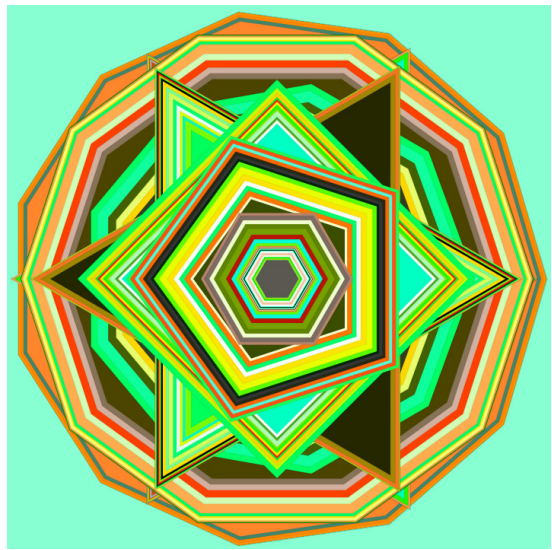


RECOGNIZING MODEL STEAM PROGRAMS IN K-12 EDUCATION

innOVATION STEAM Grant Awards | NOVEMBER 2015



Acknowledgements

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Produced by The Ovation Foundation, the President's Committee on the Arts and the Humanities and Americans for the Arts.

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Front Cover Photos from Top to Bottom: Dayton Regional STEM School, Renaissance Arts Academy, Kennedy Elementary School, Highland Park Middle School & High Tech High Media Arts

This publication is available free of charge at www.theovationfoundation.org/innovation-steam.

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Foreword by

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The benefits of arts education have been proven time and time again by various studies and research spanning decades. From students improving their reading, writing and math skills, to preparing a 21st Century workforce, to curbing drop out rates among at-risk youth, the advantages of investing in arts education are numerous.

Though arts education continues to prove its value, education budgets and resources continue to be cut across the country.

In the meantime, STEM education (Science, Technology, Engineering and Math), has gained great support from some of the largest corporations and foundations across the nation, as well as within the education field. Yet, STEM education overlooks one very important component, which would result in a more balanced curriculum – the arts. Taught in tandem with traditional STEM subjects, the arts build skills of creativity, improvisation and open-ended thinking that are critical to innovation.

For this reason, The Ovation Foundation, the philanthropic arm of Ovation, along with our partners, the President's Committee on the Arts and the Humanities and Americans for the Arts, developed a grant award program to recognize model STEAM (STEM + Arts) programs in K-12 education. Not only do we share a commitment to the arts, we firmly believe the arts play a critical role in education and must be incorporated in every student's education in order to provide our children with the best opportunities to compete for the jobs of the future.

The innOVATION STEAM Grant Awards aim to provide the education field with national models. We believe the moment is now for the arts to be incorporated into STEM education.

Overview

The Ovation Foundation, the philanthropic arm of Ovation, in partnership with the President's Committee on the Arts and the Humanities (PCAH) and Americans for the Arts (AFTA), and in consultation with the Congressional STEAM Caucus and the Rhode Island School of Design, developed the innOVATION STEAM Grant Awards Program. The program was created to raise awareness of the value of integrating the arts into STEM (Science, Technology, Engineering and Math) curricula and to highlight existing K-12 public schools across the country that have developed successful, measurable and replicable STEAM programs, which could serve as national models. The innOVATION STEAM Grant Awards Program represents the first funding program of its kind for STEAM education.

A formal grant panel was conducted in late 2013 and included representatives from the PCAH, AFTA, The Ovation Foundation, the New York City Department of Education, the Rhode Island School of Design, and an elementary school teacher. The Panel reviewed applications from over 55 schools and recommended 8 schools for funding, each of which received a \$10,000 grant award for investment in STEAM educational programming or curriculum development.

Each recipient school of an innOVATION STEAM Grant Award is an inspiring example of teachers empowering students to direct their learning experience towards a goal of college and career attainment. These programs support one of the Obama Administration's 2020 goal of increasing college attainment, as well as First Lady Michelle Obama's specific goal "...to reach out directly to young people and encourage them to take charge of their futures and complete an education beyond high school."

The STEAM programs and curricula developed by these grant recipients focused on comprehensive, skills-based education. They were well-planned, including identification of state and national standards in each subject area; and had measurable, tangible outcomes. In particular, they motivated student engagement by allowing students to direct their own learning through experimentation, with teachers as their guides or by leveraging real world connections. Over all, the programs and curricula encouraged students to ask questions and understand subject matter from a position of empowerment.

The applications proved that teachers are innovating. A majority of the schools that applied and that were recommended for funding serve disenfranchised students. On average, 50% or more of the populations are on subsidized lunch plans, many below the Federal Poverty Level. They see the arts as an open door for many of these students. They use the arts to make STEM subjects more accessible and engaging to students and are able to mutually strengthen arts and STEM learning.

From STEM to STEAM

When President George W. Bush was briefed in early 2007 on America’s competitiveness and the National Research Council’s 592-page report called “Rising Above the Gathering Storm”, the White House urged congress to quickly pass the America Competes Act also known as the STEM Act. Congress acted and that same August, President George W. Bush signed into law the bill, which authorized \$151 million to help students earn a bachelor’s degree, math and science teachers to get teaching credentials, and provide additional money to help align kindergarten through grade 12 math and science curricula to better prepare students for college.

The legislation has been reauthorized every few years and as centers and institutes for STEM popped up across the nation, educators and artists began to ask why just these disciplines? Why not the arts too? In truth, it was recognized that we needed a change in attitude about the connection between art and music, math and science. We needed to define a well-rounded education and to make the case for its importance in a global economy.

