Educational Equity Through Community STEM Programming: A Case Study of Portsmouth, Virginia, Public Schools and the AASA – JASON STEM Superintendent Cohort

Introduction: The Power and Significance of STEM Education

Without question, STEM literacy is becoming a hallmark for achieving equity in the 21st century. Graduates who will succeed in our technology-driven, change-dominated, and globally interconnected workplace must become skilled in such areas as science, technology, engineering, and mathematics. Additionally, educational leaders throughout the United States are increasingly supportive of providing an education that is experiential, inquiry-based, engaging for all learners, and focused on ensuring both excellence and equity. The increasing diversity of our nation—and our world—reinforces that "business as usual" is an outmoded paradigm for public education.

AASA the School Superintendents Association and JASON Learning through the national STEM Cohort are actively searching for ways in which students engaged in effective STEM instruction benefit from its integrated, experiential, and engaging approach to teaching and learning. Through its partnership with JASON Learning, AASA is especially committed to helping division educational leaders understand what STEM education looks like in action, particularly in diverse "turn-around" districts that have successfully used STEM education as a catalyst for school improvement and systemic transformation.

The STEM cohort convenes school superintendents and other school system leaders to learn about and to advance STEM access for all students through division level support. The cohort includes over 40 school districts across the nation including districts including Portsmouth Public Schools, under the leadership of Superintendent Dr. Elie Bracy. Through collective action the cohort members study their own practice of STEM implementation in their districts and contribute to national dialogue and leadership for STEM education globally. Since joining the AASA – JASON STEM Cohort, Portsmouth Public Schools has greatly improved the achievement of its richly diverse student population using STEM as an essential organizational catalyst and change agent to advance equity.

Introducing Portsmouth, Virginia, Public Schools

Dr. Elie Bracy recounts with pride, an episode from the 2019 "State of the Schools" address in which he highlighted the importance and impact of STEM on the division's students and schools through by demonstrating the students STEM engagement through a student operated drone: "[Using the drone] was a wonderful symbol of our commitment to STEM education and the way it can empower our learners to become critical thinkers, problem solvers, and technology-adept facilitators. As a result of our focus on STEM education, our students are constantly aware of how their education relates to the world beyond the classroom. We are empowering our students to become life-long 21st century learners."

Portsmouth, VA, Public Schools is located in the Tidewater East Coast area of Virginia:

- The division consists of three high schools, three middle schools, 13 elementary schools, three preschools and an alternative education center.
- The city of Portsmouth is in close proximity to U.S. military installations, including the Norfolk Naval Shipyard and the U.S. Coast Guard Base Portsmouth.
- Currently, the Portsmouth school division serves 13,927 students (50.2% male and 49.8% female) with a staff of 2,064 employees.
- Portsmouth's student body is 72.4% African American, 22.3% Caucasian, 3.5% multi-racial, 1% Asian, 0.4% American Indian, and 0.4% Native Hawaiian.
- 11.3% of its students receive Special Education services.

Key STEM Components of Portsmouth, Virginia, Public Schools

What makes Portsmouth truly unique is how the division is leading its students and community towards equity using STEM to create an organizational pivot that is moving the division away from over-reliance upon test preparation (i.e., a movement away from multiple-choice standardization) in favor of a holistic, comprehensive commitment to active and engaged student learning and authentic progress monitoring. Under Dr. Bracy's leadership, STEM has become a true organizational structure to improve the achievement of its diverse student population. Equity is a systemic commitment—and is reinforced by the division's K-12 commitment to STEM education. Key components of the community-supported and experience-based STEM program include:

- **Curriculum:** A standards-driven STEM curriculum design that is holistic, integrated, and focused on helping students to see real-world connections in what they are studying—and how they are studying it;

- **Instruction:** A focus on student inquiry and investigation of authentic, real-world STEM problems and decisions requiring learners' integration and application of key science, technology, engineering, and mathematical concepts, principles, themes, and skills;

- **Assessment:** Emphasis upon performance-based assessment, including problem-based STEM learning and progress monitoring, with the goal of making assessment meaningful, purposeful, and personalized;

- **Technology:** Sustained integration of technology into the learning process, ensuring that students master key technology concepts, skills, and applications while experiencing the purposeful integration of technology into their daily STEM learning experiences;

