned) from the Dust Bowl. Students have also prototyped a new live surgery fieldtrip for the museum and participated in the Brain Fair.

NASCAR: Through hands on activities and driver integration, NASCAR and its educational partners showcased how STEM and teamwork come alive outside the classroom, in sports and potential careers, in a ten-week interactive program.

NOAA: JM-MAST students participated in engaging presentations by NOAA and used their data to practice gathering and analyzing.

¡Yo Soy Hialeah! Through this community website, we post videos, articles and important events that take place at José Martí throughout the school year. This also assists us in marketing the school and recruiting more students.

Zoo Miami: Students of JM-MAST have the opportunity to participate in the Conservation Teen Scientist program (CTS). It offers high school students valuable volunteer opportunities, while fulfilling Zoo Miami's mission of wildlife conservation and enhancing the visitor experience through eco-literacy interpretation. Zoo Miami also offers field trips and presentations.

Extracurricular Partners

ALM Sports: JM-MAST students have the opportunity to play sports after school with ALM Sports. As a Magnet School we cannot offer sports.

AmericaTevé: JM-MAST Spanish-speaking students report on topics of interest and appear in the America Tevé "Los Reporteritos" segment of the local news.

Dream in Green: The students in the Green Club are participating in Dream in Green to create environmental educational programs that decrease greenhouse gas emission through a multi-pronged approach that promotes energy efficiency, conservation, and the use of renewable energy.

Fairchild: JM-MAST students have the opportunity to participate in a collection of challenges that offers an exciting mix of environmental educational opportunities. JM-MAST teachers have the opportunity to participate in Fairchild's professional development courses.

Rhythm and Pitch School of Performing Arts: Rhythm & Pitch is providing the students of JM-MAST the opportunity to participate in Dance and Musical Ensemble after school.

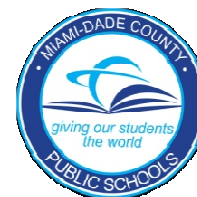
Women of Tomorrow: The Women of Tomorrow Mentor & Scholarship Program mission is to inspire, motivate and empower young women to live up to their full potential through a unique mentoring program with highly accomplished professional women, and through scholarships.

José Martí 6-12 MAST Academy
5701 W. 24th Avenue
Miami, Florida 33016
Principal: José Enriquez, Jr.
Assist. Principal: Ivette Díaz-Rubio
Tel: 305-557-5931

Contents

The Importance of and Need for STEM Education	4
Supporting Teachers Through Cultural Change	6
Partnerships to Support Change	7
A Teacher's Observation: Anthony Machado	8
Overcoming Resistance	9
Providing Teachers the Tools and Resources to Succeed	10
A Teacher's Observation: Martinnette Thompson	11
The Results	12
Graphs	12
Emerging Results (Reading and Math)	
State Required End-of-Course Passing Rate	
Continuing to Support Opportunities and Advance Teacher Effectiveness	13
10 Essential STEM Teaching Practices	15
References	16

Business Partnership to Advance STEM Success (B-PASS)



Committee for Economic Development
www.CED.org

Council for Educational Change
www.ChangeEducation.org

José Martí MAST 6-12 Academy
www.mast3.com
www.mast3.larctech.com

Miami Dade County Public Schools
www.dadeschools.net

The Importance of and Need for Science, Technology, Engineering, and Mathematics (STEM) Education

“Educators and business leaders share common goals and challenges; both manage large complex organizations and want to ensure that students graduate high school prepared” to take on the jobs which will keep them and the nation productive and competitive. This is what the American Association for School Administrators has labeled as “Mission Critical.” This mutual goal has motivated many organizations and



businesses to invest in the country's public school system to support and equip students for college, work, and more importantly, the diverse and ever-changing life ahead of them. Currently, the career fields with the greatest need for workers are science, technology, engineering and mathematics (STEM). The STEM fields are definitely the most lucrative and essential areas in the American workforce today. Growing at an astounding and unprecedented pace of three times faster than other jobs in the rest of the US economy, STEM-related careers are projected to

have nearly 230,000 jobs that will go unfilled by 2018 due to the lack of STEM trained professionals (Barquin & Henry, 2013).

