Practicality:
A Consideration in the Design and Selection of Instructional Materials to Support Implementation of NGSS

Daniel C. Edelson
BSCS

June 23, 2017

The Next Generation Science Standards (NGSS; NGSS Lead States, 2013) call for major shifts in science teaching and learning. Bybee (2014) captured the essence of these shifts in the form of five innovations in teaching:

1. Teaching that includes three-dimensions—science and engineering practices, crosscutting concepts, and disciplinary core ideas.
2. Teaching students by engaging them with natural phenomena and design problems.
3. Teaching science practices and crosscutting concepts in ways that include engineering and the nature of science.
4. Teaching a unit or year-long program based on coherent learning progressions.
5. Teaching that makes connections to mathematics and literacy standards.

Science education leaders and reformers across the country are now engaged in planning and implementing initiatives to guide teachers through these shifts and to provide them with the support that they will require to make them. There are good reasons believe that instructional materials should be part of that support.

First, instructional materials can convey an image to teachers and students of what instruction could look like. So instructional materials that are designed to be used to put the NGSS innovations into practice in classrooms can serve as an explicit representation of what those innovations look like. Being a concrete representation means that they can be the focus of examination, consideration, discussion, and reflection throughout the processes of (1) learning about the NGSS innovations, (2) preparing to implement the innovations, and (3) learning from the attempt to implement the innovations. This enables instructional materials to serve as a medium for communicating a vision of teaching and learning to classroom teachers and students.

Second, instructional materials can provide material support for implementing the innovations on a day-to-day basis for teachers and students. They can provide structures, information, and guidance that teachers and students can lean on as they attempt to implement unfamiliar practices and establish new classroom cultures. In this way, instructional materials can provide scaffolds for the complex practices called for by the NGSS innovations.

In this National Academies workshop, presenters are discussing the attributes of instructional materials that can enable them to play these roles, how to assess the likely effectiveness of specific materials at conveying a vision and supporting implementation, how to select

instructional materials and prepare teachers for the use of them, and how to improve the effectiveness of instruction with specific materials over time.

There is an important risk to beware of in any effort to transform a set of practices and improve outcomes, however. In the rush to incorporate all the attributes that are known to support transformation and improvement, it is easy to overlook the importance of *practicality.* To bring about real and lasting change, it is necessary to make sure that it is practically possible and realistic for the participants in the change to implement their part of the change. With respect to instructional materials, that means the instructional materials must both convey a vision that is practical to implement and must provide adequate support (in conjunction with the other supports included in the initiative) for the teachers and students to implement the change on a day-to-day basis.

Practicality for instructional materials has two aspects—feasibility and challenge.

- *Feasibility* refers to how well a curriculum program meets the practical constraints of an educational setting. These constraints include time and tangible resources. For example, a science program that calls for materials or supplies that are beyond the financial means of a school are impractical for reasons of feasibility.

- *Challenge* refers to the level of demand that implementing a program places on the people involved, most notably the teachers and students. So, a curriculum program is impractical for reasons of challenge, if the program calls for students to engage in tasks or reasoning that are beyond their ability.

Practicality is contextual. The thresholds for what makes a program too challenging or infeasible depend on the social capital and material resources that are available in a particular setting. Nevertheless, reform-oriented curriculum programs have gained a reputation for being impractical.

Challenge. Reform-oriented programs naturally present challenges for teachers and students because their goal is to change practices. New, unfamiliar practices are more challenging than familiar ones; hence reform-oriented programs are more challenging than programs that are consistent with the status quo. Challenges that reform-oriented programs present of teachers include requiring skills or knowledge that teachers do not possess and requiring a level of effort for preparation or day-to-day implementation that is unrealistic for teachers to sustain. Programs can also expect skills and knowledge that students don't possess, such as math and literacy skills, or the metacognitive skills necessary to manage open-ended work. Programs can also present cultural challenges for teachers and students by expecting behavioral norms that are very different from those in the school at large. These can include expecting more work than students are accustomed to, more internal initiative, collaborative work, or a constructivist approach to learning in a school where all the other instruction is didactic.

