Virginia science education at the crossroads: Connecting science education faculty to a professional community

(Paper 4 in Paperset)

Jacqueline T. McDonnough, School of Education, Virginia Commonwealth University

Elizabeth W. Edmondson, School of Education, Virginia Commonwealth University

Wendy M. Frazier, College of Education and Human Development, George Mason University

Juanita Jo Matkins, School of Education, College of William and Mary

Donna R. Sterling, College of Education and Human Development, George Mason University

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Correspondence concerning this paper should be addressed to Jacqueline T. McDonnough, School of Education, Virginia Commonwealth University, Richmond, VA 23284. E-mail: jtmcdonnough@vcu.edu

Abstract

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Historically science teacher educators have existed as lone wolves in education programs or on the fringes of science content departments at the university level. Jablon (2002) determined that doctoral granting institutions support only 1 to 2 science teacher educators. In Virginia the region that is the focus of this study, there are currently 37 higher education institutions with active teacher preparation programs. Although the size and complexity of these programs vary all produce graduates who will go on to teach science at either the elementary or secondary level or both. Faculty with responsibility for science methods courses are either science educators with content and pedagogical backgrounds or subject area specialists (e.g., Ph.D. scientists). For the purposes of this study they will all be identified as science teacher educators.

Analysis of the state's institutions with teacher preparation programs revealed that 18 institutions had one faculty member responsible for science methods instruction. Of the remaining programs 5 had between 2 and 3 faculty and the remaining 3 had 4 or more faculty with responsibility for science methods instruction. As a consequence the vast majority of these faculty have often found themselves isolated within their institutions and have limited access to the support of colleagues with similar responsibilities and interests.

To support and sustain science teacher educators across the state of Virginia, VISTA provides two opportunities. The first opportunity is the Science Educator Faculty Academy (SEFA). Last spring, VISTA conducted the first five-day Science Educator Faculty Academy (SEFA) designed to support their learning and collaboration. The second opportunity provides support for participants post SEFA by supporting their attendance at the

fall meeting of the Virginia Science Education Leadership Association (VSELA) consisting of science coordinators, department heads, specialists, lead teachers, professional employees of state, regional or governmental science education facilities, and faculty members in Virginia institutions of higher learning and the Virginia Association for Science Teachers Professional Development Institute (VAST PDI) composed of many of the members of VSELA and teachers from across the state

Review of the Literature

Doctoral Training Opportunities

A comprehensive national study of science education doctoral programs (Jablon, 2002) indicate that there is considerable variability in coursework and pre and during program teaching experiences. The study goes on to report that a full 24% of programs do not require course work on the history of science with slightly fewer programs requiring a full course on the nature of science. Requirements for courses with topics such as science curriculum materials, use of technology, assessment, methods of school change and reasoning and problem solving also showed considerable variability across programs. Surprisingly even though 100% of the doctoral program heads surveyed:

> "expected their graduates to be able to teach methods courses and supervise student teaching, ... only 34% required their graduates to be involved in a mentored teaching of a methods course or student teaching." Forty two percent said the students could do this as an elective and 24% said their graduates had no opportunity to be mentored in any of these skills (Jablon, 2002, p. 17).

This level of variability of training in science education doctoral programs runs counter to recommendations by Abell et al.(2008) who argued that, " doctoral students must be given the opportunity to observe, practice, and reflect on the pedagogical knowledge necessary to instruct science teachers." Additionally, subject area specialists who assume responsibility for science methods courses have little to no science pedagogical instructional skills. Given this inconsistency in preparation of faculty who are responsible for training teachers of science there exists a need for standards that define adequate preparation for this population.

In 2007 the Association for the Education of Teachers in Science (AETS) charged the Ad-Hoc Committee on the Professional Development of Science Teacher Educators to develop professional knowledge standards for science teacher educators. Those standards which are available on the organization's website are as follows (AETS, 2007):

Standard 1: Knowledge of Science
Standard 2: Science Pedagogy
Standard 3: Curriculum, Instruction and Assessment
Standard 4: Knowledge of Learning and Cognition
Standard 5: Research/Scholarly Activity
Standard 6: Professional Development

Standardization of preparation of science teacher educators at the doctoral level will go a long way in creating a cadre of faculty better prepared to instruct preservice teachers but doctoral preparation is but one element needing consideration in designing professional development for science education faculty.

Science Educator Faculty Personal Professional Development

Professional development specific to science education faculty is limited within higher education institutions given the low numbers of faculty on staff. This limitation results in these individuals being isolated and implementing very different types of programs.

Because if the isolation of this population access to professional development specific to science education is also limited.

Furthermore, the nature of faculty appointment which usually includes teaching, research, and service leaves little time for self-directed professional development. Traditionally science education faculty rely with varying success on annual attendance at professional conferences for their professional development and networking needs. A novel attempt to fill this need is the *Science Education at the Crossroads* conference format pioneered by Johnston & Settlage (2008) is an attempt to situate science teacher educators in a collaborative learning environment to satisfy their need for professional development and networking in a community of their peers. This professional development framework delineates three factors: critical review, practice community and joint responsibility.