Today, as demand for a new workforce to meet the challenges of a global knowledge economy is rapidly increasing, few things could be as important in this period of our nation’s history than art education. After nearly 8 years, thoughtful educators, artists, parents and politicians are focused on STEAM, adding the “A” or arts – not just STEM.

The current effort to put the A, for the arts, into our national trend of STEM education, has now reached a more crucial juncture as more states are revamping their education systems, particularly their K-12 curriculum to stimulate greater student engagement, improve learning in the subjects taught, and introduce a more dynamic and realistic view of the interdisciplinary nature of innovation and creativity.

Perhaps the single most influential action item was the release in May 2011 of The President’s Committee on the Arts and the Humanities (PCAH) landmark report: “Reinvesting in Arts Education: Winning America’s Future Through Creative Schools,” which culminated 18 months of research, meetings with stakeholders, and site visits all over the country. This report represented an in-depth review of the current condition of arts education, including an update of the current research base about arts education outcomes, and an analysis of the challenges and opportunities in the field that have emerged over the past decade. This report not only recognized the arts as essential to education, it served to legitimize the arts as a necessary part of every student’s education.

“Cutting-edge studies in neuroscience have been further developing our understanding of how arts strategies support crucial brain development in learning.”

— as reported by the President’s Committee on the Arts and the Humanities (PCAH)

According to the Committee’s report, “Cutting-edge studies in neuroscience have been further developing our understanding of how arts strategies support crucial brain development in learning.”

For example, Dr. Richard Restak in his book, *Mozart's Brain and the Fighter Pilot*, uses the words "plastic" and "malleable" to describe the brain. He believes that we can be creative by acquiring the right series of "repertoires"; that we can "preselect the kind of brain [we] will have by choosing richly valued experiences." In short, he and many other neuroscientists are beginning to conclude that we all have the capacity to be creative.

"After a decade of studying the human brain we know the arts enhance math and science comprehension."

Our success in a new economy demanding creativity and innovation will come from nurturing both hemispheres of the brain—the whole brain—working in tandem. Author and educator Mihaly Csíkszentmihályi calls it FLOW...a "mental state of operation in which a person in an activity is fully immersed in a feeling of energized focus, full involvement, and success in the process of the activity." This understanding of the brain and the importance of art and arts integration have spurred new thinking about the role of the arts in education. As a consequence, much has been happening in just the last few years, all of which reflect this new reality.

After a decade of studying the human brain we know the arts enhance math and science comprehension. We know that where art-infused education is used to redesign the curriculum, one that is truly integrated, collaborative and interactive, students' attendance dramatically improves, as does performance.

In light of the renewed interest in arts integration, several programs are especially helpful to understand the underlying trends and resurgence of art education:

The Right Brain Initiative (RBI), collaboration among artists, arts organizations, school districts, governments, businesses and donors serving the greater Portland region released a report that confirmed "a meaningful and quantifiable link between integrated arts education and student learning." Specifically, they found that students' reading and math scores increase at least 2.5 times more than the average annual rate of increase; even greater for English Language Learners.

In Dallas, Texas, an organization called "Big Thought" has a program of arts integration called Thriving Minds. Like Portland's RBI, it is an "initiative that brings together organizations that believe in the power of imagination, creativity and innovation to change the way children learn"... "that promote creative thinking, project-based learning and experimentation... students become adaptable problem-solvers who are better able to think critically, express themselves and collaborate with others." Thriving Minds serves more than 115,000 students and families.

The Conference Board, an international non-profit business research organization, with Americans for the Arts, released “Ready to Work”, a study which clearly agrees that “U.S. employers rate creativity and innovation among the top five skills that will increase in importance over the next five years, and rank it among the top challenges facing CEOs.” Confirming their assessment, IBM, after surveying 1,500 corporate executives, reported recently, “Creativity is now the most important leadership quality for success in business, outweighing even integrity and global thinking.”

Perhaps not surprisingly, the new curriculum approach has now caught the attention of the National Science Foundation (NSF), one of the most important federal agencies administering STEM. NSF, made clear in announcing a recent grant in support of Art-Based Learning of STEM, that it hopes that a new model for education will become apparent over the next few years. Specifically, they stated that the money would be used to experiment with a variety of “innovation incubator” models in cities around the country.

In 2014, the National Endowment for the Arts (NEA) also announced its grant agenda in art and science for 2014 and 2015. Proposals that demonstrate how both subjects can be woven together in an artwork, or play, demonstration or lab experiment or even an educational effort in a range of \$10,000 to \$100,000 were welcomed.

The Common Core, also known as the “state standards initiative,” is one of the more intriguing methods to spark new ways of teaching. It is now being adopted across the country and offers unique opportunities to pursue new methods of using the arts as the vehicle for transforming the curriculum. The common core “toolkit” for example, “proposes that educators engage students in inquiry and exploration of real world problems and interdisciplinary performance tasks”, and opens the door to integrating all the disciplines, merging art and science, and fashioning an interdisciplinary curriculum that enhances the thinking skills young people most need.

“Creativity is now the most important leadership quality for success in business, outweighing even integrity and global thinking.”

-as reported by IBM



Renaissance Arts Academy



A bipartisan Congressional STEAM Caucus was formed in 2013, and is currently led by U.S. Representatives Suzanne Bonamici (D-OR), and Elise Stefanik (R-NY). The STEAM Caucus “aims to change the vocabulary of education to recognize the benefits of both the arts and sciences and how these intersections will benefit our country’s future generations.” The STEAM Caucus wrote the Chairman and Ranking Member of the House Committee on Science, Space, and Technology urging inclusion of provisions supportive of STEAM. Specifically, they recommended that “STEAM should be recognized as providing value to STEM research and programs across federal agencies through ‘Sense of Congress’ provisions and language clarifying that current research, data collection, and STEM programs may include arts integration strategies and programs.”