Feasibility. Reform-oriented programs often present feasibility issues, as well. In science, where reforms have favored active learning, particularly inquiry, reform-oriented programs have typically called for more materials and supplies than traditional programs, the use of special-

purpose facilities or fieldwork outside of the school building, or the use of computational tools for modeling, simulation, or data analysis. Reform-oriented programs often place larger demands for instructional time than conventional materials. Some programs require extended class meeting times (block periods), others may require more instructional time than is available in an academic year. All of these can be a strain for schools or beyond their capacity to support for financial or logistical reasons.

Curriculum programs designed to support schools in making the transition to the NGSS are likely to present as impractical to educators, just as previous generations of reform-oriented programs have. (We must recognize that the perception of impracticality is more important than the reality. If they appear to be too challenging or not feasible, then they will not be selected for implementation.) If they do present as impractical, we face a real risk that we will never achieve the objectives of the NGSS. Therefore, instructional materials developers must take on the issue of practicality. While there are no simple solutions to the issue of practicality, there are some strategies that are worth considering.

Evaluate for practicality. In order to address practicality explicitly in materials development, it is essential to know what threats a program poses to practicality and how they will affect the practicality of that program across contexts. This means that programs should be evaluated for the challenges it presents for teachers and students and its practical feasibility through field testing. This testing must be conducted with a real commitment to identifying and addressing issues for practicality, which is a difficult mindset for designers maintain. For a developer under pressure to move forward, the temptation to ignore or explain away challenges to practicality is very strong.

Manage complexity. One of the reasons that a program can become impractical is through the accumulation of issues for practicality. A program might have a collection of attributes that individually are manageable, but collectively are impractical. A strategy for managing the accumulation of issues is to recognize the risk of cumulative challenge and to be strategic in the inclusion of attributes that present challenges or threaten feasibility. By weighing the educational benefit against threats to practicality for the different aspects of a program and including only a set of aspects with the highest benefit, it may be possible to manage impracticality stemming from complexity.

Provide professional learning to overcome challenges. While there is often little that providers of instructional materials can do to address the constraints that lead to a program being infeasible in certain settings, there is often much they can do to address the challenges it presents to teachers and other school and district personnel. By identifying and acknowledging the challenges that a curriculum program presents, materials developers can take the first step toward reducing those challenges by building capacity on the implementing side. They can develop professional learning programs to prepare teachers for the challenges of implementing the program and to prepare administrators and others to provide the assistance that will enable teachers and students to be successful. Rather than following the conventional marketing strategy of playing down the challenges that a program presents, materials providers might be able to position their product in a more productive way by being frank about a program's challenges, particularly if they can be presented in light of the educational benefits the program offers, and

also positioning themselves as partners in developing the capacity that will enable schools to implement the program successfully.

Provide transition paths. Any change in professional practice is challenging and requires time and effort to implement successfully. In the American educational system, we tend to deny the time it takes to change practice and assume that it can be implemented instantaneously. Perhaps the best strategy for addressing the challenges to implementation that are perceived as issues for practicality is to recognize that change takes time and to plan prospectively for transitioning over a realistic timeline. Rather than expecting teachers to implement a new and different program in its entirety in its first year, it may be more appropriate to present schools with a 3-5 year graded implementation plan, in which teachers implement only a portion of a curriculum or certain aspects of an approach in the first year and then incrementally take on additional aspects of the challenge each year over several years. This approach offers the benefit of enabling developers to create programs that are more ambitious than would ordinarily be considered practical, but to offer them to educators in a form that makes them practical to implement.

In summary, practicality is not an issue that developers and distributors of curriculum materials can afford to ignore. If they seek to reach a broad audience, which is a pre-requisite to broad impact, they must be aware of the specific issues for practicality that their programs present, and they must have strategies for addressing those issues.

References

Bybee (2014). NGSS and the Next Generation of Science Teachers. *Journal of Science Teacher Education,* 25, 211-221.

NGSS Lead States (2013). *Next Generation Science Standards: For States, By State*s. Washington, DC: The National Academies Press.