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Governance Brief

Summer and STEAM Make an Ideal Match

by Mary L. Perry

Introduction

The Next Generation Science Standards are challenging educators to think in new ways about student learning and instruction. As part of preparing California students for college and careers, educators and school leaders are encouraged to expand learning beyond the traditional school year calendar and outside of classroom walls.

A growing body of research supports this need to think differently, particularly in the areas collectively called STEAM — science, technology, engineering, art, and math. Research is also helping guide school district leaders on making these changes in ways that most benefit student achievement and public investment.

Is it STEM or STEAM?

In this brief, STEM and STEAM are used inter-changeably. By way of background, use of the term STEM to designate learning in science, technology, engineering, and math became widespread in education, business, and government circles about a decade ago.

More recently, STEM has often been expanded to STEAM. The impetus for this change came from two directions. One was concern that the arts must also be an integral part of the curriculum. The other was more nuanced, reflecting a strong belief that STEM and the arts are closely related.

As The STEAM Journal, published by Claremont Graduate University explains, "Although there is a long history of the interaction of the sciences with the arts, STEAM is a new acronym that has … a multitude of definitions and approaches. Some of the main themes of STEAM are fostering innovation, the need for twenty-first century skills, and divergent and convergent thinking."

An article retrieved from Slate put it this way: "STEAM says we can be better engineers by learning how to think artistically, and we can re-engage artists with science by letting them see how STEM can work in the arts. …In STEAM, creativity is the central tenet. It … addresses, through real-world projects, why the STEM subjects should matter to everyone. And that's how we should all be learning."

The government joined the discussion in November 2015 when the Congressional committee drafting the language for the Every Student Succeeds Act (ESSA) expanded STEM-focused funding to encompass and embrace the idea of STEAM.

STEAM learning – a high priority for schools

As the 21st century continues, it is clear that young people with competency in the STEAM disciplines are more likely to prosper both in their lives and in their careers. A 2014 publication by the Afterschool Alliance describes how STEAM-related learning contributes in three important areas, competency in the modern world, career aspirations, and U.S. competitiveness.[1]

Competency in the modern world

Smart phones, computer-equipped cars, and self-regulating appliances are just a few reminders of the pervasive presence of technology in our lives. We also know they are harbingers of more technology-driven change that will occur during the lifetime of today's students.

Building the capacity of young people in science, technology, engineering, and math — and working with them within the humanistic frame that the arts help provide — is essential. Young people will need a high level of STEAM literacy to

make decisions about their daily lives. And, as citizens, they will need that literacy to understand and act on complex issues such as global climate change, renewable energy sources, and genetically modified foods.

Career aspirations

More pragmatically, today's young people will find that more and more jobs require proficiency in STEAM disciplines. As Krishnamurthi et al explain, "There is great concern that without access to adequate educational experiences, large segments of the population will be unable to participate effectively in the modern workplace."

The STEM Education Coalition cites recent statistics that underscore this concern:[2]

» Between 2014 and 2024, the number of STEM jobs will grow 17% compared to 12% for non-STEM jobs.

» At all levels of educational attainment, STEM job holders earn 11% higher wages compared to their same-degree counterparts in other jobs.

» Almost all of the 30 fastest-growing occupations in the next decade will require at least some background in STEM.

U.S. competitiveness and long-term economic prosperity

U.S. employers have reason to worry when they hear that American students are being outperformed in science and math by young people in many other industrialized countries. A 2014 survey of corporate leaders showed that about 60% of job openings require at least basic STEM literacy and 40% require advanced skills.[3] Other research documents the difficulty U.S. employers have finding qualified workers for jobs requiring advanced computer/information technology or quantitative knowledge.

Girls and students of color are further behind

Even more troubling, students of color and girls tend to be less represented in STEM fields. For example, the STEM Education Coalition reports, "While women represent over 57% of college graduates, the number of women entering STEM fields is only 26% and the number of women in fields such as engineering is even lower, at 22%."[4]

Results on the National Assessment of Educational Progress (NAEP) science assessment provide additional indicators of achievement gaps in science. California students score lower than the U.S. overall student average and within the state, substantial gaps exist. Asian and White students score significantly higher than African American and Latino students, students who are not low income earn much higher scores than those who are from low income families, and boys score somewhat higher than girls (see Table 1).