“Overall, more art and science educators, parents, politicians and policy makers are coming to agree that the arts and sciences reinforce one another...”

The Caucus reflects what more and more educators, parents, policymakers and researchers are saying about merging the arts and sciences and creating more meaningful interdisciplinary experiences as the best way to nurture the next generation of leaders and workers for a workforce demanding creativity and innovation.

Overall, more art and science educators, parents, politicians and policy makers are coming to agree that the arts and sciences reinforce one another, create the neural networks that enhance learning and that an educated workforce demands we recognize STEM and STEAM.



Renaissance Arts Academy



Renaissance Arts Academy

The Economic Importance of STEAM

The landscape of manufacturing employment in America has changed dramatically in the wake of technological advancement and globalization. Low labor costs abroad, automation, and digital communications have accelerated these changes. And increasingly, software automation is also changing service sector employment in America.

In a book called *The Jobs Revolution: Changing How America Works*, former U.S. Secretary of Education Richard Riley predicted, “The top 10 in-demand jobs in the future don’t exist today. We are currently preparing students for jobs that don’t yet exist, using technologies that haven’t been invented, in order to solve problems we don’t even know are problems yet.” According to a recent report in the MIT Technology Review, nearly half of all jobs are vulnerable to machines--to applications using information technology. By one estimate reported in an Oxford University study, 47% of current jobs will disappear by 2033.

As America’s workforce changes, so does the world’s. In *The World is Flat*, New York Times columnist Thomas Friedman observed that every nation, every community, and every person is competing with every other. Not surprisingly, a whole new economy based not on manufacturing or even service provision, but on knowledge or more precisely creativity and innovation is taking shape. The economies in the world are now knitted together and competing for these knowledge-based jobs, the dollars they offer, and the enhanced quality of life such jobs create.

Despite these seismic economic changes, American public education has not yet changed to ensure our young people have the skills they need to succeed in a knowledge economy. Sir Ken Robinson, a leading expert on creativity, notes, “School systems are the product of the Industrial Revolution, which began in the middle of the 18th century, and they were designed for particular reasons. They were designed in order to produce a workforce for the industrial economy.” As Robinson reminds us, we need to redesign our K-12 and college curricula to focus on preparing students for this new economy.

One clarion answer to these educational challenges is the fusing of both STEM and arts education. In light of technological advancements and economic changes, economists and political leaders are calling for another Sputnik-level investment in science, technology, engineering, and math to create an innovation economy—one dependent on creativity and imagination. President Obama, has said that “We need to out-innovate, out-educate, and out-build the rest of the world.” In many ways, Secretary of Education Arne Duncan could have responded to President Obama when he said, “Arts can no longer be treated as a frill...arts education is essential to stimulating the creativity and innovation that will prove critical for young Americans competing in a global economy.” The argument Duncan makes is simple: arts education stimulates creativity and innovation, critical for young Americans competing in this new economy.

President Obama, has said that “We need to out-innovate, out-educate, and out-build the rest of the world.”

Best Practices

After extensive review of the applications by the innOVATION STEAM grant panel, it was clear the highest-ranking schools shared some similarities, or best practices. The panel found that high-quality STEAM education:

- Incorporates the expertise of both STEM and arts educators to create an authentic interdisciplinary experience for students: co-teaching model / co-planning is strong & replicable;
- Is thoroughly planned, including the identification of state or national standards in each subject area, balancing standards offered from each subject equally;
- Borrows from scientific method, the iterative artistic and creative processes, and artistic production and exhibition as critical milestones in the experience;
- Has the buy-in of school administrators;
- Leverages local artists, artisans, scientists, area nonprofits and other experts, as appropriate;
- Is well-documented through photography, lesson plans and other means, as a method of advocacy and to ensure partnership longevity for STEAM as a new instructional method;
- Has a tangible outcome, such as an artistic product, scientific experiment, architectural or design specs or other artifacts;
- Allows students to direct their own learning through experimentation, positioning teachers as guides and personalizing learning;
- Leverages real-world connections wherever possible and highlights the nexus of career and technical education and the arts;
- Includes built-in, tailored assessments that help students and teachers understand what students have learned and what they have not;
- Includes solid, clear and well-constructed rubrics that integrate the arts.

Awardees

The 2013-2014 innOvation STEAM Grant Award recipients selected represent the interest and commitment to arts integration and excellence in education. We applaud these awardees (fuller descriptions follow):

- BOSTON ARTS ACADEMY
Boston, MA
- DAYTON REGIONAL STEM SCHOOL
Kettering, OH
- HIGH TECH HIGH MEDIA ARTS
San Diego, CA
- HIGHLAND PARK MIDDLE SCHOOL
Beaverton, OR
- KENNEDY ELEMENTARY SCHOOL
Janesville, WI
- NATIONAL INVENTORS HALL OF FAME CENTER FOR STEM LEARNING
Akron, OH
- QUATAMA ELEMENTARY SCHOOL
Hillsboro, OR
- RENAISSANCE ARTS ACADEMY
Los Angeles, CA

Boston Arts Academy

Boston Arts Academy (BAA) is Boston's only public high school for the visual and performing arts. BAA believes that the arts and academics are equally important to the development and achievement of students. BAA serves 440 students from predominantly low-income families (71%) and from every Boston neighborhood, reflecting the diversity of the city: 43% are Hispanic, 38% are African American; 14% are White; 3% are Asian; and 2% are mixed race. Thirty percent of the students come from homes where English is not the first language. Nearly one-third of the students read below grade level when they enter BAA. All students, regardless of learning, physical, or social/emotional abilities, are part of the school community because BAA is a full-inclusion school. BAA's rigorous arts education and full college preparatory curriculum foster success for all – an average of 94% of BAA graduates are accepted to college.