- **STEM Enrichment and Extension Experiences:** Providing a rich range of enhancement and extension programs and activities that are available to all students in key areas of STEM, including summer and after-school experiences in addition to various STEM academies;

- **Cross-Institutional STEM Partnerships:** An extensive and growing number of STEM collaborative projects involving local universities, colleges, the military, businesses and corporations, and an extended network of STEM mentors. This process also now includes churches in the Portsmouth region becoming actively involved in supporting—and even teaching—STEM, including providing donations for equipment, technology, and related resources as well as offering STEM enrichment experiences conducted in school buildings and community centers.

Superintendent Bracy explains the importance of the relationship between STEM and community engagement: "We are a unique small community. We are all committed to raising our children together. Part of this process involves a common commitment to equity and its power in shaping our students' futures."

Transformational Leadership in an Effective STEM K-12 division

In Portsmouth schools, STEM has become a hallmark of equity and excellence, reinforcing the key values and leadership priorities advocated and modeled by Superintendent Bracy. This kind of transformational leadership is reinforced by Dr. Bracy's deep commitment to the quality of education provided to every Portsmouth student.

For example, Dr. Bracy is actively involved in asking questions about the design and implementation of the division's STEM curriculum. According to both Laura Nelson, Science Coordinator for Portsmouth Public Schools, and Eleanor Smalley, former superintendent and now president and CEO of JASON Learning. Dr. Bracy is unique in his understanding of and commitment to the very best in STEM teaching and learning. Dr. Bracy's transformational leadership includes his relentless commitment to both equity and excellence as guiding principles for leading the division.

A few highlights of the division's achievements under Dr. Bracy's leadership include:

- **A tireless commitment to equity and the achievement of every learner:** Under Dr. Bracy's leadership, Portsmouth emphasizes the power of students' creativity, ingenuity, and 21st century habits of mind. Learners are currently involved in robotics, health sciences, drone, and digital ship building problem-based learning modules. Portsmouth ensures STEM is for everyone. For example, the division brings all students in grades 4-6 to the division's STARBASE Victory STEM Center for four days of STEM instruction, each year for these crucial three years of learning. In addition, division STEM staff visits fourth-grade classrooms as part of STEM Outreach to help reinforce STEM learning opportunities with students. The division also offers more than 30 STEM summer camp opportunities, which annually brings in more than 500 fourth-12th grade students.

- **Purposeful and sustained progress monitoring in all STEM areas:** When Dr. Bracy first came to Portsmouth, six out of the division's 19 testing schools were fully accredited. Today, 14 sites are fully accredited, with only one site not fully accredited in math and two in science.

- **A commitment to building a true STEM culture:** Portsmouth has demonstrated continuing progress in promoting student success in the STEM areas, including a multi-year history of STEM summer camps, related enrichment experiences for every learner, and rising Standards of Learning (SOL) test scores in mathematics and science. Many classrooms now emphasize the kinds of inquiry, investigation, hypothesis testing, and technology integration associated with effective STEM education.

- **A commitment to teacher professional learning, engagement, and retention:** Portsmouth prides itself on attracting and retaining 21st century teachers who are "fearless" and highly student-centered in their approach to teaching and learning. Under Dr. Bracy's leadership, the division has reduced significantly the teacher turnover rates. These results reflect a heightened sense of collective efficacy and confidence across the division.

- **A deep commitment to the power and value of cross-institutional STEM collaboration:** Under Dr. Bracy's leadership, an extensive number of STEM partnerships are active and growing, including institutions of higher learning such as Norfolk State University, Old Dominion University, Elizabeth City State University, Hampton University and East Carolina University. Dr. Bracy also brought to the division a systemic use of the JASON Learning curriculum (described below), a National Science Foundation grant awarded to JASON Learning, and active involvement of STEM-rich businesses, military installations, and community groups (i.e., STARBASE Victory, Inc.) in supporting various aspects of STEM education.

