Editor's Perspective Article: Mathematics and Science Teaching for New Alternative Certification Teachers

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Abstract

Mathematics and science education has increasingly become more important for students in our globally competitive society. New alternative certification teachers, particularly in mathematics and science, need to support student learning in these areas in order for the United States to stay globally competitive. This article presents some ideas about mathematics and science learning for the new alternative certification teachers.

Keywords: *alternative certification, mathematics, science, problem solving, inquiry*

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As the world becomes more globalized and competitive going forward in the early 21st Century, it is clear that remaining competitive requires strong mathematics and science skills for our young students. Alternative certification programs typically focus on getting new teachers quickly into the classroom to teach high-need areas in which shortages often exist such as special education, bilingual education, and of course, mathematics and science.

In the 1990s it was clear that the United States was falling behind other industrialized nations as evidenced by student mathematics and science scores on international examinations such as those from the Trends in International Mathematics and Science Study (TIMMS, 2013) and Program for International Student Assessment (PISA, 2013). It has been found that the highly industrialized participant East Asian nations/administrative regions such as Singapore, Hong Kong, Japan, South Korea, and Taiwan have consistently performed the best, with some exception, on the examinations. It is clear that given the statistical significance between scores, the United States ranks as a second tier country in mathematics and science achievement. For such a large highly technical industrialized nation such as the United States, it's quite shameful. The United States in the early 21st Century remains the sole military and political superpower, and the wealthiest nation on the planet. Even though the United States does not rank as the country with the highest per capita gross domestic product (GDP) nation, it is the highest ranked large nation. In fact, the very highest ranked nations on per capita GDP are relatively small countries with population of several million people. In particular, the highest ranked countries have special circumstances such as oil wealth (Qatar, Norway, and Brunei) or status as a global center of banking and finance (Switzerland, Luxembourg, and Singapore).

As two important high-need areas, mathematics and science are typical content areas taught by teachers going through alternative certification programs, particularly in urban environments. As part of the alternative certification structure, teachers are immersed in teaching their own classes while typically studying in a master's degree program that leads to initial certification, or at least a program of study that leads to initial certification without a master's degree. Often, the teachers are also fulfilling missing undergraduate mathematics and/or science content courses during this same time period, which can take two to three years and means some teachers are not fully prepared in content and pedagogy preparation to teach mathematics and science to their students. It is preferable to have teachers who are completing their mathematics and science content courses teach mathematics and science rather than to use teachers who are teaching outside of their content areas teach in mathematics and science classes. Teacher educators need to be attuned to the unique needs of new alternative certification mathematics and science teachers.

Perhaps the most important advice for new mathematics and science teachers is to provide students with ample opportunities to explore. It's possible that "exploration" is the common theme between quality mathematics and science learning. In mathematics, this often manifests in student learning through problem solving. In science, this is the inquiry approach with sufficient time in the laboratory engaging in experimentation, when the resources are available for the equipment, which should be a top funding priority. Related to problem solving and inquiry, which are aspects of critical thinking in mathematics and science, is mathematics and science learning for understanding.

Since my background is mathematics education, I'll take a little more time to explain problem solving. I focused on problem solving in my article appearing in *JNAAC* in the fall 2012 issue. In the article, I said,

> The key aspect of authentic problem solving is the problem must be unfamiliar to the person solving it. If the individual has solved the problem before, or watched a teacher solve the problem previously, then the process is not authentic problem solving. (Evans, 2012, p. 35)

Additionally, I had quoted Posamentier and Krulik (2008) in which they said, "A problem is a situation that confronts a person, that requires resolution, and for which the path to the solution is not immediately known" (p. 1). I also paraphrased Krulik and Rudnick (1989) who further said that problem solving is a process in which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation. They key for new alternative certification teachers is to present students with problems in which the solution is not yet known and the problem is unfamiliar to the students. However, the problem needs to be of optimal difficulty in that the students possess the background knowledge, skills, and understanding to solve the problem. Problems that are too difficult will lead to frustration and students will not persist in solving the problem. New teachers often cite this concern as a major impediment to engagement with problem solving. That is, students are so familiar with being given the solution to problems by previous teachers that they lack the intrinsic motivation to persist. This can be quite a challenge and not one that is easy to overcome. My advice is to start slowly with students who lack the drive and persistence. Giving them easy tasks that do not take much time is a way to start building their confidence and understanding that they can indeed persist and solve problems. The benefits of this go far beyond the mathematics classroom as persistence is a very valuable trait to have for general life success, in addition to general strong problem solving skills, both in and outside of mathematics, as general life skills.

As said earlier, my area is mathematics education, but I have some experience in science education. Inquiry learning is critical for the science classroom. I had said that it is ideal to use laboratory learning in which students have the opportunity to explore scientific concepts on their own and in groups. This of course would seem to require adequate funding to support laboratory equipment. While I continue to advocate for such funding, science teachers can be creative in their use of resources in order to give students the opportunity to discover scientific concepts on their own. Often everyday household objects can be used to creatively give students materials for experimentation. If the class has online access, websites that allow for scientific discovery can be another economical option.

Problem solving and inquiry learning can lead to better content understanding, which is a major goal of mathematics and science education. A major problem with traditional lecture style teaching is that students often learn procedures without truly learning the concepts behind the procedures. In mathematics, algorithms are meant to be efficient ways of computation or solution, but do not by themselves necessarily help students understand the concepts behind the procedure. Teachers who allow students the opportunity to discover the concepts and understand the material put the students in a much better position. Students are less likely to forget what they've learned, which is a major issue for mathematics and science education. It is important that students know that scientific principles and concepts developed through scientific inquiry.

This process of investigation is one of the best aspects of science education that students can learn.

While new teachers in alternative certification programs face challenges in teaching mathematics and science, the best thing they can do is change their way of thinking about traditional mathematics and science instruction. In fact, new teachers without much experience may be most receptive to this way of thinking, which may be quite different in how they learned mathematics and science in school. Teachers with experience may be too familiar with teaching procedure through lecture, which may prove difficult, though not impossible, to change. The different way of thinking may be the best tool we can give new teachers to best serve their mathematics and science students.

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