To meet these workforce demands, the education system in the United States will need to adapt and bolster today's students with the foundational thinking and technical skills required for 21st century jobs. The urgency for change is even being felt in the White House as delineated in the April 2013 document *Preparing a 21st Century Workforce: Science, Technology, Engineering, and Mathematics (STEM) Education in the 2014 Budget*. This budget proposal for 2014 calls for a funding increase of 6.7% for STEM Education. As part of the \$3.1 billion allocated to STEM education, \$80 million has been earmarked for preparing 100,000 “excellent” teachers as part of the pilot program “STEM Master Teacher Corps.”

JM-MAST: Doing its part to address the STEM challenge

In June of 2011, José Martí Middle officially became known as José Martí MAST 6-12 Academy, a Mathematics & Science Technology school that offers an innovative and cutting-edge magnet program. This unique concept-based learning approach fully immerses students from sixth through twelfth grade in a 21st Century curriculum focusing on three essential strands: life science, physical science and mathematics/computer science. However, just building a school and declaring it a STEM institution does not make it a success or, for that matter, a STEM school. A proper and adequate educational foundation is a non-negotiable element. The quality and method with which students are educated must be adapted to the needs of the current and future workforce. Simply relying on a textbook as the sole resource for information is no longer enough to prepare students for a successful college or work career.



Today's students -- the "Google generation" -- have access to education and information at their fingertips where resources such as the Khan Academy¹ and collegiate online open courseware have become the norm. These require today's schools to incorporate new instructional techniques and learning opportunities for students.

In 2012 JM-MAST was awarded a "Business Partnership to Advance STEM Success" (B-PASS) grant by the Council for Educational Change (CEC), a Florida education think tank, which was funded by the Council for Economic Development (CED), an independent, non-profit, non-partisan public policy organization based in Washington, D.C. This grant helped enable JM-MAST to turn its vision of becoming a groundbreaking STEM Academy into a reality, thus making a powerful impact on the school's culture. The grant supported:

- Real world experiences such as field trips for students thus providing unique educational experiences beyond the classroom

¹ Khan Academy is a non-profit whose mission is to provide "a free world-class education for anyone anywhere" with a free online collection of more than 4,000 micro lectures."

- Creating resources for replication and marketing including a website that could host information on all partners, document all activities with photographs and videos, and provide a virtual resource center, as well as a guide to replicate the model district and statewide
- Teacher effectiveness activities such as professional development, mentoring and training.

Supporting Teachers Through Cultural Change

Clearly the role of a teacher is one of the most essential and influential to student success. Teachers are a fundamental part of a school and are at the heart of a school's culture. School culture is defined by interactions among its staff, students, parents, and administrators. These interactions are a "self-repeating cycle" and if a change to the school culture were to occur then it would "necessitate an interruption to this cycle"



(Hinde, 2007). This self-repeating cycle came to a halt with the transition from Jose Marti Middle School to Jose Marti MAST 6-12 Academy.

In addition to the curricular shift, there was a change in the student body being served at the school. The school had admissions standards that attracted high-achieving students.

The teachers were accustomed to having to persuade students to succeed and convince them that they could achieve great things. Now, the students believe in themselves and are achieving at a higher level so that teachers have to raise their own game. Students began superseding the high expectations set forth by their teachers, so much so that it pushed the teachers to, once again, become the student in order to find meaningful and challenging activities. This was not only a foreign concept to most, but an uncomfortable one as well.

The transformation from a typical teacher-centered classroom to collaborative environments driven by problem-solving, discovery, and exploratory interdisciplinary learning required a multi-prong approach. The most essential step was to support the teachers and build capacity for this change from within.

There were two key challenges facing JM-MAST's cultural shift:

- 51% of the teaching faculty has more than 15 years of experience. Implementing significant changes to culture, curriculum and instructional techniques with such experienced teachers would require careful planning and support to overcome concerns, skepticism and doubt.
- Additionally, since the school was a former traditional middle school, the majority of the faculty did not have the experience or certification that would enable them to teach the high school coursework required in this innovative magnet 6-12 Academy. This created a challenge especially due to the fact that JM-MAST students begin taking high school level courses in their seventh grade year. Thus, faculty members were forced to learn in tandem with the students.

