Linking After-School Programs and STEM Learning: Proceed with Caution
By Nicole Yohalem, Forum for Youth Investment and
Andrew Shouse, National Research Council

It is both encouraging and daunting when the out-of-school time learning[1] field is "discovered" by a new audience and recognized for its potential to contribute to yet another important societal goal. Whether a politician is responding to the interests of their constituency or a program director is responding to the interests of a potential funder, out-of-school time or after-school programs are being held up as a promising solution to a range of goals including preventing juvenile crime, improving academic achievement, promoting civic engagement, increasing college readiness, improving community safety and reducing childhood obesity. As awareness increases of the important role that science, technology, engineering and math (STEM) skills play in the 21st century, we have a new contender to add to the growing list.

The potential for after-school programs to help young people become scientifically engaged clearly exists. A growing number of studies and evaluations of science-focused after-school programs show promising results in terms of students' science knowledge, identity, interest, and career trajectories (Fereira, 2001, 2002; Furman & Barton, 2006; Hammrich, Livingston & Richardson, 2002; Mulkey, 1990; Rahm, Moore & Martel-Reny, 2005). Lucy Friedman and Jane Quinn put it well when they stated in Ed Week, "Afterschool programs offer an ideal setting for nurturing the potential scientist in every student, as well as reinforcing the science taught during school hours. Compared to the school day, these programs' smaller groups, longer time slots, and less-formal settings provide opportunities for young people to visit museums, study neighborhood environments, cultivate gardens, perform laboratory experiments, and have their love of discovery awakened in countless other ways."

But the fact that this potential exists – and that we can point to exemplary programs around the country that are already helping students develop STEM skills – does not necessarily mean that the after-school field as a whole is ready to successfully respond to a new set of goals and expectations. A realistic calculation of what it takes to deliver high quality, effective after-school programs – and in particular, programs with a STEM focus – is critical if the field is ever going to secure the necessary investments in capacity building that over time could yield the results that funders and other stakeholders seek.

Can after-school programs help young people become scientific thinkers? Yes. Is that the critical question? No. We need to grapple with more nuanced questions. At the program level, under what circumstances can after-school programs contribute to STEM learning? It what ways are after-school programs most able to contribute and toward what specific outcomes? At the broader field level, how can the best of what these programs have to offer be preserved and sustained while taking the logical step of exploring how after-school can play a role in addressing STEM literacy?

---

[1] We use this term broadly, to encompass the fields sometimes referred to as youth development, after-school, informal learning, free-choice learning and out-of-school time.

In this paper we offer what we hope are some useful thoughts about how to proceed in responding to these questions and point to some specific challenges and opportunities to consider while exploring the potential synergy between after-school and STEM learning.

Be careful not to over-promise

While after-school programs have powerful intuitive appeal, and there is no shortage of information about their unique value, the research base behind the answers to key questions like whether, how and under what conditions after-school programs can lead to specific youth outcomes remains thin.

The most promising evidence to date comes from a recent meta-analysis of experimental and quasi-experimental evaluations conduced by Joe Durlak and Roger Weissberg showing that after-school programs can improve academic as well as social/emotional outcomes (Durlak & Weissberg, 2007). However when the authors clustered the studies into two groups for comparison, they discovered programs are most successful when they employ sequential, focused, explicit learning activities and active youth involvement. On average, programs with these SAFE features (Sequenced, Active, Focused, Explicit), showed positive effects for nearly every outcome, while the cluster of programs without these features showed *no effect for any outcome* (Granger, Durlak, Yohalem & Reisner, 2007).

While there is certainly a glass half-full interpretation of these findings, it is important to remember that approximately one-half of the evaluated programs did not make a difference for young people (and keep in mind that programs with sophisticated enough evaluations to make in into this review are already likely atypically strong). Based on the details of the evaluations Durlak and Weissberg reviewed, as well as findings from several studies using observational measures of quality, Granger, et al. (2007), characterize the environments and activities of many after-school programs as "safe but uninspiring."

It is also important to bear in mind that while this review points to a range of socio-emotional and cognitive gains, it did not address the promise of after-school programs to attain STEM-specific results or even more specifically, changes in student course-taking patterns.

