Realizing the Vision of the *Framework*

By Linking Formal and Informal STEM Education

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Abstract

New science education standards provide new goals and a common language for formal and informal educators to collaborate more closely than ever before. In opening these lines of communication it's important not to lose sight of the vision projected by the *Framework for K-12 Science Education.*

The science education community is paying a great deal of attention these days to the *Next Generation Science Standards* (NGSS/Achieve 2013). While in my view that is a good thing, it is important that we not toss out the *Framework*, which not only provided the blueprint for science in schools, but also opened the door for closer collaboration between formal and informal science educators. Here's why.

A Framework for K-12 Science Education: Practices, Core Ideas, and Crosscutting Concepts (NRC 2012*)* is rooted in a small number of core ideas in the major disciplines of science that play out across K-12. It demonstrates the unity of science by emphasizing concepts that cut across disciplinary boundaries. The *Framework* also includes engineering and science practices such as asking questions, planning and conducting investigations, and arguing from evidence. The *Framework* also includes core ideas and practices in technology and engineering with connections to mathematics, so that it is fair to say that the *Framework* provides a vision of STEM (Science, Technology, Engineering, and Mathematics) education. Although the *Framework* describes what students are expected to know and be able to do, the document also refers to the importance of capturing students' interests and the valuable role that informal education can play in engaging students in STEM by sparking their interests, leading to motivation and persistence. For example:

> *Research suggests that personal interest, experience, and enthusiasm—critical to children's learning of science at school or in other settings— may also be linked to later educational and career choices. (Framework, p. 28)*

> *Discussions involving the history of scientific and engineering ideas, of individual practitioners' contributions, and of the applications of these endeavors are important components of a science and engineering curriculum. For many students, these aspects are the pathways that capture their interest in these fields and build their identities as engaged and capable learners of science and engineering. (Framework, p. 249)*

> *Learning science depends not only on the accumulation of facts and concepts but also on the development of an identity as a competent learner of science with motivation and interest to learn more. (Framework, p. 286)*

The purpose of the *Next Generation Science Standards* (*NGSS*) is to operationalize the *Framework* by combining all three dimensions—core ideas, crosscutting concepts, and practices—in the form of *performance expectations*, which specify what students are expected to know and be able to do. In other words, the NGSS has the limited goal of providing assessment targets. The document is not intended to guide curriculum development or teaching. All performance expectations are in the cognitive domain. That is, they are concerned with knowing, thinking, and reasoning about science and engineering. Here's what the NGSS has to say about the affective domain:

> The affective domain, the domain of learning that involves interests, experience and enthusiasm, is a critical component to science education. As pointed out in *A Framework*

> *for K-12 Science Education*, there is a substantial body of research that supports the close connection between the development of concepts and skills in science and engineering and such factors as interest, engagement, motivation, persistence, and self-identity. . . . . The NGSS strongly agrees with these goals. However, there is a difference in the purpose of the *Framework* and the NGSS. The *Framework* projects a vision for K-12 Science Education, and includes recommendations not only for what students are expected to learn, but also for curriculum, instruction, the professional development of teachers, and assessment.
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> The purpose of the NGSS is more limited. It is not intended to replace the vision of the *Framework*, but rather to support that vision by providing a clear statement of the competencies in science and engineering that all students should be able to demonstrate at subsequent stages in their K-12 learning experience. (*Final Release NGSS Front Matter*, p. 9-10)

Adopting the vision of the *Framework* as the goal for science education brings together the affective and cognitive domains, and provides the argument for supporting both formal and informal education. The additional argument for linking formal and informal science learning opportunities is the potential for synergy that is possible given the complementary strengths of the two settings.

A set of outcomes for informal STEM education that provides a common language for program developers and evaluators has been needed for some time. Recently the Afterschool Alliance (Krishnamurthi, 2013) conducted a study to determine which outcomes could best be achieved by informal STEM programs. The results of the study were to specify the following as the most realistic and achievable outcomes: 1) developing interest in STEM and related learning activities; 2) developing capacities to productively engage in STEM learning activities; and 3) valuing the goals of STEM and STEM learning activities.

Taken together, the cognitive outcomes specified by the NGSS and the affective outcomes specified by the Afterschool Alliance's study provide a set of potentially measurable goals for STEM education. If we take the vision of the *Framework* seriously, both sets of outcomes are important and inseparable. Certainly educators in both settings strive to accomplish both sets of outcomes, but there is clearly a difference in emphasis: school teachers are bound to place cognitive gains above affective outcomes, and educators in informal settings are best positioned to emphasize affective outcomes.

Perhaps most important is that the *Framework*—and to some extent the NGSS—provide a common set of goals and common language to improve communication among schoolteachers and informal educators at science centers, museums, afterschool and summer programs. Now is the time to take advantage of these important new directions in STEM education to establish lines of communication between STEM educators of all kinds and in all settings so that we can improve our own communication and collaboration skills, and better serve the children and youth of Oregon.

References

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