Partnerships to Support Change

Change is never easy. Since the STEM arena has changed significantly and rapidly, many of the teachers were ill-prepared to incorporate innovative teaching methods into their daily instruction. JM-MAST partnered with local colleges and universities and businesses to support and provide training to teachers. These efforts aimed at helping teachers incorporate new and innovative techniques into the classroom and school experience for students. Particular focus was placed on



- Increasing active learning experiences - Student motivation can be enhanced by utilizing inquiry methods, primary sources, and technology. Additionally, emphasis on real-world problem solving with direct application accompanied by opportunities for research can inspire students to explore STEM careers.
- Emphasizing creativity and innovation - Curiosity and creative thinking lead to innovation, invention, and exploration. While memorization of facts and worksheets can be stifling, using those facts in inquiry-based, real-world problems can be liberating and inspiring.
- Developing mentorships and internships - Students need opportunities to engage in real-life mentoring and internship programs to foster their interest and excitement in the wide range of STEM careers.

Also guiding the efforts at JM-MAST were the *10 Essential STEM Teaching Practices* (Jolly, 2013), which were constant reminders of the aptitudes and proficiencies which could lead to success such as fostering curiosity, providing hands-on experiential learning, and accepting failure.²

The training and support provided to teachers mirrored the classroom practices JM-MAST was hoping would become the norm for its teachers and students. Key partners included Florida International University (FIU) and Miami Dade College-North Campus

(MDC) and various local businesses and organizations that exposed students and teachers to professionals in relevant STEM fields. These experiences included:

A Teacher's Observation

Anthony Machado, a 36-year veteran of the classroom, stated the following when asked how the partnerships generated as a result of the B-PASS grant influenced his teaching:

“Now students see real-world applications. It’s more than just an assignment, it translates into sports and business uses. They can see the correlation and usefulness of math and science in the real-world activity. Having NASCAR come out provided a motivation that I haven’t seen in my 36 years of teaching.”

- Having teachers work in interdisciplinary and grade specific groups to conduct simple experiments that mirrored what students were learning in their core science content courses.
- Bringing the faculty to the MDC state of the art science complex to conduct a model intricate experiment on DNA extraction followed by various discussions on pertinent science topics that could be infused by the JM-MAST teachers into their individual classrooms.

- Fostering direct collaboration and communication between JM-MAST teachers and their college-level counterparts by providing high school level science students opportunity to receive college-level instruction and laboratory experiences from the college professors. This experience not only exposed students to college-level coursework but provided JM-MAST teachers opportunity to observe and understand what is needed to prepare students for college. This resulted in increased content knowledge as well as increased student and teacher engagement throughout the Science Department.

² A full list of these 10 Essential Elements is provided at the end of this issue brief.

STEM corporations are all too familiar with their own company's needs. What better way of ensuring that students receive these skills than by working with the very people entrusted with the task of preparing these students? Local business/organizations partners addressed this missing link by connecting classroom content with real-world experiences through expert lectures, hands-on demonstrations and field trip opportunities. For example, when NASCAR arrived at the school with simulation machines, teams of engineers, and actual stock car drivers, the teachers became excited and interested, just like the students. Students worked with NASCAR racers and engineers to design stock cars, as well as to develop methods of making the cars more efficient on the race track.

The CEC and the CED were also indirectly instrumental by way of alleviating some of the financial restrictions that JM-MAST was coping with in order to provide its students with the experiences they needed to be successful. This re-direction of funds was utilized to provide teachers with additional time after school where teams of teachers could work collaboratively to streamline their curriculum as well as discuss best practices and lessons learned. Apart from creating cohesive curriculum maps, this exercise was intended to generate a sense of teamwork and ownership of the content. In many instances this was the case, but as with any challenge, it was met with some resistance. Teachers were hesitant to be transparent for fear that they might suffer criticism



Overcoming Resistance

While some teachers embraced these newly discovered connections, others were still leery of the impact on student achievement as well as their own ability to effectively learn and integrate new strategies in the classroom. Underlying some of this skepticism are the many policy initiatives, innovations and curricular changes that have come and gone in the past – promising great things only to result in little change or be abandoned for the “next best” effort. Consequently, as JM-MAST began to transition to its new mission and focus, it became evident that some of the veteran teachers would require more support, encouragement and time to embrace the school's new approach.