Table 1: 2015 NAEP Science Assessment-Percent of California Students Scoring Proficient and Above, 4th and 8th Graders[5]

Student Group	4th Graders	8th Graders
White	43%	46%
Asian	47%	44%
African American	11%	13%
Latino	12%	10%
Boys	26%	26%
Girls	22%	21%
Low Income	11%	10%
Not low income	46%	43%
US All	37%	31%
CA All	24%	19%

A lot to do — and summer can be an opportunity of great value

Ambitious STEAM learning goals for all students can leave educators saying there are just not enough hours in the day — or at least not during the traditional school year. That problem is compounded when schools have to also address the impact of summer learning loss, which is disproportionately a challenge for children from low-income families.

For children from higher income families, the summer months frequently include activities, such as camps and vacations, proven to keep children engaged and learning in measurable and positive ways. Such opportunities are not accessible for many lower-income children whose families do not have the resources to provide for these kinds of summer activities. For children in low-income communities, summer is too often an educational drought that results in losing knowledge gained during the school year.[6]

Over the last several decades, researchers have been documenting summer learning loss and the ways that it exacerbates the achievement gap between middle- and high-income students.

A summary of the data from the Summer Matters website includes the following:

» Children from low-income families lose more than two months of reading achievement every summer.

» Summer learning loss explains two-thirds of the ninth grade achievement gap.

» By fifth grade, low-income children without summer learning opportunities are already two to three years behind their peers.

Educators and independent researchers have found that high-quality summer learning programs can have a strong impact. In a recent brief, the National Center on Afterschool and Summer Enrichment reported that "High-quality summer learning programs can not only curb summer learning loss, they can even help boost student achievement. When children continue to learn during the summer, they are healthier, safer, and smarter, and their schools and communities are more successful."[7]

In California, the development of new summer learning experiences offers examples of how school districts can create quality programs that align with learning goals while also engaging and motivating students. Evidence also indicates that summer learning programs support the approaches emphasized in California's new standards, including the Next Generation Science Standards. A 2013 report, for example, found that young people in summer learning programs were tackling complex open-ended questions; making active choices about their learning; working collaboratively; connecting themes and knowledge across subject matter areas; and developing their communication skills, including in public speaking.[8]

Research shows that summer learning and STEAM go together very well

A major strand in many summer learning programs — and sometimes the central theme — has been STEAM subjects. STEAM programming in afterschool and summer has grown at an extremely rapid pace in the past few years.[9]

The afterschool providers who often run these programs have embraced STEAM in part because the hands-on learning it affords fits well with the youth development at the core of their programs. Those approaches in turn align with what researchers report as the experiences that lead students to develop a science identity. According to Krishnamurthi et al, "Development of a science or STEM identity involves multiple pieces: getting young people interested in STEM topics and professions; developing competence and a sense of confidence; and getting youth to envision themselves as contributors and participants in this enterprise."[10]

Similarly, students with informal access to STEAM outside of school often develop interests and aptitude in those fields. Studies document, for example, that participation in informal STEM activities correlates with greater interest in STEM careers and higher test scores on the NAEP science assessments. The ability of these programs to engage young girls in STEM, in particular, has also been well-documented.

As summarized by Krishnamurthi et al, "Settings like afterschool and summer learning programs can be thought of as pollination points in a wider STEM ecosystem, where having multiple locations to learn reinforces students' developing mastery of science, technology, engineering and mathematics skills."[11]

Documented impacts of out-of-school STEM programs[12]

» The programs are successful in engaging and retaining large numbers of students from diverse populations in STEM.

» Participants express curiosity and interest in STEM subjects, in ways that extended that interest in school and out of school.

» As they participate, young people gain real skills and the ability to productively engage in STEM processes of investigation.

» Youth learn essential STEM-relevant life and career skills, such as working in teams and collaborating effectively, as well as making presentations to audiences.