Structure of the VISTA Science Education Faculty Academy (SEFA)

The goal of the VISTA Science Education Faculty Academy (SEFA) was to build an infrastructure to support effective science teaching and learning by providing an environment in which science teacher educators collaborate, learn and share new research, and establish a support network for science teacher education. The stated objectives of the SEFA were that participants would:

1. collaborate to identify challenges and develop solutions in science teacher education at the licensure and advance levels,
2. learn about new research related to effective science teacher development and science teaching,
3. share effective teaching strategies for how to best meet the needs of elementary and secondary science teachers at the licensure and advanced levels through collaborative

grant proposals, as well as collaborative syllabi and experiences for implementation in methods courses and teacher professional development seminars, and

4. network to establish an infrastructure of support among science education faculty across the state that augments and supports existing infrastructure for science teachers and coordinators in the state.

SEFA was one component of a four pronged effort in VISTA to build systematic capacity for improving science teaching and learning. This study reports on a professional development initiative that is modeled on *Science Education at the Crossroads* (Johnston & Settlage, 2008) along with opportunities to access current science teacher education research and support structures for scholarship. An overview of the agenda and relevant goals for the five day academy are found in Table 1.

Table 1
Overview of SEFA and Relevant Goals

Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Introductions VISTA Overview Construction of a Professional Learning Community through Problem-Solving* - Virginia Science Education at the Crossroads: Vexations & Ventures aka Problems/Solutions	Enrichment: PBL as a vehicle for inquiry (2, 3) Definitions: Hands-on, Inquiry, PBL, NOS (2, 3) Exploring NOS (2, 3) Scenario Development (2, 3)	Quest for Solutions: Continuous Improvement: Exploring Course Syllabi (2, 3) Collaborative Planning (4) Sharing How You Will Improve Your Practices Regarding Inquiry, PBL, and NOS (2, 3)	Quest for Solutions: Grant-writing and Funding (3) Creativity and Reflection (3) Collaborative Planning (4)	Quest for Solutions: Collaborative Planning for VAST and VSELA (4)

	Effective Classroom Discourse (2, 3)			
	Poetry Reading (evening)			

In designing the experience the facilitators endeavored to establish community and focus the participants by using Johnston and Settlage's (2008) *vexation and venture* model. Prior to attendance participants were given a prompt to frame their vexation and venture. Their written response was submitted for review, and then, during the five days of the Academy, they shared their vexations and ventures, explored problem-based learning (PBL) and how PBL can support inquiry teaching. They also shared syllabi and resources available to the science education community. . This paper reports on the impact of this first SEFA on meeting its goals.

Research Questions

The following questions guided assessment of the impact of SEFA: 1) To what extent did the Academy provide opportunities for collaboration/network building among science education faculty?; 2) What evidence exists that science education faculty learned about new research related to science teaching?; 3) What are the ways in which science education faculty plan to implement their new learning in their future professional efforts?

Methods

Participants

The five-day Academy that met in Year One brought together eight science teacher educators with varying years of experience and expertise. Participants included 4 males and 4 females ranging in age from 30 to 62 years of age from 7 different universities and colleges in Virginia. There were 2 African American, and 6 Caucasian participants. Six participants hold tenure-track positions (assistant professor of education, associate professor of education, assistant professor science content area), of these 1 is a full professor; 2 participants are adjunct faculty. All demographic data were self-reported.

Measures

Participant reflections on what was learned, what they needed to explore further and on planned future actions were collected daily for data analysis. Grounded theory drove the determination of themes/categories from the reflections. Then, the themes were compared to the Academy aims for alignment which allowed preliminary answers to the study questions.

Results/Findings

An examination of the themes identified from the participant responses allowed for development of answers to the research questions guiding this study. We used each question as the lens for reviewing and selecting themes and exemplar quotes.

For question 1, the extent to which the Academy provided opportunities to collaborate/network, it is important to first consider the contents of the agenda. The Academy began with introductions and moved directly into the participants sharing their Vexations and Ventures with one another. The Vexation/Venture prompt for the participants was:

> "…. problem-based learning, inquiry-based learning and teaching, teaching the nature of science, hands-on science, establishing and using professional learning communities in college classrooms and/or in K-12 classrooms, teaching a science methods course,

> writing and/or managing a grant– anything ranging from the personal to the global. This is your opportunity to articulate a particular frustration you have regarding any of these topics. Beyond simply identifying a problem, your solution describes a possible course of action you might initiate to resolve, diminish, conquer, or overcome your problem. It is not expected that you have yet begun your solution."