BAA is one of the only arts schools in the country that is academic-blind, admitting students solely on the basis of artistic potential. Formal study of the arts is not denied to students who struggle academically but may otherwise have untapped artistic potential. The arts help renew their commitment to school and help build a pathway to success.

STEAM at BAA: Experts estimate that as many as 65% of today's grade school students will thrive in occupations that have not yet been invented. BAA's STEAM approach is designed to prepare students for this reality. Arts-integrated, interdisciplinary STEAM teaching and learning has been a goal of the school since it opened in 1998 and in 2010, the math, science and engineering faculty officially merged to become a STEAM team.

STEAM classes are project-based and interdisciplinary, which encourages students to experiment, revise, and try again – much like the process of creating great art. BAA also continues to meet the state and national standards for math and science. Not only do the arts help students gain a deeper understanding of science and math concepts, but also the reverse is true. Learning science and math gives students a new perspective on music, dance, theatre, or visual arts. At BAA, the STEAM approach empowers students to communicate their knowledge to others more effectively – in essence, showing students that they “can do” math and science.

At Boston Arts Academy, the “A” in STEAM stands as much for access as it does for the arts. BAA students come from communities that are traditionally underrepresented in the science and math fields. In schools with a primary focus on STEM, special needs and minority students often continue to be underrepresented. Through STEAM, BAA is committed to serving all of its students.

Curriculum: The BAA STEAM team has documented its work since 2010 and has developed over 30 different curriculum units. Examples include learning basic coding to create animations on a graphing calculator, using trigonometry to design a lighting plot for theatre performances, and designing and fabricating scaled IKEA furniture for 12” and 3” dolls using a 3D printer. BAA also creates opportunities for its students to work with artists, engineers and scientists from the community during short interdisciplinary residencies. A longstanding partnership with TERC, a Cambridge-based education research organization, and the National Science Foundation, offers another example of the BAA STEAM work. Over the last five years, this collaboration has been co-creating science curricula through an arts lens.

BAA STEAM Lab: BAA is the first urban public arts high school in the country to establish a STEAM Lab. Opened in Fall of 2014, the STEAM Lab is a unique “maker space,” outfitted with technological tools and arts materials that allow students and teachers to devise novel solutions to problems, and generate innovative ideas and products. Students are accessing knowledge in new ways, understanding concepts differently, and finding new points of entry into math and science through art and technology. Using a 3D printer, a laser cutter, soft circuitry, conductive materials, and electro-mechanical devices, students are integrating robotics, TouchBoards, and electronics into movement, music, imagery, and new media production. Urban public schools struggle to keep pace with the ever-changing array of technology and resources. The STEAM Lab provides our students with the same opportunities that are available to their peers in better-resourced communities, and gives them the opportunity to explore careers in science and technology, pathways that they may not have previously considered.

Dayton Regional STEM School

The Dayton Regional STEM School (DRSS) is one of 12 STEM Schools in Ohio funded through House Bill 119 and launched in partnership with Wright State University. The mission of DRSS – ‘to prepare students with the skills necessary to compete in the global economy while nurturing in our young people the same enthusiasm for discovery, invention and application that launched the vision for powered flight’ – is inspired by the Dayton region’s history, and aimed at ensuring our community’s future success. This public school is the only STEM school in the state serving more than one district – currently drawing 610 students in grades 6-12 from 8 counties and 33 school districts.

DRSS teachers utilize a Project Based Learning (PBL) model that supports the instructional mission of preparing students to succeed in the professional world. Projects encourage critical thinking and problem solving skills while students achieve and demonstrate personal and academic goals, and engage with professionals in relevant fields of study or professional life.

DRSS equips students for college and career success with a focus on fostering five important 21st Century skills: persistence, inquiry, communication, creativity, and collaboration. Critique and reflection are key components in project development and students create digital online portfolios featuring projects that illustrate growth in relation to the qualities. In addition to presenting their portfolios to professionals and community partners, students engage with local businesses and organizations through curriculum based projects, power lunches, and job shadowing.

DRSS serves as a platform for teacher training & coaching, hosting visiting teachers (as far as Kosovo) and administrators for site visits, workshops and mentorships supporting other school districts wishing to implement Project Based Learning or learn more about STEM education.

The DRSS Visual Art program offers stand-alone classes and integration of Art into STEM and Humanities classes supporting students in a range of experiences with art curriculum that is structured to be project-based, inter-disciplinary, and collaborate in nature – allowing students to experience connections between arts and the creative process across disciplines and to recognize applications in professional and daily life. In Art, students have opportunities to make, respond to, and present artwork related to their interests and concepts they are learning in other classes. Exploring and expanding students’ personal voices through various media, design process thinking, and decision-making, is the goal of the program.

Art I is offered to all freshman. Curriculum is closely tied to their other courses such as Physics and Engineering Design where students construct wooden puzzle cubes based on drawing and 3D modeling. Projects integrating Socials Studies and Language Arts such as block printed posters relating to social justice issues, and Chinese class such as traditionally painted scrolls illustrating ancient poems are additional examples. The Art I class annually collaborates with 10th grade Biology on cross-discipline, cross grade level projects such as the Beautiful Biomes project.