Qualities of an Effective STEM Curriculum

Curriculum is the roadmap for an effective teaching-learning process designed to ensure that all students achieve proficiency in identified standards and related performance indicators. The Portsmouth curriculum, therefore, is very purposeful and intentional in its approach to ensuring alignment with rigorous Virginia Standards of Learning in science, mathematics, and technology. It also consistently integrates evidence-based best practices for ensuring student engagement, inquiry, and real-world problem solving and decision making. Key elements of the Portsmouth STEM curriculum include the following:

1. **Prioritizing STEM as a Catalyst for Equity and Excellence:** As suggested previously, the Portsmouth STEM program is available to all learners and serves as a conduit for ensuring the every student is engaged and successful in active, inquiry-based, and experiential learning opportunities that reinforce students' sense of relevance and efficacy.

2. **A Commitment to Interdisciplinary Applications and Curriculum Integration:** In moving the division toward 21st century STEM status, Dr. Bracy and his staff are deeply committed to ensuring that all students receive support, coaching, and learning opportunities to see patterns and connections evident in what they study. Portsmouth's STEM curriculum, therefore, emphasizes an interdisciplinary approach. It encourages the integration of real-world problem solving, decision making, and investigation into all students' academic experiences.

3. **Problem-Based Learning:** Effective STEM education is problem-based. It emphasizes critical and creative thinking. It also prepares all learners to develop significant workplace competencies, including academic skills, interpersonal dispositions, and intrapersonal awareness. A major benefit of this approach is its commitment to ensuring that all learners are actively engaged, see the purpose and meaning in what they are learning, and have choices about approach and product whenever feasible.

4. **Clear Organizing Structures (The Five E's):** Curriculum in effective STEM programs is inquiry-based. The Portsmouth STEM curriculum, for example, emphasizes the "5 E's," including authentic, real-world science, mathematics, technology, and engineering tasks and projects (e.g., student projects involving the local shipyards and regional medical facilities in the area). The Five E's model underlies the design and implementation of all curriculum in identified STEM areas:

   - **Engage:** Ensuring that all students understand the "compelling why" of what they are learning and how it connects to themselves and the world beyond the classroom;

   - **Explore:** Providing extensive opportunities for students to engage in experience-based research, hypothesis testing, decision making, and problem solving;

   - **Explain:** Requiring students to frame hypotheses, claims, or thesis statements and use investigations to collect and analyze evidence to support them;

   - **Elaborate:** Encouraging all learners to explain, interpret, analyze, and create STEM-related issues, products, and performances using evidence generated through real-world explorations and investigations; and

   - **Evaluate:** Reinforcing students' critical thinking skills, ensuring that they are informed consumers of information who use criterion-based performance criteria to evaluate their own work processes and products as well as those of peers and professionals in the STEM field.

5. **Use of Research-Based Best Practices:** Currently, Portsmouth is actively engaged in a National Science Foundation Grant (awarded to JASON Learning) entitled "Design and Pitch." It emphasizes the design and "doing" of things, rather than passive learning about them. The division's School Board has been a support for the division's comprehensive STEM efforts. In fact, one Board Members has been a role model in using the 5 E's model in his church's summer youth program and subsequently his work in PreK instruction. This model is powerfully aligned with the curriculum design principles of JASON Learning, including:

   - The grant focuses on turning students' ideas about making the world a better place into a living reality;
   - Design and Pitch STEM challenges ask students to examine significant problems in real-world circumstances and consider how they can create solutions;

- Students meet inventors and entrepreneurs who share their insights into the process of creation, from concept to prototype, pitch, production, and distribution;
- Learners encounter a selection of challenges that can be approached from many angles, using different areas of knowledge, techniques, and technology;
- The student's task is to come up with an innovative solution to a challenge and create a short, engaging pitch to convince a panel of investors that it's worth funding;
- Portsmouth students learn to be clear, concise, and convincing in presenting their big ideas;
- In the challenge on "Operation Lifeline," for example, students find workable solutions to problems caused by natural disasters (e.g., delivering essential supplies like water, food, and medicine in a race against time). The challenge becomes even harder when supplies have to be kept cold the whole time so that they don't spoil.

