

Position Statement

PROFESSIONAL KNOWLEDGE STANDARDS FOR SCIENCE TEACHER EDUCATORS

Preamble

The various efforts to reform science education have significant implications for both inservice and preservice science teacher education. Unless prospective and practicing teachers can develop the knowledge, skills, and beliefs called for in the reform documents (either the National Science Education Standards or Project 2061), little will change. Science teacher educators are clearly critical to both inservice and preservice efforts. Although science teacher educators have been involved in the development of reforms in science education, they have been virtually ignored in discussions about the implementation of reform efforts. That is, the essential qualifications for the science teacher educator have not been addressed.

The Association for the Education of Teachers in Science (ASTE) focuses its efforts on all aspects of science teacher education and, consequently, recognizes the importance of setting standards for those individuals designing and implementing teacher education programs, institutes, workshops, etc.

We have developed six standards that, although not meant to represent absolute prescriptions, should provide a clearly defined framework for the knowledge, skills, experiences, attitudes, and habits of mind essential for the successful science teacher educator. These standards should provide significant guidance for the development and revision of graduate level programs that prepare science teacher educators, criteria for the qualifications of a university level science educator, and guidelines for the qualifications of individuals conducting staff development projects, institutes, and workshops.

It is important to note that science teacher educators may fit a variety of categories, some of which are as follows:

- **Faculty in higher education who provide course work in science subject matter and/or science pedagogy**
- **School-based mentor teachers**
- **Personnel in schools who provide professional development activities**
- **Personnel from agencies other than universities or schools who provide for the professional development of science teachers**

The Standards may appear to be focused more on the science teacher educator holding an academic position in a university than those employed in other situations; however, this is more a reflection of the current composition of the community of science teacher educators than a recommendation for employment situation. The Standards are meant to focus on the skills, knowledge, and experiences necessary for ALL science teacher educators, regardless of where and by whom they are employed.

A simple definition of a science teacher educator is anyone who educates science teachers. However, such a definition is much too general to be useful in establishing professional standards. ASTE agrees with the perspective taken by the Association of Teacher Educators in their recommendations for the Certification of Master Teacher Educators (1996). Defining a science teacher educator as "anyone who educates science teachers" will only diminish the professionalism of science teacher educators and compromise clear distinction between highly qualified science teacher educators and all others who contribute to the education of science teachers. The Standards that follow are meant to distinguish the highly qualified, experienced science teacher educator.

Finally, the Standards are meant for individuals beginning a career as a science teacher educator, with the expectation that on-going development in each area (while maintaining currency) would continue throughout their professional career. Just as science teacher development is a lifetime effort, so, too, is the development of the science teacher educator.

Standard 1: Knowledge of Science

A strong knowledge of several science disciplines is essential. The science teacher educator should have a particular area of expertise (represented by an academic degree or the equivalent) and/or breadth of knowledge across several other science disciplines. We recognize, however, that an academic degree may not be indicative of the desired levels of subject matter knowledge.

Standard 1.a

The beginning science teacher educator should possess subject matter knowledge and skills exceeding those specified in the reform documents (National Science Education Standards or Project 2061).

Note that, although a precise level of subject matter knowledge is difficult to identify, it is hoped the science teacher educator would possess a level of knowledge exceeding that mentioned in the reform documents and required for teacher licensure in a particular state. Few would disagree that science teacher educators should have more in-depth subject matter knowledge than the level at which their instruction is focused.

The realities of staffing for teacher education programs and the emphasis on interdisciplinary science curriculum clearly indicate that the qualified science teacher educator must have in-depth theoretical knowledge and practical knowledge.

Standard 1.b

The beginning science teacher educator must have active inquiry/research experiences within his/her discipline preparation in at least one science discipline and a strong functional knowledge in several other science disciplines.

We recognize that elementary level science teacher educators have different needs than secondary level science teacher educators. However, the difference is one of the relative balance between the depth of subject matter knowledge and process/inquiry skills, with the elementary level science teacher educator needing more breadth versus depth in foundational subject matter knowledge. For example, while possessing a M.S. (or equivalent) in a particular area of science may be desirable for the secondary level science teacher educator, possessing additional breadth of knowledge across several areas of science may be more useful for the elementary level teacher educator. Although attention to "science as inquiry" is often withheld until upper division courses, we do not recommend that elementary science teacher educators simply accumulate introductory level courses/knowledge.

Standard 1.c

Science teacher educators, regardless of level of focus, need both depth and breadth of subject matter knowledge with a strong knowledge of science process skills.

The qualified science teacher educator should also have a functional understanding of the nature of science. Given the lack of consensus concerning the nature of science, the individual should possess a particular coherent perspective and also be able to articulate a range of alternative viewpoints held by other respected professionals.

Standard 1.d

The beginning science teacher educator should possess levels of understanding of the philosophy, sociology, and history of science exceeding that specified in the reform documents.

Although a strong knowledge in each of these areas is ideal, expecting an individual to have a strong background in all of these areas may be unrealistic. Knowledge of these aspects of science, as a discipline, provides the necessary context for the in-depth understanding of particular science content. Laboratory and research experiences during subject matter preparation may serve to enhance the development of such understandings but are not a substitute for specific instruction in philosophy, sociology, and history of science.

Standard 2: Science Pedagogy

The qualified science teacher educator should have a strong knowledge of science pedagogy. In particular, the individual should possess the formal credentials (or the equivalent) required of practicing teachers. Recognizing that there are differences

among states' credential requirements, we recommend that the science teacher educator possess a formal background in science pedagogy equivalent to (and preferably exceeding) that required of the inservice and preservice teachers with whom he/she works on a consistent basis.