At no time was this more evident than when the school volunteered to adopt the College Board's SpringBoard curriculum which is designed to help students succeed in Advanced Placement (AP) courses and, subsequently, in college. The adoption of this student-centered curriculum aligns with the other essential STEM practice of transferring control of the learning process to students. Extensive professional

development and mentoring on numerous levels was inevitable for the SpringBoard curriculum to be a success. The district provided workshops in the summer as well as curriculum planning sessions.

Several teachers became excited by the challenge and new pedagogical approach of the curriculum. They sought continued collaboration amongst their peers and fully integrated the new curriculum into their classrooms – imparting not only SpringBoard’s mission of thinking critically and in multiple dimensions onto the students.

Conversely, for other teachers, this paradigm shift would require additional support and guidance in order to transition into the curriculum smoothly. Some remained skeptical of its validity which translated into hesitation and they began to use the curriculum as a resource and supplement as opposed to the main source of instruction. Teachers reverted back to the use of the ancillary materials provided with the state adopted textbooks, but to maintain and encourage student interest they still had to seek out alternate resources. This caused more work for the teacher without yielding greater interest from the students.

To continue to support these teachers – the hesitant adopters - additional professional development sessions will be provided quarterly, along with opportunities to engage in more subject-specific training.

Providing Teachers the Tools and Resources to Succeed

Another key element of supporting teachers is arming them with the appropriate infrastructure, tools and resources to succeed. This includes technology, capital facilities and equipment that can help teachers supplement and support a rigorous curriculum. Additionally, simply placing a new piece of equipment or technology in a school will not mean it is used by teachers. Teachers must be supported in the adoption and integration of these resources with the appropriate training.

JM-MAST, leveraging the resources provided through the B-PASS grant, has begun to address some of the facility, equipment and technology upgrades, along with the related training needs, that will ultimately help bring the vision of JM-MAST to full realization. Some examples include:

- Upgraded computer labs: Along with the need to rewire the school to accommodate Wi-Fi, new computer labs provided teachers with the ability to infuse technology more easily into the curriculum in order to use real world data sources and innovative methodologies.

- Science equipment: A key facility change will be the conversion of a former home-economics classroom into a chemistry lab. The school brought in new equipment but the teachers were not trained to use the equipment. To close this gap, JM-MAST leveraged its partnership with Miami-Dade – teachers were provided training at Miami-Dade’s state of the art facility and brought it back to the school and its students.

Various partners were approached to assist in a needs assessment of the school and in providing the non-negotiable items, such as science equipment, facility upgrades, and the hiring of appropriate staff.

- SparkVue: JM-MAST sought new technology to bolster the STEM curriculum. One of these resources was SparkVue – a scientific probeware that allows students to integrate science content with data collection, analysis and assessment. This digital hand-held scientific equipment was very complex yet had the potential to be very effective in the classroom. To support teachers in integrating the resource into the classroom, the company sent a master trainer from California to provide professional development. The SparkVue equipment has been

successfully implemented in the JM-MAST classrooms. Smart Boards: When JM-MAST was first converted into a STEM magnet school, the school installed SmartBoards in specific classrooms. Teachers were somewhat familiar with the capability and benefits of SmartBoards, but not to the extent of utilizing this tool’s entire potential. The B-PASS grant enabled extensive training for the teachers with this technology in their classrooms as well as for those who may be receiving SmartBoards in the near future. This has stimulated teachers to look into methods and lessons to integrate this technology to inspire and spark the students’ creativity.