Portsmouth's Ongoing Partnership with JASON Learning

JASON Learning offers a nationally recognized STEM curriculum built around real-world phenomena and guided by practicing scientists. It emphasizes lessons and units designed to help students think scientifically about the world around them, connect with a diverse group of science role models, and tackle challenging standards-based lessons. Portsmouth has integrated JASON Learning curriculum into all of its Science SOL-tested grade levels (3, 5, 8, and end-of-course). It also benefits from a National Science Foundation grant awarded to JASON learning (described above), providing state-of-the-art STEM professional development for Portsmouth teachers and real-world STEM experiences for learners.

JASON lessons and units focus on standards-aligned labs and related forms of experiential learning. Available units (which Portsmouth has carefully aligned with the scope and sequence of the Virginia Standards of Learning in science, mathematics, technology, and engineering) include:

- Physical Science: World of Waves
- Wetlands: Race to Restore
- Climate: Seas of Change
- Energy: Infinite Potential
- Forces and Motion: Terminal Velocity
- Geology: Tectonic Fury
- Weather: Monster Storms
- Recycling: ISRI Activities Collection
- Ecology: Resilient Planet
- Computer Science: Think Digital
- Immersion Learning: STEM K-6
- Innovation Generation
- Design Thinking Challenges

- Engineering Workplace
- Design Thinking: Water Warriors
- Biology: Living Well
- Design and Pitch Challenges in STEM
- Cutting Edge (Neuroscience Research)
- Quest for Mars
- Mathematics: JASON's ARGO Math

JASON Learning also regularly reaches out to Portsmouth educators for ideas and recommendations. Currently, 50 teachers from the division (grades 4-12) are involved in Design and Pitch inquiry (funded through the JASON Learning NSF grant described previously), emphasizing strategies for helping students gather evidence and draw conclusions. This same approach is reinforced in mathematics and social studies.

Enrichment, Enhancement, and Extension STEM Experiences

Portsmouth is deeply committed to ensuring that every learner has a rich set of opportunities to extend and refine their STEM learning into pathways of personal interest and scientific value. In addition to the requirement that all students spend several weeks annually engaged in the division's STEM academy activities, enrichment options include the following:

- STEM Summer Academies
- Grade Four STEM Outreach for all students - a "push in" initiative at the 13 elementary schools
- Annual STEM Expo: Programs designed to engage parents, guardians, and community members in interactive sessions reflecting STEM education

The Importance of STEM Professional Learning

In Portsmouth, STEM-related professional learning is ongoing, including monthly STEM workshops for teachers and administrators. Science Coordinator Laura Nelson explains that: "Our comprehensive professional development catalog offers a detailed range of STEM workshops and academies, with a major emphasis in our science-tested grades, 5, 8, and high school end-of-course Standards of Learning Tests. We offer extensive training on STEM-related instructional best practices and strategies and the infusion of technology to enhance the STEM experiences of all learners."

STEM-proficient teachers are actively involved in peer coaching and facilitating professional learning workshops at both the school and division levels. Administrators also receive ongoing STEM professional development. Both Dr. Bracy and Laura Nelson stress that: "Our principals, assistant principals, and central office staff receive ongoing support in providing meaningful STEM feedback as part of informal and formal observations. Also, we engage all our principals in an annual STEM intensive and

actively engage them in using the GOOGLE classroom platform as part of their STEM portfolio development process."

The Integration of STEM into All Portsmouth School Improvement Plans

A key element of Portsmouth's success in the area of STEM education is its deep commitment to all professional learning communities being actively involved in monitoring students' achievement in the areas of science, technology, engineering, and mathematics. Portsmouth school and division leaders are actively involved in working with teachers to integrate STEM achievement data and related evidence-based STEM practices into their School Improvement Plans.

According to Dr. Bracy: "Although a majority of schools initially involved in improvement processes used the Virginia State SIP template and process, we added STEM processes, activities, and strategies for all our learners under the same plan. We continue to strive to meets the needs of all our stakeholder groups, including monitoring and adjusting SIPs on a quarterly basis. Additionally, we use state rubrics from the Virginia Department of Education to monitor our curriculum, its implementation in our classrooms, and the alignment of lesson plans with STEM-related standards."

Contact Information:

- Mort Sherman, Executive Director, AASA Leadership Network: msherman@aasa.org
- Bernadine Futrell, Director, AASA Leadership Network: bfutrell@aasa.org