DRSS teachers work in grade level teams and share curriculum plans vertically across grade levels. This level of sustained communication allows instructors to make natural connections between subjects in order to create dynamic, meaningful experiences for students that are content rich. Art plays a central role in this process. In addition to teaching Art classes, the Art instructor works with teachers to help coordinate arts integrated curriculum in their classrooms, provide materials and technical support, establish connections with guest artists and organizations to bring outside expertise, as well as coordinate the exhibition of student work publicly.

DRSS recently completed a renovation of its existing space from 40,000 square feet to 85,000 square feet. Classrooms are designed with an open door policy in mind – including windows into hallways or adjacent classrooms, and in the case of the art and engineering rooms, floor-to-ceiling glass walls. Visitors can witness the investigation of artistic concepts and the design process being infused into lessons across grade levels. They see students learning the value of critique in creating quality products as they work through multiple drafts, hone technical skills and refine their aesthetic awareness. There are designated open classroom spaces for collaborative work, in addition to multiple conference rooms.

High Tech High Media Arts

High Tech High began in 2000 as a single charter high school launched by a coalition of business leaders and educators. It has evolved into an integrated network of 11 schools spanning grades K-12, housing a comprehensive teacher certification program and a new, innovative Graduate School of Education. High Tech High Media Arts (HTHMA) serves 409 students grades 9-12. Founded in 2005, HTHMA implements the following HTH design principles and features a focus on a college-going culture supported through a strong liberal arts and sciences foundation.

Personalization: Teachers know their students well, and are committed to a learner-centered approach that supports and challenges each student. Through projects, students pursue passions and reflect on learning. Special needs students are supported through a full inclusion model. Each student has a faculty advisor and meets regularly to build community, support academic progress, and plan for the future.

Adult World Connection: Students connect their studies to the world beyond school through field studies, community service, internships, and consulting outside experts. Students routinely create work for authentic audiences and exhibit it in professional venues. All 11th grade students complete internships in the world of work and service, where they develop projects that contribute to the workplace. The schools have a distinctive “workplace” feel, with windowed rooms, small-group learning/project areas, laboratories equipped with modern technology, wireless access, and areas for artwork and prototype display.

Teacher as Designer: Teachers are program and curriculum designers. They work in interdisciplinary teams to design the courses they teach. They participate in critical decisions regarding curriculum, assessment, professional development, hiring and other areas of the school. Teachers have ample planning time to devise integrated projects, common rubrics for assessment, and rituals by which students demonstrate learning and progress toward graduation.

HTHMA is a progressive project based learning high school that holds cross-curricular teacher collaboration between the arts, mathematics and sciences as a central tenant of its pedagogy. HTHMA facilitates design principles of personalization, adult world connections, common intellectual mission and teacher as designers for grades 9-12 in a highly collaborative student environment. Our school focuses on serving all students to fully engage in cutting edge projects and technologies by bridging the gap between academic disciplines. Students are afforded block schedule classroom experiences immersed in conceptual and practical investigations into the intersections between academic disciplines. At HTHMA, students articulate these complex interdisciplinary concepts through rigorous hands-on projects. STEAM curriculum pairings include projects grounded in math and design, environmental science with humanities and the arts paired with computer science. Some examples of STEAM student projects include algorithmic music composition, environmental science sound art, cartographic animation art and mathematical based sculpture.

HTHMA students are also supported in their STEAM pursuits through school-wide design critiques with peers and expert community members from a diversity of interests and fields. Through rigorous processes in critique and revision, students receive constructive feedback from a variety of experts and disciplines on how to develop their projects so that they are meaningful and relevant. At the conclusion of each semester, students present their final works for community viewings and teacher assessment in public spaces such as The Museum of Contemporary Art, The Museum of Photographic Arts, Ruben H. Fleet Science Center, and the University of California, San Diego. In this context, students dialogue with the public through their interdisciplinary work and are able to demonstrate their innovative projects, thinking and growth.

HTHMA is well positioned to serve as a model STEAM program because of high student achievement rates, which is a big part of HTH schools’ success story: 99% HTHMA students go to college; 89% of graduates have finished or are still enrolled in college; 34% of graduates choose STEM careers; 41% of HTHMA students’ families qualify for the National Free and Reduced School Lunch Program; all 11th graders do an intensive internship, working in professional settings aligning with their interests giving each an authentic connection to the adult-world they will enter after high school and college. Also, HTHMA is a good example of STEAM programming because of how widely available projects are to external teachers and students. The existing in-person mechanisms in place at HTHMA for the dissemination of practices are diverse (i.e., credentialing, regular tours, residencies, and other outreach services & publications that are part of the HTH Graduate School of Education) and can also be found online; accessible anywhere there is an internet connection.

Highland Park Middle School

Highland Park Middle School is a suburban middle school in Beaverton, Oregon, and is one of the oldest middle schools in the Beaverton School District currently serving 900 students in sixth, seventh and eighth grades. Highland Park families range from affluent and middle class families to working class families and individuals who are currently living in poverty and are homeless. There are also multiple religions practiced and languages spoken by our students. Students self-identify themselves as 61% White, 19% Hispanic, 9% Asian, 9% Multiracial and 2% African-American. During the 2014-15 school year, 32% of our population received a free or reduced lunch and breakfast plan.

Our mission is to provide a well-rounded education for all students so they may be college and career ready upon graduation. We meet this goal by focusing instruction around the themes of collaboration, equity, innovation, and excellence. In addition, instruction is centered around the foundations of education by: learning through a unique, experimental and collaborative process; inspiring creative, critical and analytical thinking; providing a rigorous and technologically enhanced curriculum; creating educational opportunities for students that will broaden their experience and meet future school and work force needs; assisting our children in becoming globally competitive in the world economy, and incorporating researched-based information with our community-based partners.