The protocol for this sharing and discussion and the number of participants resulted in all of day 1 having a strong collaborative focus. Day 2 through 5 involved inquiry investigations and debrief, a session on grant opportunities, a session on publication opportunities, a session on methods course planning and an overview of resources available for science educators from the Virginia Association of Science Teachers. All of these sessions had opportunities for participants to gain new information/insights as well as sharing of experiences and opportunities. In the evenings participants had opportunities to interact through a poetry shearing, exercise and dinner that promoted community building. During the participant's conversations, they identified the need to use Facebook to share information among themselves and set up a page that week (Virginia Science Education Faculty http://www.facebook.com/#!/groups/220846441276330/). In the participant daily reflections as to their learning and areas they wanted to explore further, themes that emerged with respect to collaboration/network building include the development of a Virginia Association of Science Teachers PDI presentation, identification of opportunities for joint publishing, and other unspecified collaborative projects. Individual comments provide insight into the importance of their experience. A sampling include the following:

- [I feel] "much more connected with peers and their situations"
- [I have the opportunity to] "explore more on " collaborative "teaching", "funding", and "publishing"."

- [This opportunity is] "helping educators to channel or increase energy/thought into reaching those that are most in need."
- [I feel] "a sense of new power and competence."
- "I felt supported. I learned I am not alone in my desires/problems. Camaraderie"
- [There is a} "commonality of problems."

Even after the first day, a participant commented that "This was the best day I have had professionally in a long time. Total Collegiality."

For question 2, what evidence exists that science education faculty learned about new research related to science teaching, participant reflections indicated that they would make changes in their methods course based on their learning (Table 1).

Table 1
Changes to Make to Methods Course (n= 7)

Changes to Make	**Number of Participants Indicating**
Increase emphasis on classroom discourse	4
Expand nature of science activities	3
Use inquiry analysis tool	3
Redesign inquiry activities	1
Need to dissect hands-on, inquiry, and Problem-based learning to make sure students know the difference and can use them effectively	1

Participant reflections also indicated that they had gained new insights into several science teaching strategies. These strategies include the VISTA definitions for hands-on, inquiry, and problem-based learning. One participant indicated they had gained "more resources both about curriculum and research articles." One participant indicated an interest in studying the "role of engineering/design process in inquiry and problem-based learning."

For question 3, ways in which science education faculty plan to implement their new learning in their future professional efforts, participant reflections indicate a desire to make changes in their methods courses as shared above for question 2. The participants also identified action steps. Several themes emerged from participant reflections (Table 2).

Table 2
Action Items (n=7)

Areas for Action	Example Quotes	Number of Comments
Engagement with the Virginia Association for Science Teaching	"prepare VAST/NARST proposals to disseminate PBL work" "petition VAST to form an engineering committee"	5
Professional engagement	"becoming more involved professionally- journal reviews, etc"	3
Grant Development	"Have two grants ready to go out by the fall"	2
PBL Lessons and Research	"IRB approval for collaborative PBL project"	2
Others of interest	"Go back and make a case for me to observe my students teaching science during practicum- instead of those who are doing it and are not science minded" "Need to influence colleagues from other disciplines to help increase the importance of science education in our program" "increase minority participation"	

Discussion and Limitations

Science teacher educators usually ply their trade in isolation at institutions of higher learning and have limited opportunities to benefit from collaboration with their peers. The

VISTA Science Education Faculty Academy has been established to provide an infrastructure to support creation of this collaborative community across universities. Preliminary results of the Academy indicate both an impact on the teaching practices in the methods courses and scholarship of some participants. Their interactions with one another at the VSELA and VAST conferences indicate that they have built collaborative relationships that had continued through the fall. These relationships will continue we hope.

Evidence of continued interaction among participants is evident on the Virginia Science Education Faculty Facebook page. Members on the page number 12- all of whom were either participants or presenters at SEFA. The site is a closed group so only accepted persons are allowed membership and posting privileges. Over the 10 months members have initiated 60 posts which spawned multiple comments from other members. The posted topics included planning for attendance at state conference, sharing of instructional resources and personal milestones and invitations to collaborate on various projects. This Facebook site has provided an avenue for continued interaction and community building thus extending the first goal of SEFA which was to promote networking among state science education faculty. Another sign of the impact of the Academy was the receipt of applications from four year 1 participants to attend the Academy a second time.

This study does have several limitations that we hope will be abated with continued study over the next several years. The participant numbers and available data for use in this study are very limited. Additional data collection strategies will be undertaken in the following years to enrich the data and more completely reflect the outcomes of the Academy.

Providing opportunities for faculty to experience new science teaching strategies and network with peers is an outcome of the Academy that can have far reaching impact on

participants' professional growth and their preservice teachers' future effectiveness. Activities modeled on the Settlage and Johnston approach and the SEFA have the potential to develop a community of practice among science teacher educators that could add coherence in teacher preparation across regions. Such activities could also improve the delivery of teacher preparation regionally and perhaps beyond. The VISTA Science Education Faculty Academy efforts to build capacity for establishment of a collaborative community of science teacher educators can serve as a model for other regions.

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Appendix

Standard 1: Knowledge of Science

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).
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.
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.
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.

Standard 2: Science Pedagogy

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

Standard 3: Curriculum, Instruction 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.
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 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

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.
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.
Standard 5.c- The beginning science teacher educator should possess the skills to be a successful grant writer.

Standard 6: Professional Development

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

(AETS, 2007)