

## Next Generation Science Teacher Educators

Norman G. Lederman · Judith S. Lederman

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In 1994 and 1995, when Norman Lederman was President and Past-President of ASTE (then called AETS) he wrote two *AETS Newsletter* presidential messages (Lederman 1994, 1995) that discussed issues surrounding curriculum and instructional integration. At this time the *Benchmarks for Science Literacy* (AAAS 1993) had already been published and one of the Drafts of the *National Science Education Standards* (NRC 1996) was available. Several months ago the *Next Generation Science Standards* (NGSS) (Achieve 2013) appeared on the scene. Depending on who you speak to, the NGSS build upon previous science education reform efforts or they represent a totally new perspective. We prefer the former interpretation. Lederman's expressed concern in the *AETS Newsletter* related to the professed integrated structure of the K-12 curriculum and instructional approach. We believe that with all the differences between the NGSS and previous reform documents (e.g., the centrality of engineering practices) one important commonality is the focus on integration. It could be argued that prior reforms only focused on the integration of disciplinary subject matters and the NGSS is more comprehensive in its focus on the integration of science and engineering practices, core concepts, and cross-cutting concepts.

Our organization is the premier professional organization of science teacher education worldwide. Reform documents and initiatives typically put a magnifying glass on desired student outcomes, and with less frequency on instructional practice. It is not uncommon to hear the authors of such documents say that the reform in question "is not a curriculum" or that it is "pedagogically agnostic." Nevertheless, we think our membership would all agree that each reform effort has strong implications for science teacher educators. The last two words are correct; we are talking about the education of those who become teacher educators, who then in turn educate classroom teachers.

In 1997 *AETS* published a position statement on *Professional Knowledge Standards for Science Teacher Educators* (Lederman et al. 1997). The document

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N. G. Lederman (✉) · J. S. Lederman  
Chicago, IL, USA  
e-mail: JSTE@iit.edu

can be found on the *ASTE* website. There were plans for a subsequent position statement on performance standards for science teacher educators, since we all know that knowledge does not necessarily translate into practice. However, the second position statement never came to fruition for a variety of reasons. However, given the release of the NGSS, this is the perfect time to revisit the necessary knowledge and performance of science teacher educators. Do we all have the background and abilities to help prepare current and future science teachers to promote the vision of the NGSS? This question has implications for current science teacher educators as well as the future science teacher educators that populate our PhD programs. It is quite possible that program requirements at the PhD level will need to be change substantively.

### **The Issue of Subject Matter Integration**

As previously mentioned the NGSS is more comprehensive with respect to integration than previous reform documents. The problems with integration have been well-documented in the literature with respect to teaching and learning. However, little is written about the knowledge and ability of science teacher educators in this area. Few of us experienced a science curriculum in precollege or postsecondary education that highlighted integration across and within the sciences. In addition, the NGSS is now adding engineering practices to the mix. Adding engineering practices is complex enough by itself, but it is also important to note that engineers and scientists may use differently terminology for the same concepts. It can be argued that the cross-cutting concepts are analogous to “unifying or common themes.” So, one is compelled to ask, how qualified are we to help teachers address this integrated perspective? Clearly, we all need some professional development, but who designs and delivers the professional development? The idea of integration has intuitive appeal and it has always been the view of science that we both have had for many years. Judith has a strong academic background in physics and biology and so her chances of developing, if she has not already done so, an integrated perspective between these two disciplines is quite possible. Norman, on the other hand, primarily has a strong biology background, but strong supportive knowledge in the chemistry and physics necessary to succeed in biology at the graduate level. How well is he able to develop an integrated perspective across the sciences? The point is simple, virtually all of us have been educated in an educational system that separated the science disciplines out of necessity, and only made connections when necessary. How can teacher educators bring themselves to a position that enables them to efficiently assist teachers (who have gone through a similarly discrete attention to science) to meaningfully (i.e., not superficially) align instruction with the vision of NGSS?

### **The Issue of Engineering Practices**

It is safe to say that most science teacher educators (and science teachers) have not had any formal education in engineering. Of course, many of us have had

experiences that are more aligned with engineering than science, and many of us have worked on various projects with our engineering colleagues. The integration of engineering design with science practices is quite seriously addressed in the NGSS. We have all experienced and probably used the infamous egg drop, boats supposedly not capable of floating, best liquid insulator, best potato chip mailer, balloon rockets, and twirly activities. These all have science and engineering components. For many years teachers doing the egg drop activity in science class were criticized for confusing engineering design with science, but we guess this will be considered good practice in the future. For many years it has been documented that students approach our science laboratories with an engineering mindset. That is, they are trying to produce a certain result as opposed to trying to answer a question. This was considered a problem by many. This perception may change in the near future. Our point here is will our background and experiences with engineering design allow us to work with teachers in a more than superficial level? How much engineering background will science teacher educators need and where will they get? There are clear differences in the purposes and practices of science and engineering. This distinction has not been clearly made by teachers in the past who would interchange science and engineering activities within science classes. It will be critical for science teacher educators to help teachers maintain the integrity of the two disciplines, while at the same time integrating them in a science classroom.

### **Quo Vadis?**

So, what is the point of all this? Are we totally pessimistic about any reforms or the idea of changing the status quo? Do we think that the NGSS vision is short sighted or flawed? No, we think a change is needed and we have both felt this way throughout our careers. But what we have noticed over the years, is that reform efforts place much attention on students and teachers, and ultimately lack of change is at least partially blamed on the lack of support provided for teachers in the form of quality professional development. However, we would like to take the conversation one step further this time. The NGSS is truly an ambitious vision for K-12 science education. But, as has been the case with previous calls for change, there is little conversation about the knowledge and ability of science teacher educators to help facilitate the change. Science teacher education, as well as teacher education in general, is consistently under attack by policy makers and other stakeholders. If we are truly a part of the solution to improve the quality of teaching and learning of science, we must carefully consider the specific elements of professional development that is needed for our current and future science teacher educators, and the qualifications and abilities of those who will deliver the professional development. We know this is a difficult question to answer, but we must think about it. In our opinion, the members of ASTE should be leading this discussion.

We certainly do not claim to know the answer to the questions we have raised. The questions and discussion are meant to be provocative, but more importantly the questions raised should not be buried as in the past. We need to be more proactive in

the monitoring of our profession. This is one of the responsibilities of professional societies. Please refer to the ASTE position statement on the professional knowledge of science teacher educators that is posted on the organization's website and consider how it should be changed and improved.

One of the changes you will see in *JSTE* under our editorship is the inclusion of an editorial in each issue. These editorials are meant to focus the ASTE members' attention on what we consider to be important issues facing science teacher educators. We intend to raise provocative questions and/or answers. If you know us, you would not expect otherwise. Please feel free to respond to our discussions (hopefully not ramblings). Critical discussion is never a bad thing.

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