Highland Park's STEAM approach facilitates a learning experience driven by problem solving, discovery, and exploratory learning by creating collaborative learning opportunities between core and elective classrooms. By weaving a STEAM culture into all subjects it allows students the opportunity to connect what they learn across many classrooms with what they see in the world around them. During the 2014-15 school year STEAM planning and programming focused on professional development for teachers and implementing STEAM-focused integrated units of instruction across the curriculum. Cross-curricular partnership teams exist between science and physical education/health and art; 6th grade math, drama and physical education, 7th grade math, fine arts and science, 8th grade math and performing arts; and humanities, fine arts, technology, and world languages. Each of these partnerships created a series of lessons that are being taught in the different classrooms across the building during the 2015-16 school year. Lessons created by these partnerships continued to be implemented across all curricular areas. By the 2015-16 school year all three core content areas will be implementing lessons in partnerships with all three elective specialties. Specifically, band, drama and fine art will have lessons and units that are aligned with humanities, science and math common core targets in a standards based system.

At Highland Park Middle School the interdisciplinary units of instruction grounded in Common Core learning targets, standards based instruction, and student-centered lessons is innovative and visionary. The cross-curricular partnerships are imbedding innovation, learning targets and common language across the school. Even though Highland Park is in year three of implementing a STEAM vision, we have already seen shifts in practice and collaboration. For example, the band instructor is guest teaching in 8th grade math classes to make connections to reading music and understanding fractions. This is partnered with our music students becoming teachers themselves and sharing with their peers how to read music and make connections to math concepts. In addition, the fine arts teacher is teaching origami and traditional Japanese arts in connection to geometry common core targets being taught in math. Students are not only learning origami, they are applying geometry in art, and art in geometry. To meet the 6th grade learning targets on budgeting, the math and drama students are using productions, currently being staged by the Oregon Children's Theater, to apply a real-world example to their learning. The students are learning how to stage a production in drama, build and maintain a budget in math, and will apply both concepts when they visit the Oregon Children's Theatre to interact with the director of the production and watch the play. As our STEAM-focused work deepens we have created strong bonds with community partners such as The Wisdom of the Elders, who brings local Native American story tellers into our classrooms to tell indigenous stories in relation to our study of climate change and science, and Clean Water Services who is working with our students in designing a bio-swale that not only teaches about the water cycle, but also includes student-created art.

Kennedy Elementary School

Kennedy Elementary is a public school located in Janesville, Wisconsin, serving approximately 380 K-5 students, with close to a 50% poverty rate. Kennedy's Mission Statement reads: "Enter with hope and aspiration. Learn with dignity and enthusiasm. Leave with pride in self and community." A strong sense of community is a distinguishing feature at Kennedy School. The building architecture visually represents the integral role of community with "neighborhoods" (a Kindergarten Neighborhood, a 1st and 2nd Grade Neighborhood, a 3rd and 4th Grade Neighborhood, and a 5th Grade Neighborhood), all uniquely designed to promote teamwork and collaboration. In addition, strong community develops because students typically "loop" with the same teacher for two years—thus, strengthening relationships, fostering academic success, and allowing for long-range, comprehensive STEAM projects.

Kennedy School recognizes the unique demands of the 21st Century, and therefore, relies upon STEAM as guiding philosophy for its educational approach. The curriculum and teaching methods are relevant to the culture of modern age, embodying an ardent belief in the value of integration. Throughout our everyday world, subjects do not exist in isolation; similarly, learning is maximized through interdisciplinary contexts. Kennedy embraces STEAM by utilizing the Arts as an incredible vehicle for integration. One of Kennedy's core belief statements reads: "[...] visual and performing arts enhance the development of the whole child." By providing dynamic, engaging, and innovative instruction, Kennedy staff is steadfast in their commitment to inspire students' desire for life-long learning and to develop critical and creative thinkers.

Overall, Kennedy delivers STEAM by integrating the Arts with STEM (and other curricula). Arts Integration is accomplished through a rigorous and systemic framework for integrative lesson design. Kennedy staff regularly participates in professional development related to Arts Integration. Additionally, staff possesses a strong knowledge of benchmarks and standards across subject areas. As teachers design and plan for their curriculum delivery, they identify conceptual areas where diverse academic standards overlap. At this point of overlap, the Arts become profound impetus for integration. The Arts provide a resonance between disciplines – facilitating amazing possibilities for student discovery, innovation, critical-thinking, and creativity.

While Kennedy strives to build critical-thinking and creativity among its students, staff demonstrate these qualities as well. Being critical and creative thinkers means being visionaries and acting upon bold ideas. Profound accomplishments are attainable through the composite of staff initiative and students' talent. For example, Kennedy's 2014 Dance Residency—Water Bridges: connecting environmental advocacy, arts, and academics incorporated a magnitude of design and scale virtually unheard of at the elementary level! Students culminated their integrated curriculum work with a visiting dance artist through two public performances, featuring almost 400 K-5 children who showcased their own original choreography. Many of Kennedy School's recent Arts Integration endeavors, such as the Dance Residency, have earned local, national, and even international, recognitions.