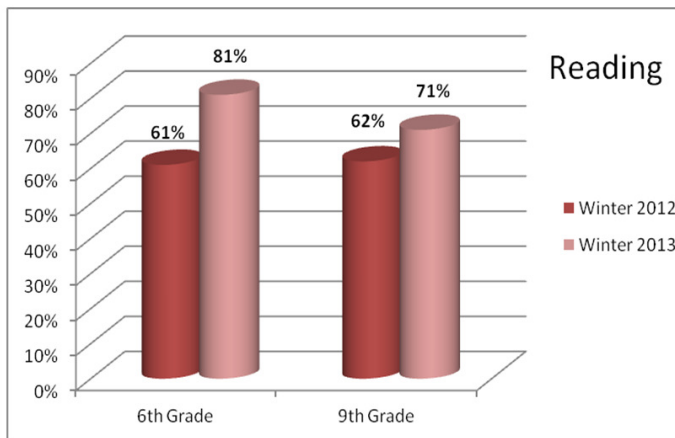
A Teacher’s Observation

**Martinnnette Thompson -
English/Language Arts Department**

“This year I was enthusiastic about our school’s decision to change our traditional methods of teaching literature by adopting SpringBoard’s Pre-Ap English Language Arts Curriculum. Although the preparation and studying was a daunting task, the advanced placement strategies learned were worthwhile. I was able to witness first-hand my students’ ability to confront challenging texts, write effectively to complex tasks, and apply higher-thinking skills to the demand of college-level work. The rigorous criteria allowed my students to become successful and prepared for college.”

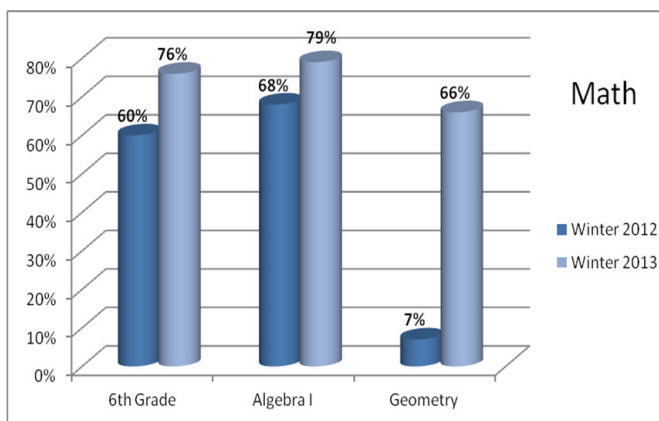
Emerging Results

Percent Meeting High Standards on District Interim Assessments

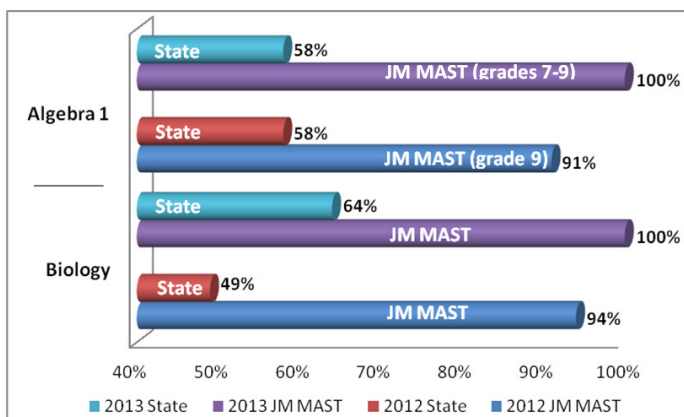


Emerging Results

Percent Meeting High Standards on District Interim Assessments



State Required End-of-Course Exams Passing Rate



Graded on a scale of level 1-5, with 5 being the highest, 59 out of 67 students in grades 7-9 this year scored at a level 5. This is equal to 88% scoring at the highest possible performance level.

The Results

Professional development and mentoring have proven to be the most essential aspects in creating a school that provides effective advanced learning and an engaging classroom environment.

Since the inception of JM-MAST, teachers and administrators alike have been working tirelessly to ensure that justice is done to the STEM designation bestowed upon the school. The design team, students, teachers and administrators have accomplished tremendous strides in a short time. Many of the teachers have already begun to embrace strategies acquired during professional development and report increased student engagement as a direct result of the positive impact of the business partnerships. Additional emerging successes can be seen in the classrooms where interactive lessons and projects have become commonplace and students are fully engaged in rigorous lessons. As a student said, *"I love this school because every week is a new adventure... its hard work. There are so many amazing things I've learned about. I'm having a hard time deciding on a career, but until I do I get to do things my friends at other schools don't do."*

Even at this early stage of implementation, there have been marked increases in student achievement in reading, math and science, as evidenced by the learning gains on the District's winter interim assessments. The academic impact is undeniable, particularly with a 59% increase over last year in students meeting high standards in geometry. Moreover, the 100% passing rate in both Algebra 1 and Biology end-of-course (EOC) state examinations is impressive particularly when compared to the state average scores of 58% in Algebra 1 and 64% in Biology. These achievements were no small task to accomplish, which only further enhances the benefits for partner involvement at the school site. The ability to accomplish all these feats would not have been possible without the B-Pass grant and the cooperation of the CED and CEC to support the training, mentoring and professional development of teachers.