Think creatively about the potential added value

Thus far our discussion has been a fairly general one, about adding STEM-focused content to after-school programs. The SERVE literature review (McClure, P., & Rodriguez, A., March 2007) focused specifically on course-taking and identified advanced STEM coursework in high school as an important predictor of later STEM achievement and participation in related careers. Whether and how after-school might influence course-taking behavior or attainment is a different and more specific question than thinking about how after-school programs might generally encourage STEM learning, and addressing it could benefit from thinking outside-of-the-box.

One of the more powerful lessons from the aforementioned meta-analysis (Durlak and Weissberg, 20007) is that programs need not be academically focused in order to achieve

academic impacts. In fact, because the authors were interested in programs with a socio-emotional learning focus, academic-only after-school programs were *not* included in their sample and still, they found positive gains overall for school grades. Similarly, a recent evaluation of Chicago's After-School Matters (Goerge et al, 2007) found that programs without an explicit academic focus (they focus on career awareness and development), had a positive effect on several school-related outcomes including increased graduation rates and attendance.

Given these findings and what we know about the capacity of the after-school field, it seems fair to ask whether offering STEM-related content is necessarily the best or only way for programs to increase the likelihood that students will take advanced STEM courses in high school. How else might after-school contribute?

Rather than train staff to become de facto science or math teachers, what if after-school practitioners were trained to serve as advocates who work alongside parents, students and school counselors to intentionally encourage advanced course-taking? Playing this role requires good communication skills; trusting relationships with parents, students, and school counselors; and knowledge of the curriculum and graduation requirements; characteristics that may be much easier to train to than STEM content expertise. While less content-focused, this approach would ensure after-school programs promote the "continuity" piece of the "engagement, capacity, continuity" trilogy considered critical to ensuring student continuation in the STEM disciplines (Jolly, E.J., Campbell, P.B., & Perlman, L. 2004)

While the scientific knowledge of after-school program staff could be strengthened through high quality professional development opportunities and perhaps through changes to staffing strategies and requirements, it is important to be creative about what assets after-school programs and staff bring to the table and realistic from a workforce and training perspective.

Beware of mission creep

Debates persist about the purposes of after-school programs and how and for what they should be held accountable. Framing after-school as a venue for STEM learning raises legitimate concerns about the encroachment of academic attainment and achievement goals into after-school settings. Could introducing this agenda set some programs up for failure by diminishing their ability to pursue goals for which they might be better suited?

These debates aren't going to go away soon, especially given that federal and state funding for after-school is increasingly coming through education departments. The good news is that the positions may not be as polarized as they appear. Few would argue with the notion that after-school programs can play a vital role in bridging the gap between classroom and community. But there is a difference between impacting academic achievement and increasing engagement in learning, and the devil is indeed in the details of how outcomes are defined and measured.

Adding a STEM content focus to after-school programs could, in theory, undermine what good programs are already doing to help students develop and practice important related skills like communication, problem-solving, and creativity that are critical to success in the 21st century and

related to STEM learning[2]. While not every program would be susceptible to such pitfalls, staff could be distracted by new curricula, mandates and activities; changes made to staffing requirements, qualifications and patterns could have unanticipated negative effects; alterations to schedules could reduce time spent on other important activities; youth who stand to gain a lot form participation could become disinterested and disengaged due to the shift in focus.

A lot of programs already promote opportunities for inquiry, innovation, exploration, career awareness, but without an explicit STEM focus. It is important to ask ourselves how and under what conditions we can enhance this focus without disrupting what programs are already successful at.

Think systemically

If after-school programs are to successfully deliver subject-matter content – in this case STEM – there are several important technical challenges the field will have to address from a system-building perspective.

Alignment
Around the country, emerging after-school systems are developing intentional strategies for aligning program content with school learning. In some places this means orchestrating staff exchanges between schools and programs; in other places it means incorporating specific benchmarks from state standards into after-school program design.