Kennedy truly incorporates a breadth of STEAM initiatives throughout its curriculum, ranging in scale from small to large. Below is a short "success story" from a sample third grade Science/electricity/Dance lesson:

Movement helped students embody concepts of open vs. closed circuits and the need for a continuous flow of electrical current through closed connection points. The teacher delivered this movement lesson twice: to her class and to the other third grade class. Meanwhile, the other teacher administered a district-mandated Science test about electricity. One ELL student was frustrated to the point of tears during the written portion of the test, and he was unable to finish. The next day, it was his class's turn to participate in the movement lesson. Afterward, he created a written reflection, now easily incorporating specific Science vocabulary. The teachers realized they had stumbled upon an experiment of sorts. Class A, a "control" group (with the ELL student), had taken its test before participating in the movement lesson. Class B had taken its test after the lesson. Class B had 100% of the students correctly distinguish between open and closed circuits on the written portion of the test, while Class A had approximately 20% of the students answer incorrectly. Also, Class B more frequently incorporated new vocabulary from the movement lesson in the test's written responses. Looking at this short example, a STEAM lesson indeed proved to maximize student success.

Kennedy's commitment to STEAM education is incredibly beneficial for its students. Over the last several years, Kennedy has been identified as a school that "significantly exceeds expectations" on its state standardized test. The strong scores, particularly among minority students, helped earn Kennedy School the National Blue Ribbon Award in 2011.

Kennedy School is proud to embrace STEAM philosophy and to serve as a leader throughout the educational community.

National Inventors Hall of Fame Center for STEM Learning

The National Inventors Hall of Fame® School ... Center for Science, Technology, Engineering and Mathematics Learning (NIHF STEM) is designed to let students work collectively with inventors, STEM-related businesses and organizations, and faculty and students from The University of Akron. Forged by six institutions of the city of Akron in 2009, this middle school currently houses 430 5th – 8th grade learners.

The school allows students to take intellectual risks and prepare them to become inventive, creative problem-solvers. By infusing the arts into curriculum, more authentic and real “Problem-Based-Learning” and instruction can occur. Visual and performing arts are part of the daily class routine to provide skills necessary for critical and creative thinking, as well as making the students more well-rounded citizens, ready to participate in their own education.

As a STEM school, NIHF STEM is focused on 21st Century learning. There is a shift at the school from compartmentalizing content to teaching subjects integrated with each other, better modeling real life. The visual art space is an opportunity for students to approach a project or problem their own way. Expectations are high and communicated through formative assessments, rubrics, conferencing and individual help. Learners are taught to self-assess and rework their art for better composition and meaning with each assignment. There is similar activity in engineering class, where students learn how to create, solve problems, and design using the engineering design process.

Another method used to accomplish creative and inventive thinking is problem-based learning. Learners are presented with a well-designed, real world question that drives their learning into the content standards to provide a well-rounded deeper understanding of the subject matter. With this focus on real world problem solving, students are encouraged to think creatively and outside the box. NIHF STEM is seen as having a distinctive approach to fostering creativity and innovative thinking in all students through STEM components.

Digital Literacy class is embedded into students’ schedules and integrates arts deeply. The course was designed using information literacy standards, technology standards and visual arts standards; technology is the tool, not the outcome. Students are pushed to a higher level thinking by discussing art concepts digitally. As students design presentations, publications, videos, and use web 2.0 tools creatively with available technology, principles of design are taught, reinforced and utilized to communicate meaning. This intentional and purposeful designing leads to strong, well-designed products from learners. As students move from core subjects to other subjects, there is emphasis on creative problem solving, designing and producing quality final products.

NIHF STEM students present to other schools, community members and at conferences. As a platform school in the Ohio STEM Learning Network, there are a growing group of educators who facilitate schools looking to become STEM schools, STEAM schools or embed STEM components into existing curriculum. NIHF STEM is known as having a distinctive approach to fostering creativity.

“Perry’s Principles,” a segment of Anderson Cooper’s 360° on CNN, followed Akron STEM School learners in a problem-based learning activity helping park rangers rid an area of autumn olive trees. A Newsweek feature article titled “The Creativity Crisis” focused on a noise reduction project at the Akron STEM School that required learners to research material, budgets, aesthetics, and maintenance proposals.

A good example of strong arts integration was 5th grade problem-based learning unit asking the question, “What makes a healthy ecosystem?” Learners were charged with helping to advise nearby landowners as they returned a family farm to wetlands. Time was spent by the art teacher in the science lab and outside in rock gardens, under trees and in the grass looking, observing and drawing. Learners studied field journals of artists and scientists and learned to identify plants, insects and birds by looking at lines, shapes, values, textures and colors. When time came to design and prepare a presentation, students scanned their drawings and used their photography in the digital presentation. All work shown was theirs, and all work was put together into a visually pleasing composition for their presentation of learning.

Quatama Elementary School

Quatama Elementary School is a diverse school with families that speak 25 different languages. Of the 560 students, approximately 250 live in poverty, but come to the school with great potential. Quatama opened as a new K-6 school in the Hillsboro School District in 2008 and became an inaugural Right Brain Initiative school, a new initiative of the Regional Arts & Cultural Council, which is working to achieve equitable access to arts education in the Portland metropolitan area, regardless of neighborhood, language, or income.

Providing real world learning opportunities to all students, Quatama uses an integrated approach to teaching and learning through STEAM. As members of Right Brain and the Portland Metro STEM Partnership, they believe deeply in developing and sustaining partnerships and connections with the larger community to provide the students with innovative learning experiences across the curriculum. This is their equity work, and they are closing the achievement gap by bringing difficult but engaging challenges that are relevant, important, worthwhile, and connected to the cultural and personal lives of the students both in and out of the classroom. Quatama loves the arts and is still learning the power of different art forms and how to bring that power to the students. The same is true for STEM subjects. When Arts and Design are added into STEM, it increases the power of both exponentially. With STEAM they can realize the mission of engaging the hearts and minds of the students.