Continuing to Support Opportunities and Advance Teacher Effectiveness

In the two years since JM-MAST opened its doors, much has been done to ensure the vision of the school is fully achieved. Changing a school's culture, mission and curricular focus are daunting tasks. The teachers of JM-MAST have played an essential role in the success realized so far. To continue this success will require providing teachers opportunities to advance and grow. Grounded in the lessons

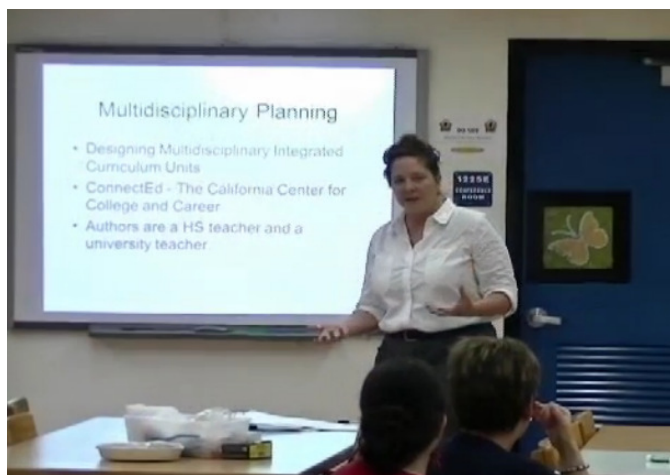


and experiences to date, JM-MAST will incorporate the following concepts into its professional development and teacher advancement efforts moving forward:

- **Teacher Ownership.** Teachers need to have opportunities to gain ownership of individual partnerships that would work well with their specific subject areas. By empowering teachers to do so, integrating outside experiences such as field trips and visits to businesses will enhance their teaching and students' classroom experience. This will also ensure a seamless infusion of real-world content into the classroom. To further foster teacher ownership, teachers were given the opportunity to submit mini-grant proposals for partnerships they felt would work

well in their specific disciplines. By choosing the partnerships, it becomes easier to integrate those experiences into their classes,

- **Teacher Mentor.** Teachers embarked on this journey to increase rigor in a solitary fashion. Now that some success has been achieved, teachers can take advantage of others' successes by visiting model classrooms in schools with a highly rigorous curriculum. This will give teachers a better idea as to the goal as well as provide them with a mentor to help them get to that point.
- **Professional Development.** In order to maximize teacher effectiveness, teachers need to continue to expand their knowledge bases and some may choose to acquire additional certifications that are conducive to teaching high school coursework within their disciplines. Encouraging doing just that and seeking additional training in STEM and content area knowledge is essential in order to fill the necessary gaps in the classroom.
- **Find the Root.** Some teachers will not embrace change. Administrators can conduct individual conversations with hesitant teachers in order to gain insight as to what is the root of their hesitation. In this conversation, areas for improvement may also become evident and opportunities to address issues can be explored.
- **Collaboration.** Provide teachers with multiple opportunities, during work hours, to collaborate on an interdisciplinary level frequently. In addition to collaborating during the school year, JM-MAST teachers are engaging in collaborative workshops and summer planning sessions to begin planning their teaching guides for the following school year. They will also establish dates for business partner visits, possible dates for field trips, and ways to integrate knowledge garnered from business partners into the curriculum.
- **Support.** Administration support is essential and must be sustained in order to facilitate teacher creativity and allow the infusion of diverse and reliable resources. Administrators at JM-MAST are committed to continuing to foster relationships with business partners to further enhance educational experiences at the school, as well as their own growth, in order to remain effective and current.



10 Essential STEM Teaching Practices

1. Believe in your students. Set high expectations for your students, challenge them to succeed, and believe that they will. Most students will perform at the level you expect, so trust them to make informed choices, come up with creative solutions, complete complex tasks, and work together smoothly.