Standard 2

The beginning science teacher educator should possess the knowledge and skills of science pedagogy specified in the reform documents (National Science Education Standards and Project 2061).

The theoretical knowledge of pedagogy is not sufficient for successful direction of inservice or preservice education efforts. Science teacher educators should have experiences appropriate to the type of teacher education they are expected to provide. The individual focusing on K-12 school-based instruction should possess proficiency in science teaching, demonstrated by three or more years of successful teaching experience in appropriate school settings. Three years is considered to be a bare minimum, as derived from the empirical literature on novice and expert teaching. Alternatively, those focusing on informal science education (e.g., museums, aquariums, etc.) should possess significant experience in such settings.

This Standard is not intended to preclude the involvement of subject matter specialists (e.g., Ph.D. scientists) in teacher education. However, it behooves such individuals to pursue opportunities that will allow development of the necessary pedagogical knowledge. For example, the interested scientist could serve as an aide or resource person in appropriate educational settings for extended periods of time (as opposed to being the "official" teacher of record), until the necessary instructional skills and knowledge can be demonstrated. Again, these Standards are meant to distinguish between the highly qualified professional science teacher educator and individuals who, in some regard, educate teachers.

Standard 3: Curriculum, Instruction, and Assessment

The qualified science teacher educator should possess a strong theoretical and practical background in curriculum development, instructional design, and assessment.

Standard 3.a

The beginning science teacher educator should have documented expertise in the development and implementation of curriculum and instructional materials in school settings.

Expertise in assessment of educational outcomes should be both theoretical and practical (as with knowledge of curriculum and instruction).

Standard 3.b

The beginning science teacher educator should possess expertise spanning a variety of assessment approaches, including "traditional" and alternative assessment.

Standard 4: Knowledge of Learning and Cognition

The well-qualified science teacher educator must possess an extensive background in cognitive science and behaviorism and their applications to student learning. This knowledge should include the various applications of cognitive psychology and their relationships to the epistemology of science. Knowledge of learning theories previously advocated on a wide basis (i.e., behavioristic family) will help inform the science teacher educator of the historical roots of cognitive psychology and the changes occurring in the science education community's views of teaching and learning. Overall, the beginning science teacher educator should possess an in-depth knowledge of cognitive psychology, including a strong background in developmental psychology, constructivist epistemology, and conceptual change theory/instructional practice.

A knowledge of the practical interrelationships of the aforementioned ideas is absolutely essential.

Standard 4

The beginning science teacher educator must possess an in-depth functional knowledge of the relationship among specific learning outcomes, specific instructional approaches, and approaches to assessment and evaluation within the context of a cognitive perspective.

Standard 5: Research/Scholarly Activity

The science teacher educator necessarily synthesizes, applies, and creates knowledge directly and indirectly related to science teacher education. The well-qualified individual should have in-depth knowledge of both qualitative and quantitative research approaches.

Standard 5.a

The beginning science teacher educator should possess the skills necessary to appropriately apply varied research approaches to answer significant questions in science teacher education.

Such research is necessarily classroom based and emphasizes the connection between teaching and learning. In addition to using emerging research findings to improve teacher education, the qualified individual must possess the ability to conduct research and disseminate findings in peer-reviewed professional journals and at professional meetings on a consistent basis.

We recognize that many science teacher educators may focus on the development of products/materials and or professional development activities that extend the research of others. These individuals must be able to read and functionally interpret research. Materials and program development efforts are as important as research efforts designed to improve science teaching and learning.

Standard 5.b

The beginning science teacher educator should possess expertise in the development of educational products/ materials or professional development programs that are informed by the research literature.

Finally, many science teacher educators may be involved in the planning of grants/programs that focus on the development of professional development activities for science teachers.

Standard 5.c

The beginning science teacher educator should possess the skills to be a successful grant writer.

Even though grants do not necessarily involve research, the individual participating in grant activities should still disseminate the results of such activities in professional journals and at professional meetings on a consistent basis.

The development into an active scholar, researcher, and grant writer is a continual process and can be significantly enhanced through purposeful mentoring by experienced and knowledgeable colleagues and associates during the early career stages.

Again, although we recognize that not all science teacher educators hold academic positions, this Standard is considered important for ALL teacher educators, whether or not they hold academic positions. The Standard reflects the critical influence of research/scholarship on practice, as well as the influence of practice on research/scholarship.

Standard 6: Professional Development Activities

Becoming an effective science teacher is a continuous process that stretches from undergraduate years to the end of a professional career. The qualified science teacher educator must possess the knowledge, habits of mind, and skills necessary to work with prospective and practicing science teachers as they move through this developmental process. The process of collaborating with teachers and schools in an effort to achieve the systemic and programmatic changes advocated by the reform documents is a central role of the science teacher educator. Considering oneself an equal partner with classroom teachers is absolutely essential for science teacher educators, as both attempt to improve science teaching and learning.

Standard 6

The qualified individual must have a strong knowledge of, and experience in, science faculty development, including the design and implementation of workshops and institutes.

This participation should be guided by the theoretical and practical knowledge of individual and organizational change processes and recognition that we must all be lifelong learners.

Postscript

These Standards attempt to delineate the knowledge and skills necessary for the professional science teacher educator. The Standards are more than a checklist of skills, knowledge, and experiences to be achieved, and simply possessing them will not automatically transform an individual into a professional science teacher educator. A difference in perspective exists between the experienced scientist or science teacher and the professional science teacher educator. The integration of the Standards and continued reflection upon the content of and interrelationships among the Standards should facilitate lifelong development in the career of a professional science teacher educator.

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