Quatama is part of the Portland Metro STEM Partnership (PMSP), a regional collective impact partnership of K-12 schools, businesses, community, and university partners which have taken on the challenge of transforming STEM teaching and learning cultures. Arts integration is the secret weapon or ribbon for blending the other content. By “thinking in STEAM” it becomes even easier to think outside of the silos of individual subjects and bring together more meaningful and engaging learning opportunities to meet and exceed state and local learning targets, as well as the “soft skills” that all students need to be successful in life. The arts are woven into the core curriculum to enhance and support teachers’ ability to reach all students with learning that is meaningful. Each year, artists work with the students as well as staff in using arts integration strategies to enhance content.

The most striking aspect of Quatama’s work over the last 5 years is that their approach can be replicated in nearly any school in the country, because it boils down to community partnerships and harnessing the assets of the larger community. Quatama TEACHERS are the agents of change, and are empowered with the resources, expertise, and support needed to change their students’ lives. By collaborating with and supporting teachers with professional development around STEAM integration, Quatama is changing the way they think about instruction both inside and outside the classroom, and the students are the beneficiaries. The school is building partnerships, which will endure beyond the grant-cycle or a funding period, because they are built on a shared emotional investment in the students at the school. With focused determination while learning from successes and failures, the Quatama family has built and is still building this STEAM school.

The best success stories are anecdotal:

- Engagement and vocabulary: Students working with an artist created a ceramic mural while learning about soil, erosion, fossils and native plant life. Following a big storm, a 4th grader bursts out the door, shouting, “check out the sandy loam,” as he observes the changes in the erosion inquiry project.
- Kinesthetic Math: 6th graders create (and use!) dance positions to master the “order of operations” to solve difficult math problems.
- Freedom to fail: During an electricity activity, students learned from an artist that you have to check every part of the circuit in your wire sculpture when it doesn’t work the first time. When the artist’s sculpture did not light up on the first try, she persisted to make it work; there were no 2nd graders who gave up after just one or two unsuccessful tries.
- Breaking stereotypes and building science knowledge: Despite adult skepticism, upper grade boys literally soared with the Oregon Ballet Theater teaching artists as they learned and internalized the water cycle.

Renaissance Arts Academy

Co-Directors PK Candaux and Sidnie Gallegos Myrick founded RenArts in 2003 to provide equitable arts training to public school students in the belief that arts achievement and academic excellence go hand in hand. RenArts is an academically rigorous public arts school with a mandatory STEM emphasis and a tuition-free afterschool conservatory program. RenArts has an interlocking academic and arts program in which all instruction is inter-related in both content and design, and all students participate fully.

Renaissance Arts Academy cultivates autonomous scholarship in an ensemble setting by providing an integrated classical curriculum focused on music and performing arts disciplines. Instruction takes place in flexible multi-age groups in a large open classroom located in a converted warehouse setting. RenArts serves 375 6th - 12th grade students from all backgrounds, developing 21st Century citizens through challenging academic inquiry, collaborative small-group instruction, and professionally guided arts training. Admission is by random lottery.

RenArts has no auditions or prerequisites - 95% of incoming students have no prior arts training. Students develop artistic discipline as an alternative gateway to intellectual inquiry in all subjects. RenArts serves a diverse population in Northeastern

Los Angeles: 67% economically disadvantaged; 32% English learners; 10% special needs (IEP/504); 59% Hispanic/Latino; 24% White; 9% African American; 4% Filipino; 3% Asian.

RenArts has a 100% graduation rate and 97% of graduates attend 4-year universities, including acceptances ranging from MIT, Caltech, Harvard, Berkeley and UCLA to USC Thornton, IU Jacobs and Juilliard.

Over the past decade, RenArts has developed and piloted a schoolwide instructional reorientation toward Integrated Enrichment learning in all subject areas. This cross-curricular integration of content and concepts is rooted in joint, inquiry-based professional development building on the strengths of RenArts' entire faculty team: academic specialists regularly collaborate with resident professional artists, curating materials and experiences for schoolwide intellectual and creative projects. Through shared curricular goals, the RenArts faculty team helps students re-imagine their relationships to science and mathematics. By providing enriched learning experiences for all students, RenArts' faculty focuses on underlying critical thinking and creative problem solving functions, the coherence of STEM study from year to year, and the layering of various models for solving problems. Integrated Enrichment learning sets student expectations far beyond minimal proficiencies and allows them to collaborate in applying interest, knowledge, ideas, and discipline to the investigations of real problems through metacognitive inquiry, hypothesis testing, linguistic analysis, and heuristics.

Students and faculty build on this curricular integration to develop schoolwide, student-created performances combining music, dance, technology, sculpture, engineering, and puppetry through speculative themes. In these public presentations, RenArts synthesizes the student work emerging from ongoing collaborative research. In recent projects, student choreography workshops and music composition groups created a joint work exploring binary code, and the STEM team collaborated with the dance department and art workshop to explore models for combining human and robotic choreography. Through joint professional development, STEM faculty and resident artists work together to calibrate academic and Conservatory programs in response to student needs. Recent adjustments include specialized music classes to support advanced repertoire, physics of movement to build dance technique and choreographic skills, rhythm workshops to analyze and coordinate music, dance and technology collaborations, and STEM workshops to explore and implement program-based video, audio, structural and conceptual engineering.

RenArts has been widely recognized for its exemplary academic and arts programs, and its history of success for all students. This year RenArts was one of only four schools recognized by the California Department of Education as a statewide model for Career and Technical Education in Arts, Media and Entertainment.

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