» Participants in many programs come to understand the value of STEM in contributing to society and solving global and local problems. They begin to see how STEM intimately connects to their everyday lives.

» Students display an increased awareness of career options, as well as a nuanced understanding of those careers.

Quality is a critical ingredient for STEAM success

According to research, quality is a crucial pre-condition for ensuring STEAM learning in summer programs. A vast compendium of research and evaluations have helped define what high-quality, productive programs look like.

That work has been summarized by the National Research Council, which concluded that there were three characteristics of successful informal STEM education programs:[13]

» "Productive programs engage young people intellectually, socially, and emotionally. …In such programs, young people are engaged in firsthand, materials-rich, and place-based learning experiences that involve processes of scientific or engineering investigation and practice." Such programs engage young people in ways they find compelling and challenging, that encourages them to continue engaging in STEM learning.

» "Productive programs respond to young people's interests, experiences, and cultural practices." These programs make STEM relevant to young people, support their collaboration and leadership, and train staff to support and develop student interest. By being responsive to young people's prior interests and experiences, these programs enable them to "see STEM as meaningful and relevant to their own experiences and aspirations."

» "Productive programs connect STEM learning in out-of-school, school, home, and other settings." Such programs "explicitly help young people make connections among STEM experiences in and across settings and programs, leveraging community resources and partnerships and brokering ongoing opportunities to engage in STEM learning activities." They also help young people relate what they learn to other settings, including school.

These criteria — combined with additional research regarding program quality — show that teaching STEAM subjects successfully in informal summer programs is vital. To make that happen, school districts have to invest in purposeful planning, staff capacity building, and creative partnerships.[14]

Summer STEAM and the role of school board members

Effective leadership and active support from boards and superintendents are key to successful summer programs. Not only does the board establish the vision and goals for the district, it adopts the budget, sets the policies that provide direction and structure, and monitors program effectiveness.

Researchers offer several recommendations to school boards for building better summer learning programs:[15]
Move summer programs from the periphery to the core of school reform strategies through better planning, infrastructure, data collection, and accountability.

» Strengthen and expand partnerships with community- based organizations and public agencies to tap into existing resources, identify gaps, and improve programs.

» Provide budget and logistical information to participating schools and potential partners by March to allow sufficient time for planning and recruitment.

» Be creative with funding: use multiple sources.

» Create a summer learning task force of local stakeholders who can identify areas of collaboration and planning.

» Change the summer focus from remediation and test preparation to a blended approach of academic and enrichment activities.

Through all its areas of responsibility, the board can also create the expectation that summer programs are part of a school district's overall educational effort and that STEAM subjects should be a particular focus in those programs. To achieve this goal, school districts and their governing boards should treat summer learning equally with traditional school year programs, and include them in the district's central strategy and efforts to reduce the achievement gap in STEAM learning.

Endnotes

1 Krishnamurthi, A. B. (July 2014). Examining the impoact of after-school STEM programs. Afterschool Alliance.

2 STEM Education Coalition Policy Forum. (April 2016). The case for investing in out-of-school learning as a core strategy in improving science, technology, engineering, and mathematics (STEM) education.

3 See endnote 2

4 See endnote 2

5 Summary of data from: National Center for Education Statistics. State profiles. Retrieved November 1, 2016 from http://nces.ed.gov/nationsreportcard/states/

6 California School Boards Association. (2015). Summer learning: as easy as 1, 2, 3.

7 National Center on Afterschool and Summer Enrichment. (2016). NCASE summer learning brief.

8 Summer Matters Network. (November 2013). Putting summer to work: getting a head start on the common core.

9 See endnote 2

10 See endnote 1

11 See endnote 1

12 Afterschool Alliance. (2011). Seizing opportunity: developing quality STEM learning for summer and afterschool.

13 See endnote 2

14 See endnote 12

15 McCombs, J.E. (2011). Making summer count: how summer programs can boost children's learning. Rand Corporation.

Mary L. Perry, is an education consultant with extensive experience in education policy. She was Deputy Director of EdSource for 18 years and served for more than nine years as a school board member in the Campbell Union School District.