Seattle Public Schools' Community Alignment Initiative is one such intentional effort to strengthen the relationship between schools and out-of-school time providers to maximize student learning. In Seattle's model, teams of after-school providers and school staff work together to complete an alignment plan which lays out how they intend to partner to support children's learning in school and out by specifying details related to use of resources, curriculum and communication. Programs whose alignment plans are approved gain rent-free access to Seattle Public Schools facilities, but must also have a plan for reinvesting the rent savings to maintain or enhance the quality of programming. Programs are accountable to principals for reaching objectives and receive both evaluation and technical assistance support through the district and other key partners like School's Out Washington (Wilson-Ahlstrom, A., Yohalem, N., & Pittman, K., 2003).

Workforce/Professional Development
The successful transfer of any specific content rests on the staff's ability to deliver it effectively. We should not be swayed by the myth of "facilitator-proof curriculum" given the long, unfortunate history of analogous efforts to develop "teacher-proof" school-day curricula (Tyack & Cuban, 1995). Productive learning environments hinge on deeply knowledgeable and committed educators who understand both the learner and the subject matter. This is good news and bad for the after- school field. It is good news because historically, youth workers have been encouraged to build upon learners' interests and strengths and establish productive, often "near-peer" relationships with children and youth. The field's student-centered orientation is an asset we should focus on and think creatively about tapping in efforts to address STEM learning.

---

[2] These skills are in fact related to science learning (Duschl, R.A., Schweingruber, H.A, Shouse, A.W., 2007).

The bad news is that STEM subject matter knowledge is probably thin among current after-school staff. While some programs may already have STEM expertise on staff, the vast majority do not. Staffing after-school programs with STEM expertise in mind will require surmounting challenges that many in education have struggled with to develop the classroom teacher workforce. STEM knowledge in the adult population is thin and those who have relevant credentials can find many lucrative workforce options. In our technology-rich economy this trend is likely to continue, making the challenge of recruiting STEM expertise to after-school increasingly daunting and underscoring the need for creative approaches including targeting groups like college students and volunteers from industry.

Of course, a serious commitment to professional development is a viable response. High quality professional development would focus on raising awareness among program leadership about the importance of STEM, immersing staff in STEM-focused experiences, supporting staff to develop STEM knowledge and dispositions, and providing them with tools and strategies to recreate such experiences for the children and youth they work with. It would provide training over time and help develop a community of STEM educators. Building professional development systems would require partnerships among science-rich institutions (e.g., museums, universities, science centers), after-school programs and schools – an exciting but challenging and expensive proposition.

Curriculum/Program Design
A typical (and potentially important) response to the challenges of improving program quality and infusing subject-matter specific content is to develop, test and endorse specific "high quality" curricula that programs can use to deliver specific content. Multiple efforts are underway to do this now in the after-school field, in STEM and other content areas. Identifying good after-school curricula and adapting classroom curricula for use in after-school programs is an important step. But we know from decades of research in fields like education and public health that implementation is critical.

In our zeal to train staff in STEM-specific content, integrate new tools and materials, and roll out new curricula, we must be careful not to jeopardize those qualities of after-school learning experiences that inspire participation and may actually matter most. We must not let child and youth-centered, voluntary, choice-driven learning experiences give way to a system that takes subject matter seriously but forgets its commitment to providing fun, flexible, engaging opportunities for growth and development.

Assessment
As more after-school programs turn their energies to developing a STEM focus, documentation and assessment of efforts is critical. Analysis of the formative phase of such efforts is crucial to long-term successes. The kinds of questions we need to be asking include what do high quality STEM after-school programs look like? What are the preconditions for developing one? What are the most productive and sustainable strategies for developing staff expertise? Once programs are in place they will need continuous improvement systems that monitor performance and provide ongoing feedback to inform program development.

In fact, if specific references to "STEM" were removed from the above paragraph it would essentially describe key assessment questions the after-school field broadly speaking is now grappling with. At the same time that after-school is being asked to consider new challenges like how programs might contribute to STEM learning, practitioners and researchers involved in maturing after-school systems around the country are beginning to ask formative questions about programs quality and effectiveness. While consensus is beginning to emerge about what constitutes high quality programming and tools are increasingly available to assess quality, important questions remain about what strategies are most effective for building and improving quality (Wilson-Ahlstrom & Yohalem, 2007).