2. Transfer control of the learning process to the students. Develop new roles and rules that stress student responsibility. Then guide from the sidelines while keeping students on target with their direction and purpose. Aim at helping them become self-sufficient learners.

3. Foster curiosity. Learn the art of asking open-ended questions with plenty of possible answers. Pose problems rather than answers and send students on a search for solutions. Use discrepant events to intrigue students and draw them into the problem.

4. Provide hands-on, experiential learning. Don't be the old-fashioned sage on the stage if you want to stimulate 21st century learning. Learning through reflection and doing is compelling. When your students have their imagination piqued, give them opportunities to actually investigate multiple possible solutions to a problem, or to solve a mystery. Provide materials that teams of students can explore and manipulate.

5. Increase collaboration among students. Get comfortable with teamwork. Actively teach teamwork skills and work with students to heighten awareness of their team behaviors and ways of interacting in the class.

6. Accept failure – both yours and the students – as a necessary part of learning and growing. That is, accept failure that accompanies taking a risk and experimenting, knowing that they might not get it right. Everyone in the classroom should feel safe in taking risks. In fact, failure is a necessary part of learning.

7. Be an inspiring leader and role model for your students. Be positive and enthusiastic about what students are learning and how they are learning it. Be passionate in your teaching and your love of your subject area.

8. Accept some drawbacks. STEM education will improve student engagement, critical thinking skills, and workforce skills. But it may also play havoc with the lesson plan you wrote and make it more difficult to cover content benchmarks in a stepwise process. In the STEM classroom, you'll need to be flexible and ready to make some quick shifts in your thinking.

9. Evolve and grow as a learner. One of the most important things you can do, as a STEM teacher, is to pay attention to the art of teaching. Develop your skills in facilitating (as opposed to dictating) so that students focus on learning how to think like a STEM professional. Embrace digital tools and technology in the classroom with help from your students. (They will enjoy being in the role of teaching you!)

10. Learn in community. Work with your colleagues to study effective ways of teaching STEM lessons.

References

- Atkinson, R. (2013). ***A short and long-term solution to America's STEM crisis.*** Retrieved from <http://thehill.com/blogs/congress-blog/technology/287435-a-short-and-long-term-solution-to-americas-stem-crisis#ixzz2TkopVS5z>
- Branham, M. (2012). ***Fulfilling technology's promise to education.*** Retrieved from <http://knowledgecenter.csg.org/drupal/content/fulfilling-technology%E2%80%99s-promise-education>
- Barquin, R., & Henry, W. (2013). ***The science, technology, engineering and math (STEM) crisis: What should we do?*** Retrieved from <http://www.b-eye-network.com/view/16878>
- Carnevale, A. P., Melton, M., & Smith, N. (2011). ***STEM.*** Retrieved from www9.georgetoen.edu/grad/gppi/hpi/cew/pdfs/stem-complete.pdf
- Common Goals Unique Strengths: Education and Business Partnerships.*** (2010). American Association of School Administrators. Retrieved from www.aasa.org/uploadedFiles/Childrens_Programs/Beyond_High_School/Education_and_Business_Partnerships_Final.pdf
- Hinde, E. (2007). ***School culture and change: An examination of the effects on school culture on the process of change.*** Phoenix, AZ: Publisher.
- Jolly, A. (2013). ***10 stem teaching practices.*** Retrieved from <http://www.middleweb.com/6624/10-stem-teaching-practices/>
- Preparing a 21st Century Workforce.*** (2013). Retrieved from www.whitehouse.gov/sites/default/files/microsites/ostp/2014_R&Dbudget_STEM.pdf
- Stangler, D. (2013). ***Entrepreneurs to America: Send us more geeks.*** Retrieved from <http://www.inc.com/dane-stangler/how-to-make-more-geeks.html>
- STEM Education: Science, Technology, Engineering, Mathematics.*** (2013). Retrieved from www.Suny.edu/educationpipeline/stemeducation.cfm
- Weldon, T. (2011). ***Creating effective business-education partnerships.*** Retrieved from <http://knowledgecenter.csg.org/kc/content/creating-effective-business-education-partnerships>