Closing Thoughts

We agree with the assertion in the Coalition's 2007 blueprint that despite the limitations many after-school programs grapple with (tight budgets, under-supported and often inexperienced staff, limited planning time and fragile organizations, to name a few), the potential benefits of connecting after-school and STEM make it worth the effort. But not every after-school program, we would argue, is an appropriate venue for STEM learning. There are likely some baseline circumstances that when present, make pursuing a tighter STEM focus a worthwhile endeavor (relationship with school, program location, access to materials, staffing make-up).

While every after-school program could be encouraged to make sure STEM careers are featured as part of their efforts to expose students to career options, or add the science museum to their list of field trips, every after-school program should not necessarily adopt a specific content focus on STEM. Doing so could undermine good work they may already be doing and reduce the variety of program options available in a community.

References

Durlak, J. and Weissberg, R. (2007). *The Impact of After-School Programs that Promote Personal and Social Skills.* Chicago, IL: Collaborative for Social and Emotional Learning.

Duschl, R.A., Schweingruber, H.A, Shouse, A.W., eds. (2007). *Taking science to school: Learning and teaching science in grades K8.* Committee on Science Learning, Kindergarten Through Eighth Grade. Board on Science Education, National Research Council of the National Academies. Washington DC: The National Academies Press.

Ferreira, M. (2001) Building communities through role models, mentors, and hands-on-science. *School Community Journal,* 11(2)**,** 27-37.

Ferreira, M. (2002) Ameliorating equity in science, mathematics, and engineering: A case study of an after-school science program. *Equity and Excellence in Education,* 35(1)**,** 43-49.

Furman, M. & Barton, A. C. (2006) Capturing urban student voices in the creation of a science mini-documentary. *Journal of Research in Science Teaching,* 43(7)**,** 667-694.

Goerge, R.M., Cusick, G.R., Wasserman, M., & Gladden, R.M. (2007) *After-School Programs and Academic Impact: A Study of Chicago's After School Matters.* Chicago, IL: Chapin Hall Center for Children**.**

Granger, R., Durlak, J., Yohalem, N., and Reisner, E. (2007, March). *Improving After-School Program Quality.* A working paper of the William T. Grant Foundation. New York, NY: William T. Grant Foundation.

Hammrich, P. L., Livingston, B. & Richardson, G. (2002) *The sisters in science program: Barriers broken and lessons learned.*

Jolly, E., J., Campbell, P.B., & Perlman, L. (2004). *Engagement, capacity, and continuity: A trilogy for student success.* GE Foundation. Retrieved December 12, 2006, from http://www.smm.org/ecc/ecc_paper.pdf

Mulkey, L. M. & Ellis, R. S. (1990) Social stratification and science education: A longitudinal analysis, 1981-1986, of minorities' integration into the scientific talent pool. *Journal of Research in Science Teaching,* 27(3)**,** 205-17.

McClure, P., & Rodriguez, A., (2007, March). *Factors Related to Advanced Course-Taking Patterns, Persistence in STEM, and the Role of Out-of-School Time Programs: A Literature Review.* Commissioned by the Coalition for Science After-School. Greensboro, NC: SERVE Center at University of North Carolina, Greensboro.

Rahm, J., Moore, J. C. & Martel-Reny, M.-P. (2005) The role of afterschool and community science programs in the lives of urban youth. *School Science and Mathematics,* 105(6)**,** 283.

Tyack, D., & Cuban, L. (1995). *Tinkering towards utopia: A century of school reform.* Cambridge, MA: Harvard.

Wilson-Ahlstrom, A., Yohalem, N. and Pittman, K. (2003). Out-of-School Time Policy Commentary #5: Inside the Black Box: What is the Content of After-School? Washington, DC: The Forum for Youth Investment, Impact Strategies, Inc.

Wilson-Ahlstrom, A., & Yohalem, N., with Pittman, K. (2007, March). *Building Quality Improvement Systems: Lessons from Three Emerging Efforts in the Youth-Serving Sector.* Washington, D.C.: The Forum for Youth Investment, Impact Strategies, Inc.